Appendix B

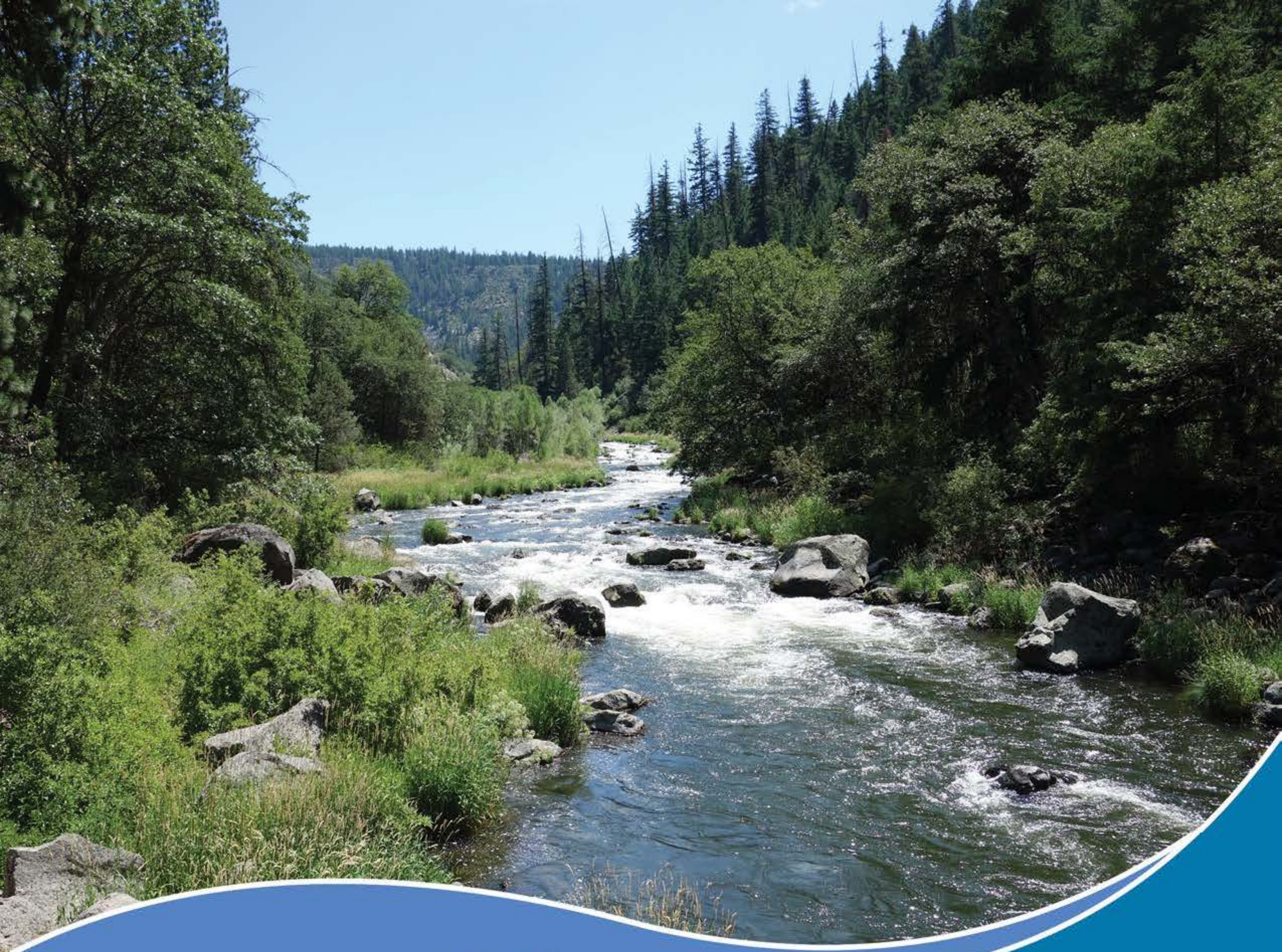
Definite Plan

The Definite Plan (Appendix B) for the Lower Klamath Project is available on the State Water Board's website at the following link (originally released on June 29, 2018):

https://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/docs/lower_klamath_ferc14803/lkp_def_pln.pdf

The Definite Plan Updated Aquatic Resource Measure 7 Freshwater Mussels for the Lower Klamath Project is available on the State Water Board's website at the following link (originally released on October 16, 2018):

https://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/docs/lower_klamath_ferc14803/krrc_updatear.pdf



Definite Plan for the Lower Klamath Project

KLAMATH
RIVER RENEWAL
CORPORATION

June 2018

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Acronyms and Abbreviations

ACHP	Advisory Council on Historic Preservation
ACM	Asbestos Containing Material
ADA	Americans with Disabilities Act
AR	Aquatic Resources
ATWG	Aquatic Technical Work Group
BCE	before the Common Era
BLM	Bureau of Land Management
CA	California
Caltrans	California Department of Transportation
CDFW	California Department of Fish and Wildlife
CDM	Camp Dresser and McKee
CE	California Endangered
CEII	Critical Energy/Electric Infrastructure Information
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
cfs	cubic feet per second

CFM	Cubic Feet per Minute
CFR	Code of Federal Regulations
CHP	California Highway Patrol
CHR	Cultural and Historic Resources
CMP	Corrugated Metal Pipe
CNDDB	California Natural Diversity Database
COD	Chemical Oxygen Demand
CORP	Central Oregon and Pacific Railroad
CRHR	California Register of Historical Resources
CSSC	California Species of Special Concern
CT	California Threatened
CWT	coded wire tag
CY	cubic yards
D	Diameter
DDT	Dichlorodiphenyltrichloroethane
DEM	Digital Elevation Model
DRE	Dam Removal Entity
DSOD	California Division of Safety of Dams
DSSMP	Dam Safety Surveillance and Monitoring Plan
DWR	California Department of Water Resources
EAP	Emergency Action Plans
EIR	Environmental Impact Report
EIS/R	Environmental Impact Statement/Report
EM	Engineering Manual
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily significant unit
FC	Federal Candidate Species
FE	Federal Endangered
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FP	Fully protected
FSC	Federal Species of Concern
FT	Federal Threatened
ft^2	feet squared
GHG	Green House Gas
GIS	Geographic Information System

GPS	Global Positioning System
GW	Groundwater
H	Horizontal
HABS	Historic American Building Survey
HAER	Historic American Engineering Record
HALS	Historic American Landscape Survey
HEC-RAS	Hydrologic Engineering Center River Analysis System
HGMP	Hatchery and Genetics Management Plan
hp	horsepower
I	Interstate
IEV	Invasive Exotic Vegetation
IGH	Iron Gate Hatchery
IM	Interim Measure
IPaC	Information for Planning and Conservation
JPBO	Joint Preliminary Biological Opinion
KBMP	Klamath Basin Monitoring Program
KBRA	Klamath Basin Restoration Agreement
KHHD	Klamath Hydroelectric Historic District
KHP	Klamath Hydroelectric Project (FERC Project no. 2082)
KHSA	Klamath Hydroelectric Settlement Agreement (2010, as amended 2016)
KIP	Klamath Irrigation Project
KRRC	Klamath River Renewal Corporation
kV	kilovolt
kVA	kilovolt amperes
KWAPA	Klamath Water and Power Authority
lb	pound
LBP	Lead Based Paint
LiDAR	Light Detection and Ranging
LKP	Lower Klamath Project
MBTA	Migratory Bird Treaty Act
MOA	Memorandum of Agreement
MPH	Most Probable High
MPL	Most Probable Low
MVA	Megavolt-amperes
MW	Megawatt
N/A	Not Applicable
NAGPRA	Native American Graves Protection and Repatriation Act

NAHC	Native American Heritage Commission
NAVD	North American Vertical Datum
NISIMS	National Invasive Species Information Management System
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
No.	Number
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSO	Northern Spotted Owl
NW	Northwest
OC	Candidate listing by ODA
ODA	Oregon Department of Agriculture
ODC	Other Direct Cost
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OE	Listed as endangered by ODA or ODFW
ONHP	Oregon Natural Heritage Program
OR	Oregon
ORBIC	Oregon Biodiversity Information Center
ORS	Oregon Revised Statute
OSS	Oregon Sensitive Species
OT	Listed as threatened by ODFW
OWRD	Oregon Water Resources Department
PAH	Polynuclear aromatic hydrocarbons
PCB	Polychlorinated biphenyls
PFMA	Potential Failure Modes Analysis
PIT	Passive Integrated Transponder
PRO	Partial Removal Option
QA	Quality Assurance
QAP	Quality Assurance Plan
QC	Quality Control
QCIP	Quality Control Inspection Program
RL	Reporting limit
RM	River Mile
RSET	Regional Sediment Evaluation Team
RSL	Regional screening levels

RT	Round Trip
RV	Recreational Vehicle
RWQCB	Regional Water Quality Control Board
RWS	Reservoir Water Surface
SAP	Sampling Analysis Plan
SE	Southeast
SEF	Sediment Evaluation Framework
SDOR	Secretarial Determination Overview Report
SIR	Supplemental Information Report
SL	Screening level
SLV	Screening level values
SONCC	Southern Oregon Northern California Coast
sUAS	Small Unmanned Aircraft System
SVOC	Semi-volatile organic compound
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	California State Water Resources Control Board
SPT	Standard Penetration Test
TCPs	Traditional Cultural Properties
TER	Terrestrial Resources
TMP	Transportation Management Plan
TSS	Total Suspended Sediments
UKBCA	Upper Klamath Basin Comprehensive Agreement
U.S.	United States
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
V	Vertical
VOC	Volatile organic compound
WQ	Water Quality
WSE	Water Surface Elevation
WUMA	Water User Mitigation Authority
WY	Water Year

Definitions

The following definitions are provided for use throughout this report:

- Decommissioning means PacifiCorp's physical removal from a facility of any equipment and personal property that PacifiCorp determines has salvage value, and physical disconnection of the facility from PacifiCorp's transmission grid. KHSA section 1.4.
- Detailed Plan means U.S. Bureau of Reclamation *Detailed Plan for Dam Removal – Klamath River Dams – Klamath Hydroelectric Project – FERC License No. 2082 – Oregon-California* (July 2012). See also KHSA section 7.2.2.
- 2012 EIS/R means U.S. Department of the Interior and California Department of Fish and Wildlife, *Klamath Facilities Removal: Final Environmental Impact Statement/Environmental Impact Report* (December 2012), State Clearinghouse # 2010062060.
- Facilities Removal means physical removal of all or part of each of the Facilities to achieve at a minimum a free-flowing condition and volitional fish passage, site remediation and restoration, including previously inundated lands, measures to avoid or minimize adverse downstream impacts, and all associated permitting for such actions. KHSA section 1.4. For this purpose, Facilities are: Iron Gate Dam, Copco No. 1 Dam, Copco No. 2 Dam, J.C. Boyle Dam, and appurtenant works currently licensed to PacifiCorp. KHSA section 1.4.
- Klamath Hydroelectric Project means FERC Project No. 2082. As originally licensed, the project consisted of eight developments: East Side, West Side, Keno, Fall Creek, J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate, and appurtenant works. Federal Power Commission, "In the Matters of the California Oregon Power Company," 13 FPC 1 (January 28, 1954), as amended by "Order Adopting Decision of Presiding Examiner," 23 FPC 59 (January 13, 1960). In 2018 FERC amended the license for this project to remove J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Developments and appurtenant works. FERC, "Order Amending License and Deferring Consideration of the Transfer Application," 162 FERC 61,236 (March 15, 2018).
- Klamath River Renewal Project means Facilities Removal consistent with the terms of the KHSA.
- Lower Klamath Project means the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Developments and appurtenant works. FERC has stayed the effectiveness of the license for the Lower Klamath Project, pending its final action on the transfer application. The Definite Plan uses the term Lower Klamath Project for ease of reference. See, "Order Granting Stay and Dismissing Request for Rehearing," 163 FERC 61,208 (June 21, 2018). The Definite Plan uses the term "Lower Klamath Project" for ease of reference.

Executive Summary

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EXECUTIVE SUMMARY

The Definite Plan for the Lower Klamath Project prepared by the Klamath River Renewal Corporation (KRRC) implements the Klamath Hydroelectric Settlement Agreement (2010, as amended 2016) (KHSA). The KHSA resolved disputes among numerous parties regarding the relicensing of the Klamath Hydroelectric Project (FERC No. 2082) (KHP). The parties include: U.S. Departments of Interior and Commerce; States of California and Oregon; Humboldt County, California; Yurok and Karuk Tribes; Upper Klamath Water Users Association; conservation and fishing groups; and PacifiCorp, as the licensee for the KHP.

In the KHSA, the parties agreed to a process whereby PacifiCorp and a dam removal entity, now KRRC, would apply to the Federal Energy Regulatory Commission (FERC) to split the KHP into two projects, the KHP and the Lower Klamath Project, and proceed with the actions necessary to achieve dam removal, a free-flowing condition on the Klamath River, and volitional fish passage. The KHP was constructed between 1911 and 1962 and includes eight developments: East Side, West Side, Keno (non-generating), J.C. Boyle, Copco No. 1, Copco No. 2, Fall Creek, and Iron Gate. PacifiCorp operated the KHP under a 50-year license issued by FERC, until the license expired in 2006. PacifiCorp continues to operate the developments under an annual license.

In September 2016, PacifiCorp and KRRC submitted an application to FERC to amend the existing license for the KHP, establish an original license for the Lower Klamath Project consisting of four developments (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate), and transfer the original license for the Lower Klamath Project to the KRRC. At that time, the KRRC also applied to surrender the license for the Lower Klamath Project, including removal of the four developments. Now that the applications have been filed, KRRC is moving forward with the Definite Plan in accordance with Section 7.2 of the KHSA.

Proposed Action

The KRRC proposes to remove four hydroelectric developments: J.C. Boyle, Copco No. 1, Copco No. 2, Iron Gate, along with appurtenant facilities (the Project). The purpose of the Project is to achieve a free-flowing condition and volitional fish passage in the Klamath River, in the reaches currently occupied by these developments (river miles 193.1 to 234.1). Under the KHSA, the Project consists of measures to remove the four developments; remediate and restore the reservoir sites; avoid or minimize adverse impacts downstream; assure completion of the Project with committed funds; and avoid damages and liabilities for PacifiCorp, the States, and third parties. The Project also proposes a schedule for decommissioning of the developments, which may commence on January 1, 2021 without payment to PacifiCorp for foregone power generation, and subsequent removal.

As outlined in Section 7.2 of the KHSA, KRRC's Definite Plan provides a comprehensive statement of the methods and other specifications to implement the Project. The Definite Plan states the scientific and engineering analyses that support those specifications. The Definite Plan will be a basis for FERC's hearing of the license transfer application for the Lower Klamath Project, subsequent hearing of the surrender application, reviews by other regulatory agencies with jurisdiction over certain portions of the Project, and public comment. KRRC expects to revise the Definite Plan over the next year, as a result of (1) regulatory hearings; (2) the engagement of a Board of Consultants, required by FERC to provide an independent review, starting in August 2018; and (3) the KRRC's engagement of a general contractor, as well as insurers and similar entities for risk management, by early 2019. The KRRC will propose to incorporate the Definite Plan, in its final form, into all regulatory authorizations, including license surrender, to implement the Project.

Definite Plan Components

The Definite Plan is comprised of nine Sections, seventeen appendices, and numerous figures and tables:

- Section 1 describes the KRRC's objective for the Definite Plan and provides a Project description and background, corrections to elevation and river miles from previous documents, and document organization.
- Section 2 describes the existing features and developments of the four dams and their powerhouses.
- Section 3 provides an explanation of KRRC's proposed program to comply with FERC dam safety requirements and engineering guidelines.
- Section 4 describes the drawdown facilities, process, flows and sediment releases, anticipated downstream effects, monitoring, and adaptive management measures.
- Section 5 describes the removal limits, construction access, staging and disposal areas, removal process, demolition methods and equipment, imported materials, and waste disposal for the four dams and powerhouses.
- Section 6 describes the restoration plan for the former reservoir areas and other areas disturbed by the Project.
- Section 7 describes other features of the Project including proposed aquatic and terrestrial resources measures, long-term road improvements, City of Yreka water supply infrastructure improvements, recreation facilities demolition/restoration, and other resource management plans.
- Section 8 provides the latest understanding of project costs and construction schedules.
- Section 9 provides citations for references used in the Definite Plan document.
- The appendices, figures and tables are listed in the table of contents of the Definite Plan.

Chapter 1: Objectives and Background

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1. OBJECTIVES AND BACKGROUND

1.1 Objectives

This Definite Plan for the Lower Klamath Project (Definite Plan) provides information that the Federal Energy Regulatory Commission (FERC) requires to act on the transfer and surrender applications for the Lower Klamath Project. The Definite Plan serves as a basis for all other regulatory approvals required to implement the Klamath Hydroelectric Settlement Agreement (2010, as amended 2016) (KHSA). The Definite Plan is consistent with the requirements of Section 7.2 of the KHSA.

The Klamath basin's hydrologic system consists of a complex of inter-connected rivers, lakes, marshes, dams, diversions, wildlife refuges, and wilderness areas. Alterations to the natural hydrologic system began in the late 1800s, accelerating in the early 1900s, including water diversions by private water users, water diversions by and to the United States Bureau of Reclamation's (USBR) Klamath Irrigation Project and by hydroelectric developments operated by PacifiCorp.

PacifiCorp's Klamath Hydroelectric Project (KHP) (FERC No. 2082) was constructed between 1911 and 1962. The KHP included eight developments: East Side, West Side, Keno (non-generating), J.C. Boyle, Copco No. 1, Copco No. 2, Fall Creek, and Iron Gate. PacifiCorp operated the KHP under a 50-year license issued by FERC, until the license expired in 2006. PacifiCorp continues to operate the developments under an annual license. In March 2018, FERC amended the KHP license to remove four developments (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate), which now comprise the Lower Klamath Project. In June 2018, FERC stayed the effective date of the Lower Klamath Project license pending its final decision on the joint license transfer request. As noted in the definitions above, the term "Lower Klamath Project" is used in this document for ease of reference.

The KRRC proposes to decommission and remove the Lower Klamath Project consistent with the terms of the KHSA (the Project). This Definite Plan provides the blue print to achieve this purpose. The Definite Plan delineates the (i) methods to be undertaken to effect dam removal and a timetable for dam removal; (ii) plans for management, removal, and disposal of sediment, debris, and other materials; (iii) plans for site remediation and restoration; (iv) plans for measures to avoid or minimize adverse downstream impacts; (v) a plan for compliance with all applicable laws; (vi) a detailed statement of the estimated costs of dam removal; and (vii) measures to reduce risks of cost overruns, delays, or other impediments to dam removal. The purpose of the Project is to provide for a free-flowing river with volitional fish passage from Keno Dam to the Pacific Ocean.

Figure 1.2-1 provides an overview of the Klamath River watershed and the locations of the four dams. Figure 1.2-2 (Appendix C) provides an overview of the Project area and the major access routes to the area.

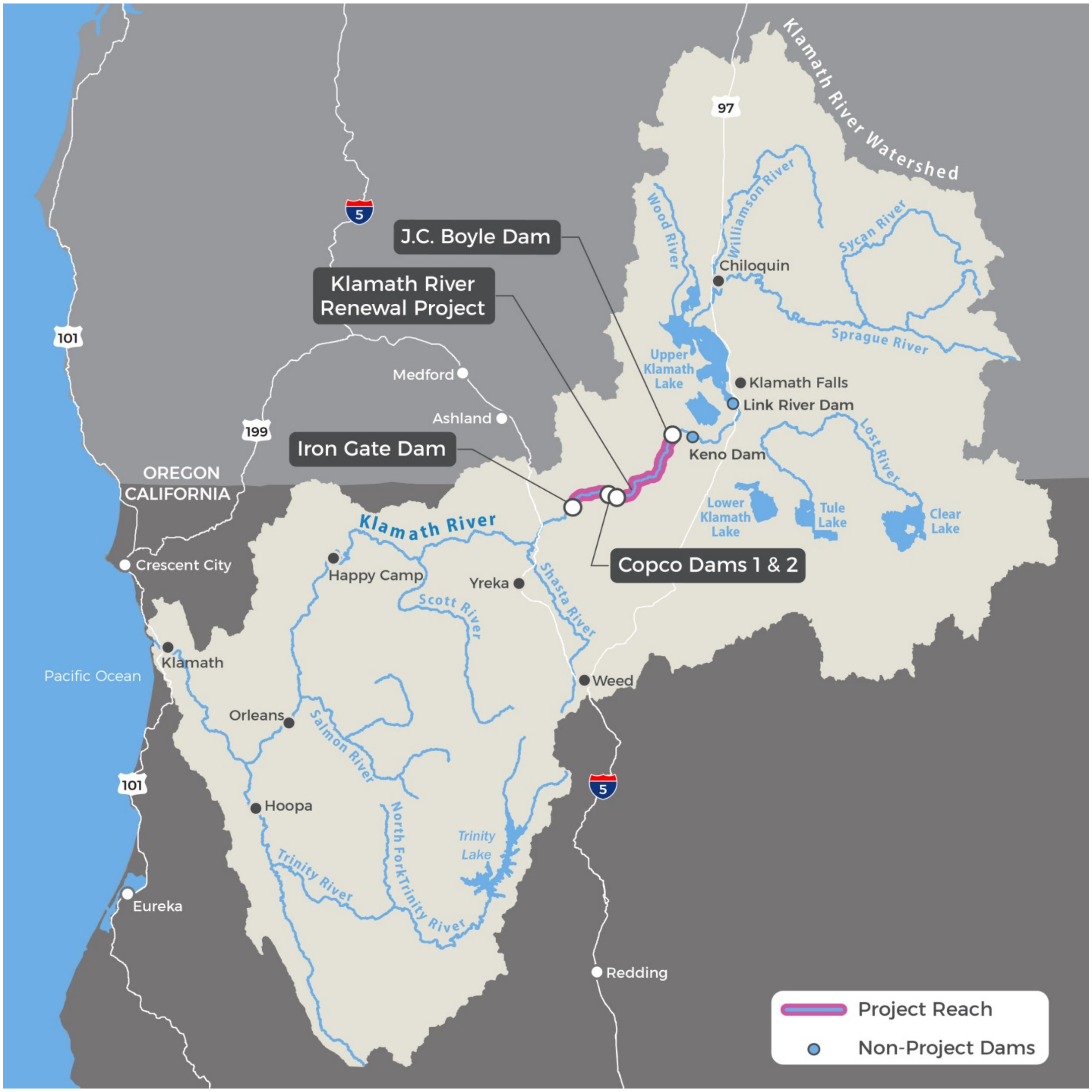

Figure 1.1-1 Klamath River Watershed and Development Locations

Figure 1.1-2 Project Vicinity and Access (Appendix C)

1.2 Project Description

The KRRC proposes a Project which is the physical removal of the four dam developments of the Lower Klamath Project (Iron Gate, Copco No. 1 and No. 2, and J.C. Boyle), consistent with the terms of the KHSA, to achieve at a minimum a free-flowing condition and volitional fish passage. The Project also includes site remediation and restoration, including previously inundated lands, and measures to avoid or minimize adverse downstream impacts, and all associated permitting for such actions. The Project is located on the Klamath River approximately 200 miles from the Pacific Ocean in the states of Oregon and California (see Figure 1.1-1).

The Definite Plan describes “Full Removal” as the proposed Project. Full Removal involves the complete removal of dams, power generation facilities, water intake structures, canals, pipelines, and ancillary buildings, of the Lower Klamath Project. The Definite Plan also describes a “Partial Removal” alternative for purposes of environmental review. Under the Partial Removal alternative, portions of each dam could remain in place, along with ancillary buildings and structures such as powerhouses, foundations, tunnels, and pipes, while still achieving the project purpose to achieve a free-flowing condition and volitional fish passage.

Prior to removal of the hydropower developments, KRRC (through its contractor) will draw down the water surface elevation in each reservoir as low as possible to facilitate accumulated sediment evacuation and to create a dry work area for development removal activities. Section 4 describes the drawdown timing and duration, as well as any infrastructure modifications necessary to facilitate drawdown. In general, drawdown will begin on or about January 1, 2021, and will extend through March 15, 2021.

After drawdown is accomplished, remaining reservoir sediments will be stabilized to the extent feasible, as described in Section 6, and dam and hydropower development removal will begin. Section 5 details the development removal and summarizes pertinent activities, material volumes, truck trips and other construction means and methods information.

Full reservoir area restoration will also be accomplished as described in Section 6, and will begin after drawdown, and extend throughout the year, and possibly extend into the subsequent year. Vegetation establishment could extend several years.

Other key project components include measures to reduce project-related effects to aquatic and terrestrial resources, road and bridge improvements, relocation of the City of Yreka’s pipeline across Iron Gate Reservoir and associated diversion facility improvements, demolition of various recreation facilities adjacent to the reservoirs, recreation improvements, downstream flood control improvements, groundwater system improvements, water supply improvements, fish hatchery modification and improvements, and measures to protect identified historic, cultural, and tribal resources. Section 7 summarizes these other project components.

Since the development of the Detailed Plan by USBR as part of the 2012 EIS/R process, the KRRC assessed whether the new information resulted in any changes to the project description as new information became available. The numbered list below, and further detailed in the referenced sections of this document, summarizes changes or refinements to the project description relative to the Detailed Plan resulting from new information or analyses.

1. Copco No. 1 Dam Modifications: The Detailed Plan (USBR 2012b) included sequential dam notching activities as part of the reservoir drawdown. Due to constructability and schedule risks associated with this activity, it is no longer the preferred plan for demolition of the Copco No. 1 development. The modification activities at Copco No. 1 now include a larger new gate installed on the downstream end of the existing diversion tunnel, to be used as the primary mechanism for reservoir drawdown. Sections 5.2 and 4 provide additional detail on the refined approach and the issues associated with the discarded notching option.
2. Maximum Reservoir Drawdown Rate: Based on the stability analyses and assessments in Appendices D and E, the maximum recommended drawdown rate is 5 feet per day. Section 4 describes associated drawdown plans for each development.
3. Material Quantities: Material quantities have been refined and updated to reflect the latest understanding of the work. Sections 5.2, 5.3, 5.4 and 5.5 summarize material quantities in text and table format for each development.
4. Partial Removal Alternatives: While KRRC proposes full removal at each development location, an alternative for leaving some existing infrastructure is included as an alternative for purposes of environmental review. A list of these alternatives is included in table format at the beginning of Sections 5.2, 5.3, 5.4 and 5.5.
5. Aquatic and Terrestrial Resource Measures: Aquatic and terrestrial resource measures have been refined from the previous AR and TER mitigation measures included in the 2012 EIS/R (USBR and CDFW 2012), and these measures are now included in the project description. The refinement process included collaboration with state and federal fisheries, other biological resource agencies, and tribes, to develop measures that have the highest potential to reduce project-related effects, using the latest science and case studies available. Sections 7.2 and 7.3, with further detail provided in Appendices I and J, summarize the measures.
6. Road and Bridge Improvements: Field and technical assessments concerning road and bridge improvements required for construction access, or to address project-related effects, have updated the understanding of what is required for the Project. Section 5 summarizes refined construction access improvements, while Section 7.4 summarizes road improvements required to address project-related effects.
7. City of Yreka Waterline Relocation: The Detailed Plan (USBR 2012b) included an overhead pipe bridge as the pipeline relocation solution for the Project. Due to ongoing technical assessments and discussions with the City of Yreka, there are three possible options for waterline relocation included in this document. Section 7.5 describes each option that KRRC will analyze for possible implementation.
8. Recreation Facilities Removal and Development Plan: The Project includes demolishing existing recreation facilities and restoring the areas to native habitat, and the Project will provide new

recreation facilities. Section 7.6 provides additional information on the recreation facilities and proposed recreation plan.

9. Downstream Flood Control Improvements: For those habitable structures and river crossings downstream along the Klamath River that the Project will impact, flood control improvements will be constructed to maintain the current level of flood control. See additional information provided in Section 7.7.
10. Fish Hatchery Improvements: The Project will implement the agency-developed hatchery plan to meet agency expectations and requirements associated with fish production. See additional information provided in Section 7.8.
11. Cultural Resources Plan: The Project will comply with all local, state, and federal laws, including those for cultural and tribal resources. Section 7.9 and Appendix L outline the plan for compliance.

To the extent that there is conflicting information in this document relative to the 2012 Detailed Plan, the information in this document supersedes the information in the Detailed Plan.

1.2.1 Project Area and Other Definitions

The Definite Plan and appendices use several terms to describe the location of the Project in its environs. The following summarizes these terms and their uses in the Definite Plan.

- Project area: refers to the area defined by the boundaries of the Lower Klamath Project. Such boundaries encompass lands and waters between the upper reach of J.C. Boyle Reservoir (RM 234.1) and the toe of Iron Gate Dam (RM 193.1). This definition of Project area is used for purposes of the Definite Plan. It may be revised for purposes of environmental review under the National Environmental Policy Act, the California Environmental Quality Act, or other applicable laws, in future procedures.
- Limits of work: refers to the physical extent of on-the-ground construction activities (i.e., demolition and removal) and restoration activities proposed as part of the Project, to occur within the Project area.
- Construction area: refers to areas where construction activities will occur in the Project area.
- Action area: this term has a specific meaning under Section 7(a)(2) of the Endangered Species Act and will be defined in the biological assessment.
- Area of Potential Effects: this term has a specific meaning under the Section 106 of National Historic Preservation Act and will be defined in the appropriate Section 106 document.

1.3 Compliance with Applicable Laws

The following text summarizes the KRRC's plan for compliance with applicable laws and regulations. This portion of the Definite Plan is responsive to the requirements of Section 7.2.2 E of the KHSA.

1.3.1 Federal

Federal Power Act

Pursuant to Sections 7.1.5 and 7.1.7 of the KHSA, on September 23, 2016 PacifiCorp and KRRC filed a "Joint Application for Approval of License Amendment and License Transfer" (Transfer Application) seeking a separate license for the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate developments (the Lower Klamath Project) and to transfer the license for the Lower Klamath Project from PacifiCorp to KRRC. Concurrently with this filing, the KRRC filed an Application for Surrender of License for Major Project and Removal of Project Works (Surrender Application) seeking FERC's approval of an application to surrender the license for the Lower Klamath Project and to achieve, by implementation of the Definite Plan, a free-flowing condition and volitional fish passage through the portions of the Klamath River that are currently occupied by the Lower Klamath Project.

FERC noticed the Transfer Application and the Surrender Application on November 10, 2016. FERC initiated informal consultation with: (a) the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) under Section 7 of the Endangered Species Act and the joint agency implementing regulations at 50 C.F.R. Part 402; (b) NMFS under Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations at 50 C.F.R. § 600.920; and (c) the California and Oregon State Historic Preservation Officers, as required by Section 106 of the National Historic Preservation Act, and the implementing regulations of the Advisory Council on Historic Preservation at 36 C.F.R. Part 800. FERC also designated PacifiCorp and the KRRC as the Commission's non-federal representatives for carrying out informal consultation, pursuant to Section 7 of the Endangered Species Act, Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act, and Section 106 of the National Historic Preservation Act and the Advisory Council's regulations at 36 C.F.R. § 800.2(c)(4). KRRC is undertaking such consultations as the non-federal representative.

On March 15, 2018, FERC amended the KHP license. It created the Lower Klamath Project, consisting of J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Developments. On June 21, 2018, FERC stayed the effectiveness of the license for the Lower Klamath Project, pending its final action on the transfer application. The Definite Plan uses the term Lower Klamath Project for ease of reference.

Transfer Application

In making its decision on the Transfer Application, FERC will evaluate and determine whether KRRC is qualified to be a licensee and whether the transfer of the License from PacifiCorp to KRRC is in the public interest (18 C.F.R. § 9.3). FERC may impose conditions relating to the KRRC's legal, technical, and financial capacity to fulfill its responsibilities as a licensee. KRRC will accept the license subject to Section 7.1.4 of the KHSA, which provides that "[b]efore the FERC license transfer to the DRE [Dam Removal Entity] will become effective, the DRE must demonstrate to PacifiCorp's and the States' reasonable satisfaction that the DRE has met the obligations in KHSA Appendix L and the following conditions:

A. The DRE has provided Notices required under Section 7.2.1.B of the KHSA;

B. The DRE has met the requirements of Section 7.1.3 and Appendix L of the KHSA;

C. PacifiCorp and the States agree that the DRE has made sufficient and Timely progress in obtaining necessary permits and approvals to effectuate Facilities Removal;

D. The DRE, the States, and PacifiCorp are assured that sufficient funding is available to carry out Facilities Removal;

E. The DRE, the States, and PacifiCorp are each assured that their respective risks associated with Facilities Removal have been sufficiently mitigated consistent with Appendix L of the KHSA;

F. The DRE, the States, and PacifiCorp agree that no order of a court or FERC is in effect that would prevent Facilities Removal;

G. The DRE and PacifiCorp have executed documents conveying the property and rights necessary to carry out Facilities Removal; and

H. The DRE accepts license transfer under the conditions specified by FERC in its order approving transfer."

If the conditions of transfer are acceptable to KRRC and satisfy the above requirements to the reasonable satisfaction of PacifiCorp and the States, KRRC will accept the license and comply with all terms and conditions of the license and the transfer order in connection with its implementation of the Definite Plan.

Surrender Application

In taking action on the Surrender Application, FERC will evaluate and determine whether surrender and decommissioning are in the public interest. It has the authority to impose conditions necessary to protect the public interest in connection with project decommissioning and, as in this case, dam removal. However, there is generally no public interest in keeping a decommissioned project under the Commission's jurisdiction for an extended time. Surrender is not effective upon the issuance of a surrender order, but when the licensee fulfills all the conditions of the surrender order. KRRC expects that implementation of the Definite Plan (as proposed) is in the public interest and does not anticipate that FERC will impose any conditions that conflict with, or are inconsistent with the Definite Plan. Additionally, Section 7.1.8 of the KHSA states: "The DRE will perform Facilities Removal in accordance with the Definite Plan, as approved and as may be modified by the FERC surrender order and other applicable Regulatory Approvals."

On October 5, 2017, FERC issued a directive to PacifiCorp and KRRC to convene an Independent Board of Consultants (BOC) to review and assess various aspects of the proposed dam removal process. FERC approved the BOC on May 22, 2018. The BOC is a six-member fully independent body that includes three members with experience in civil engineering (with specialized experience in dam construction and removal of both concrete and embankment dams, hydrology, hydraulics, and stream diversion) and geotechnical engineering. In addition, the BOC includes members with experience in aquatic and terrestrial biology, and a heavy civil construction cost estimator with experience in dam removal and restoration activities. KRRC anticipates that the BOC will commence its review of the Definite Plan in August of 2018. Initially, the BOC is called upon to review and provide recommendations regarding the adequacy of available funding and reasonableness of updated cost estimates for the most probable cost and maximum cost for implementation of the Definite Plan. The BOC is also called upon to review and provide recommendations regarding the adequacy of amounts and types of insurance coverage and bonding arrangements for dam removal, and to review and provide recommendations regarding other technical aspects of the Definite Plan to better define and understand the plans, schedules, specifications, staging, and sequencing for taking on the responsibilities for dam removal and decommissioning of the Lower Klamath Project. KRRC will incorporate the BOC recommendations into a revised Definite Plan and will provide FERC with a greater level of detail of the various project elements proposed in the Definite Plan. These recommendations will build upon and improve the Definite Plan and assist KRRC in maintaining compliance with the Federal Power Act, and in particular, FERC dam safety requirements and engineering guidelines.

FERC’s decision on the Surrender Application requires compliance with additional regulatory requirements. Section 7.1.4 of the KHSA requires that before the FERC license transfer to KRRC will become effective, the KRRC must demonstrate to PacifiCorp’s and the States’ reasonable satisfaction that the KRRC has made sufficient and timely progress in obtaining necessary permits and approvals to effectuate Facilities Removal. As a means to provide such assurances to PacifiCorp and the States with respect to the following requirements, KRRC will pursue a proactive approach with each agency to develop draft terms and conditions of approval that are consistent with the Definite Plan.

National Environmental Policy Act (NEPA):

FERC will act as lead agency for purposes of securing compliance with NEPA. In order to provide FERC sufficient information to undertake environmental review, KRRC provided FERC as part of its Surrender Application “Exhibit E” (Environmental Report) comprised of: the Klamath Facilities Removal Environmental Impact Statement/Report (2012), published by the U.S. Department of Interior and California Department of Fish and Wildlife; the Klamath Dam Removal Overview Report for the Secretary of the Interior: An Assessment of Science and Technical Information (2013); the Detailed Plan for Dam Removal – Klamath River Dams, Klamath Hydroelectric Project, FERC License No. 2082, Oregon – California (2012); and a contact list for property owners pursuant to 18 C.F.R. § 4.32(a)(3). This “Exhibit E” information is supplemented by this Definite Plan (updating, replacing and superseding the 2012 Detailed Plan) and KRRC’s responses to FERC’s July 14, 2017 Request for Additional Information. KRRC intends to further supplement Exhibit E with the Draft Environmental Impact Report (EIR) being prepared by the California State Water Resources Control Board (SWRCB) in compliance with the California Environmental Quality Act (CEQA). The plan and schedule approved by FERC for the BOC states that if the Commission approves the transfer, FERC will issue a public notice of the surrender application inviting comments, interventions, and protests. Based on any comments received, FERC will then determine if there is a need to further supplement the environmental record.

Section 401 of the Clean Water Act (CWA):

Activities that may result in any discharge into navigable waters require certification from the State in which the discharge will originate that any such discharge will comply with the applicable provisions of the Clean Water Act (CWA) (i.e., effluent limitations, other limitations necessary to assure compliance with provisions of the CWA, and appropriate state law requirements). No federal license or permit shall be granted until the water quality certification required by Section 401 of the CWA has been obtained from the state agency authorized to administer the CWA. Appropriate conditions of a water quality certification as determined by such state agency are binding upon FERC, and FERC must include them in the surrender order. See generally, PUD No. 1 of Jefferson City. v. Washington Dep't of Ecology, 511 U.S. 700 (1994).

KRRC has requested a water quality certification from the SWRCB and from the Oregon Department of Environmental Quality (ODEQ). Both agencies have released draft certifications for public comment. Before it can issue a water quality certification, the SWRCB, as lead agency in California, must also comply with the requirements of CEQA.

On May 23, 2018, ODEQ issued a proposed water quality certification identifying the requirements of state and federal law that are applicable to the certification. The proposed certification states that the Project, as proposed, will comply with the applicable provisions of Sections 301, 302, 303, 306 and 307 of the Clean Water Act, Oregon Administrative Rules, Chapter 340, Division 41 and other appropriate requirements of state law, provided KRRC conducts activities as proposed and implements the Section 401 conditions proposed in the certification.

On June 7, 2018, SWRCB issued a draft water quality certification identifying the requirements of state and federal law that are applicable to the certification. The draft certification states that the Project, as proposed, will comply with Sections 301, 302, 303, 306, and 307 of the CWA, and with applicable requirements of California State law, provided KRRC conducts activities as proposed and implements the Section 401 conditions proposed in the certification.

Exhibit E to KRRC’s Surrender Application and the Definite Plan, as augmented by additional information that was requested and provided to the SWRCB, provide a basis for CEQA compliance. SWRCB is developing a draft EIR that will be released for public review and comment in 2018. Prior to drafting final conditions for certification and taking a final action on the certification application, SWRCB will consider public comments, issue and certify a final EIR, and make relevant CEQA findings. KRRC will submit comments on the Draft EIR, as appropriate. As noted above, KRRC will also file the Final EIR with FERC as a supplement to Exhibit E to KRRC’s Surrender Application.

Endangered Species Act and Magnuson-Stevens Fishery Conservation and Management Act:

KRRC is serving as FERC's designated non-federal representative for carrying out informal consultation with the USFWS and NMFS under Section 7 of the Endangered Species Act and with NMFS under Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act. The KRRC is working informally with NMFS and USFWS to confirm species lists, the definition of the proposed action, identification of the Action Area, effects analysis methods, environmental baseline conditions, and to identify the best available science. These compliance efforts are ongoing. The complete list of terrestrial federal and state-listed, proposed, candidate, and petitioned for listing species that are known to occur or that may be present in the Action area is found in Appendix J. Identification of critical habitat and essential fish habitat that may be present in the Project Area will be described in a Biological Assessment that KRRC will submit to USFWS and NMFS in 2018.

KRRC anticipates that any measures that may be determined by the U.S. Fish and Wildlife Service and NMFS to comply with the Endangered Species Act and the Magnuson-Stevens Fishery Conservation and Management Act will be consistent with the Definite Plan and that FERC will include them in the surrender order. Sections 6, 7.2, 7.3, 7.8, and Appendices H, I, and J of the Definite Plan are responsive to these regulatory requirements.

National Historic Preservation Act

KRRC is serving as FERC's designated non-federal representative for carrying out consultation with the California and Oregon State Historic Preservation Officers (SHPOs), Tribal Historic Preservation Officers (THPOs), and other interested parties as required by Section 106 of the National Historic Preservation Act (NHPA). These efforts are ongoing. The information provided in Appendix L discusses efforts to comply the NHPA and its regulatory requirements.

Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act (NAGPRA), 32 U.S.C.§ 3001, et seq. establishes the ownership of cultural items excavated or discovered on federal or tribal land lies with the lineal descendants and culturally affiliated Indian tribes and Native Hawaiian organizations and, among other things, establishes procedures for the inadvertent discovery or planned excavation of Native American cultural items on federal or tribal lands. Information on compliance with NAGPRA is included in Appendix L.

Section 404 of CWA

Implementation of the Definite Plan will result in fill and/or dredging of jurisdictional waters of the United States, including wetlands, within and adjacent to the Klamath River during construction activities. These activities will require a Section 404 individual permit from the United States Army Corps of Engineers (USACE).

KRRC representatives attended a pre-application meeting with the USACE on May 25, 2017, and KRRC is providing periodic informal updates to the USACE's assigned project manager. At this juncture, USACE has not identified any issues that give rise to any concern that the USACE cannot issue an individual permit on terms and conditions that are consistent with the Definite Plan. KRRC believes that the preferred and best means to achieve this result is to continue pre-application meetings and discussion with the USACE, and to review a draft application with the USACE when KRRC is ready to do so. The application may be available for submittal in mid-to-late 2018, although KRRC has not established a firm date for a submittal. Issuance of a Section 404 individual permit by the USACE is contingent upon the issuance of the 401 water quality certifications, completing the Section 106 consultation, as well as the completion of Section 7 consultation with USFWS and NMFS. KRRC will pursue a proactive approach with USACE and seek to develop draft terms and conditions of approval that are consistent with the Definite Plan and can be shared with the States and PacifiCorp.

Section 402 of CWA

Implementation of the Definite Plan will require coverage under National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permits for construction-related stormwater discharges to surface waters in California and Oregon. NPDES permit applications for general construction stormwater discharges are required to be submitted at least 30 days prior to commencement of land disturbance. The selected dam removal construction contractor will likely prepare the applications by February of the year prior to reservoir drawdown, with submission to each state agency planned for the end of March in the year that pre-drawdown construction activities are planned to occur. KRRC does not anticipate any significant issues or concerns in connection with securing and complying with these permits.

Section 10 of the Rivers and Harbors Act

Section 10 of the Rivers and Harbors Act prohibits the obstruction or alteration of navigable waters without a permit from the USACE. KRRC will monitor whether any project components require a Section 10 permit, and will obtain such permit from the USACE as needed.

Wild and Scenic Rivers Act

The National Park Service designates two segments of the Klamath River as Wild and Scenic Rivers (WSRs), one in Oregon and one in California. The Oregon segment commences 0.25 miles downstream of the J.C. Boyle Powerhouse and flows 11 miles to the Oregon/California state line. The California section commences 3,600 feet downstream of Iron Gate Dam and ends 189 miles later at its confluence with the Pacific Ocean.

A Section 7(a) determination of the WSRA for a proposed project is required if there could be a potential to unreasonably diminish the scenic, recreational, fish, or wildlife values present within a designated river from its date of designation. The National Park Service will develop a determination following the evaluation procedure under the direct and adverse effects standard for existing projects licensed by FERC, or other federally assisted projects inside the designated river (Section 7(a)). Permits, such as the 404 permit, may not be issued until any adverse effects are eliminated. KRRC has initiated discussions with the National Park Service and will provide requested documentation in 2018.

1.3.2 State and Local Permits

The Federal Power Act, 16 U.S.C. 791 et seq. vests FERC with broad authority to regulate hydropower facilities and establishes that state and local regulation of matters to be decided by FERC with respect to such hydropower facilities is preempted by operation of the Supremacy Clause of the U.S. Constitution. *California v. FERC*, 495 U.S. 490 (1990); *First Iowa Hydro-Electric Cooperative v. Federal Power Commission*, 328 U.S. 152 (1946). This preemptive authority extends to license surrender and project decommissioning decisions. For example, in the case of *PacifiCorp*, 115 FERC ¶ 61,194 (2006), FERC ruled:

> *It is well-established that the FPA preempts all state and local law concerning hydroelectric licensing apart from those adjudicating proprietary water rights. Furthermore, since the determination of whether a license should be surrendered is an action taken pursuant to the FPA, and the Commission retains jurisdiction over the Project until the license surrender is accepted and becomes effective, federal preemption applies to a license surrender.*

However, in this case, FERC stated the licensee has a responsibility to work with state and local jurisdictions and address state and local requirements in an appropriate manner:

> *We prefer for our licensees to be good citizens of the communities in which projects are located, and thus to comply with state and local requirements, where possible. However, to the extent that state or local regulations make compliance with our orders impossible or unduly difficult, we will conclude that such regulations are preempted.*

Consistent with FERC's preference, KRRC will address state and local interests by reaching out to state and local agencies and pursuing mutually acceptable means and methods to address their interests in the FERC process.

The first step in this process has been to meet and consult with state and local jurisdictions to develop a better understanding of their interests and concerns. Outside of general public meetings, KRRC has held numerous working group workshops to discuss aquatic resources, terrestrial resources, cultural resources, and the restoration plan. Applicable regulatory agencies and other stakeholders attended these workshops.

Based on this outreach and the information obtained from state and local jurisdictions and other stakeholders, KRRC has made changes or modifications to the Definite Plan to address these agencies' and stakeholders' interests and concerns. Changes that fall under this category include revisions to the aquatic resource measures, terrestrial resource measures, the restoration plan, and the fish hatchery plan. Specifically, this includes Sections 6, 7.2, 7.3, 7.8, and Appendices H, I, and J. This outreach and iterative process is ongoing and is "business as usual" for purposes of the development and implementation of the Definite Plan.

KRRC also understands that in a given instance, the specific actions to be taken, or avoided, to address state and local regulatory requirements may need to be documented outside of the Definite Plan and presented to FERC as recommended conditions of approval. In such circumstances, KRRC proposes that

KRRC and the relevant state or local agency enter into an agreement to submit joint recommendations to FERC regarding terms and conditions that should be adopted by FERC as conditions of approval.

The parameters for such agreements are limited only by the requirements of applicable law, consistency with the KHSA, and the requirements that the KHSA established for the Definite Plan. The factual nexus of any recommended condition to implementation of the Definite Plan, as well as the reasonableness of any recommendations that would be contained in the agreement, are further considerations just as they would be in any regulatory context. These "good neighbor" agreements with state and/or local agencies would specify reasonable measures that the parties agree are appropriate to recommend that would address the state and local regulatory requirements that are otherwise preempted by the Federal Power Act. These agreements will commit both parties to propose and advocate for these recommended measures to FERC in the surrender proceeding.

California

As noted above, KRRC has requested a water quality certification from the SWRCB pursuant to Section 401 of the Clean Water Act. Before the SWRCB can issue a water quality certification, the SWRCB must comply with the requirements of CEQA. As part of CEQA, SWRCB must also consult with California Native American tribes pursuant to Assembly Bill 52 (AB 52). SWRCB's CEQA review and AB 52 consultation remain ongoing.

California state law requirements preempted by FERC's authority under the FPA include California Fish and Game Code Sections 1602 and 2081. Implementation of the Definite Plan may require local permits and approvals for construction traffic, road maintenance, grading, minor road widening, tree trimming and similar activities at various locations. KRRC will first seek to address these state and local interests in the context of its ongoing outreach efforts through incorporation of measures included in the Definite Plan. Should there be outstanding issues that otherwise would be addressed through state and local permitting outside of the FERC context, KRRC will pursue "good neighbor" agreements with the jurisdictions that view this mechanism as an appropriate and effective means to address their interests. In the event that these state and local requirements are not addressed in the FERC Surrender Order and such requirements are deemed to not be preempted by the Federal Power Act, KRRC's contractor will be instructed to apply for any additional local permits that may be required at the appropriate time.

Oregon

As noted above, KRRC has requested a water quality certification from the ODEQ under Section 401 of the Clean Water Act. In connection with this pending request, KRRC filed Findings In Support Of Land Use Compatibility For Removal Of John C. Boyle Dam "[a]n exhibit that … includes land use compatibility findings for the activity prepared by the local planning jurisdiction (OAR 340-048-0020(2)(i)(A))" with ODEQ on May 10, 2018 to demonstrate that the Project is compatible with the applicable comprehensive plan and land use regulations of Klamath County. ODEQ found the material submitted by KRRC in lieu of a Land Use Compatibility Statement (LUCS) from Klamath County adequately identifies and addresses specific provisions of local land use and the implementing regulations applicable to the proposed activity and demonstrates project conformity with local land use regulations. KRRC will continue to consult with Klamath County as a means to fully and satisfactorily address Klamath County's interests through the FERC process.

Oregon state law requirements preempted by FERC's authority under the FPA include Oregon Fill/Removal permit from Oregon Department of State Lands and the Oregon Fish Passage Approval. Implementation of the Definite Plan may require local permits and approvals for construction traffic, road maintenance, grading, minor road widening, tree trimming and similar activities at various locations. KRRC will first seek to address these state and local interests in the context of its ongoing outreach efforts through incorporation of measures included in the Definite Plan. Should there be outstanding issues that otherwise would be addressed through state and local permitting outside of the FERC context, KRRC will pursue "good neighbor" agreements with the jurisdictions that view this mechanism an appropriate and effective means to address their interests. In the event that FERC does not address these requirements in the surrender order and such requirements are deemed to not be preempted by the Federal Power Act, KRRC's contractor will be instructed to apply for any additional permits that may be required.

1.3.3 Further Consultation

This Definite Plan includes many measures that, as of the date of publication, are subject to further consultation. As non-federal representative under certain laws, and under the good neighbor policy described in Section 1.3.2, KRRC will undertake further consultation in an effort to reach agreements on measures that will protect resources affected by the Project. Such consultation will include the following entities:

- Federal and state agencies which have permitting or regulatory jurisdiction over the Project, including USFWS, NMFS, USACE, and the SWRCB. Consultations with these agencies will be complete prior to FERC's decision on the surrender application.
- KRRC will also consult with a number of state agencies, including ODFW and CDFW, that may not have jurisdiction over the Project; however, KRRC understands that these state agencies are important stakeholders in the process.
- Federally recognized tribes in the Klamath Basin, specifically, Cher'Ae Heights of the Trinidad Rancheria, Hoopa Valley Tribe, Karuk Tribe, Klamath Tribes, Modoc Tribe of Oklahoma, Quartz Valley Indian Reservation, and Yurok Tribe; and other tribes, including Shasta Nation and Shasta Indian Nation pursuant to Section 106 of the NHPA and California AB 52. These consultations will be complete prior to issuance of the FERC surrender and SWRCB decisions, respectfully.
- Siskiyou, Del Norte, and Humboldt Counties, California; and Klamath County, Oregon.
- City of Yreka, California.
- Other consulting parties designated or required under applicable procedures.

1.4 Elevations and Measurement Corrections

Previous documents and reports prepared for the project developments used older datum sources and outdated measurement techniques. When applicable, KRRC has updated numbers cited in this report. Some project record drawings note elevations in "project datum", which is the National Geodetic Vertical Datum of 1929 (NGVD29). Elevations were converted from project datum to North American Vertical Datum of 1988 (NAVD88) according to Table 1.4-1. In addition, some older documents provide elevations in "local datum" (a datum relevant to only specific locations in the Lower Klamath Project), and elevations were converted from local datum to NAVD88 according to Table 1.4-1.

River miles (the distance a river feature or location is demarked from the Pacific Ocean in river miles (RMs)) were previously incorrectly calculated; the river mile locations noted in this report have also been updated using a river route that aligns with the channel thalweg shown in the 2018 bathymetry surveys of Iron Gate Reservoir and Copco Lake. The river route in J.C, Boyle Reservoir will be updated in summer 2018 based on the latest bathymetric survey of that reservoir. Table 1.4-2 provides a sampling of river mile conversions from those noted in the Detailed Plan (U.S. Bureau of Reclamation (USBR) 2012). KRRC has also used GIS to update areas and acreages previously reported.

Table 1.4-1 Elevation Conversion Factors

Location	From project datum (NGVD29) to NAVD88	From local datum[1] to NAVD88
J.C. Boyle	+ 3.71 feet	
Copco No. 1	+ 3.48 feet	+ 2414.48 feet
Copco No. 2	+ 3.48 feet	+2214.48 feet
Iron Gate	+ 3.33 feet	

Note:
1. Local datums were used during design and construction of Copco No. 1 and No. 2

Table 1.4-2 River Mile Comparison

Location	River Mile in Detailed Plan	River Mile in Definite Plan
Upstream end of J.C. Boyle Reservoir	228	234.1
J.C. Boyle Dam	224.7	230.6
J.C. Boyle Powerhouse	220	226.0
Upstream end of Copco Lake	204	209.0
Copco No. 1 Dam	198	202.2
Copco No. 2 Dam	199	201.8
Copco No. 2 Powerhouse	196	200.3
Upstream end of Iron Gate Reservoir	197	200.3

Location	River Mile in Detailed Plan	River Mile in Definite Plan
Iron Gate Dam	190	193.1

1.5 Document Organization

The document is organized into the following sections:

- **Section 1 –Objectives & Background**: describes the objectives of the Definite Plan, background on the Project, corrections to elevations and river miles from previous documents, and document organization.
- **Section 2 – Existing Feature Descriptions**: describes the existing features and developments of the four dams and their powerhouses.
- **Section 3 – FERC Compliance & Dam Safety**: provides an explanation of KRRC's proposed program to comply with FERC dam safety requirements and engineering guidelines
- **Section 4 – Reservoir Drawdown & Diversion Plan**: describes the drawdown facilities, process, flows and sediment releases, anticipated downstream effects, monitoring, and adaptive management measures.
- **Section 5 – Dam Removal Approach**: describes the removal limits, construction access, staging and disposal areas, removal process, demolition methods and equipment, imported materials, and waste disposal for the four dams and powerhouses.
- **Section 6 – Reservoir and Other Restoration**: describes the restoration plan for the former reservoir areas and other areas disturbed by the Project.
- **Section 7 – Other Project Components**: describes other features of the Project including proposed aquatic and terrestrial resources measures, long-term road improvements, Yreka water supply improvements, recreation facilities demolition/restoration, and other resource management plans.
- **Section 8 – Project Costs and Schedule**: provides the latest understanding of project costs and construction schedules
- **Section 9 – References**: provides citations for references used in the document.
- **Figures**: the document includes figures throughout text as well as in two appendices. Figures throughout the document are numbered according to their respective subsection and then sequentially. Figures that can be found in an appendix are noted after the figure number with a letter in parentheses. For example, Figure 2.1-2 is associated with the text of Section 2.1 and can be found in the text; whereas, Figure 2.1-3 (B) can be found in Appendix B.
  + Appendix B includes figures designated as Critical Energy Infrastructure Information (CEII) that is not generally available to the public. Information in Appendix B will only be provided to specific agencies and individuals according to FERC rules and regulations.
  + Appendix C includes figures that do not contain CEII.

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Chapter 2: Existing Feature Descriptions

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2. EXISTING FEATURE DESCRIPTIONS

This section describes the four dam developments (Iron Gate, Copco No. 1 and No. 2, and J.C. Boyle) KRRC will remove as part of the Project. The purpose of this description is to support our analyses, described in later sections, and to support the surrender application. The April 2015 Supporting Technical Information Documents prepared by PacifiCorp for FERC provide additional detail on the four developments.

2.1 J.C. Boyle Dam and Powerhouse

The J.C. Boyle Development (originally known as the Big Bend Development) consists of a reservoir, combination embankment and concrete gravity dam, gated spillway, diversion culvert, water conveyance system, and powerhouse located on the Klamath River between RM 234.1 and RM 226.0, in Klamath County, Oregon. Refer to Figure 2.1-1 (C) for plan views of these features.

Figure 2.1-1 J.C. Boyle Dam Existing Features (Appendix C)

California-Oregon Power Company completed J.C. Boyle Dam in 1958 at RM 203.6, and is downstream of Keno Dam and upstream of Copco No. 1 Dam. The primary purpose of the development is to generate hydroelectric power. Structures at the site include an office building (known as the Red Barn), maintenance shop, fire protection building, communications building, two occupied PacifiCorp-owned residences near the dam, and a large warehouse near the powerhouse.

2.1.1 Reservoir

J.C. Boyle Dam impounds a narrow reservoir (J.C. Boyle Reservoir) of 350 acres based on 2010 aerial imagery (Woolpert 2010), and according to a 2003 bathymetric survey (Eilers and Gubala 2003), provides approximately 2,267 acre-feet of total storage capacity at reservoir water surface (RWS) elevation 3797.2.[1] The maximum and minimum operating levels are between RWS elevations 3796.7 and 3791.7, a vertical operating range of 5 feet, although the reservoir is normally maintained at RWS elevation 3796.7, or 0.5 foot below the top of the spillway gates.

2.1.2 Dam, Spillway, and Diversion Culverts

The dam is composed of an earthen embankment section, fish ladder, spillway and diversion culverts, intake to the powerhouse, and concrete gravity section (from right abutment to left abutment, looking downstream). Figure 2.1-2 shows the dam.

[1] All elevations in this Definite Plan are in NAVD88 vertical datum. Previously reported elevations were in project datum. See Table 1.3-1 for conversion factors.

Credit: River Design Group

Figure 2.1-2 J.C. Boyle Dam

The earthfill embankment portion is 68 feet tall (on the dam axis at its maximum height above the original streambed elevation 3735.7) with a 15-foot-wide crest and a crest length of 413.5 feet at elevation 3803.7 (Figure 2.1-3 (B)). The zoned embankment has a central impervious clay core flanked by upstream and downstream shells composed of compacted sand and gravel, with a downstream filter blanket. The upstream face above elevation 3783.7 has a 2½H:1V slope with a 3-foot-thick riprap layer, and a 3H:1V slope below elevation 3783.7. The downstream face has a 2½H:1V slope, with a 2-foot-thick riprap layer below approximately elevation 3771.7. The dam includes a 3-foot-high concrete cutoff wall along the bedrock foundation about 7 feet upstream of the dam axis.

Figure 2.1-3 Cross Section of J.C. Boyle Dam (Appendix B)

The concrete portion of the dam is 279 feet long and from right to left (looking downstream) is composed of a 117-foot-long spillway section, a 48-foot-long intake structure, and a 114-foot-long concrete gravity section with a maximum height of 23 feet (Figure 2.1-4 (B)).

Figure 2.1-4 Elevation of J.C. Boyle Spillway and Diversion Culverts (Appendix B)

The spillway section is a concrete gravity overflow structure with three 36-foot-wide by 12-foot-high radial gates and upstream stoplog slots (Figure 2.1-5 (B)). The spillway crest is at elevation 3785.2, with the top of gates at elevation 3797.2 (0.5 feet above the normal operating level). The spillway includes a traveling gate hoist for operation of the spillway gates. The spillway bays discharge onto a 13-foot-long concrete apron stepped at three elevations generally following the profile of the bedrock surface. Below the apron is a vertical drop of 15 feet to the discharge channel, which was excavated in rock. The discharge channel is generally unlined. The estimated spillway discharge capacity at RWS elevation 3796.7 with all three gates open is 15,400 cubic feet per second (cfs).

Figure 2.1-5 Cross Section of J.C. Boyle Dam Spillway (Appendix B)

A concrete box culvert with two 9.5- by 10-foot bays is located beneath the center and right spillway gates at invert elevation 3755.2 (30 feet below the spillway crest, as shown in Figure B2.1-4 (B)). This feature was used for diversion during construction of the dam, and has been sealed with concrete stoplogs at the upstream end. Approach and outlet channels for the diversion culvert were excavated in bedrock.

2.1.3 Intake, Fish Screens, and Fish Ladder

The intake structure is located to the left of the spillway and consists of a 40-foot-high reinforced concrete tower (Figure 2.1-6). It has four approximately 11-foot by 37-foot openings to the reservoir, each of which has a steel trash rack followed by a stoplog slot and a vertical traveling fish screen (with 0.25-inch-square openings) with high pressure spray cleaners. Spray water along with any screened fish are collected and diverted downstream of the dam through a 340-foot-long, 24-inch-diameter fish screen bypass pipe, which provides approximately 20 cfs to the Klamath River below the dam. A fabricated metal building was added to the intake structure in 1989. Downstream of the traveling fish screens is the entrance to a 14-foot-diameter steel pipeline. The upstream end of the 14-foot pipeline includes a wheel-mounted slide gate and hoist, with upstream stoplog slots, for operation and maintenance purposes.

A concrete pool and weir fish ladder located along the abutment wall between the embankment and concrete sections provides upstream fish passage at the dam. The fish ladder is approximately 569 feet long with 63 pools. A 24-inch slide gate regulates reservoir releases to the fish ladder, and the fishway operates over a head range of approximately 61 to 66 feet.

Figure 2.1-6 J.C. Boyle Intake Structure

2.1.4 Water Conveyance to Powerhouse

A water conveyance system connects the dam to the powerhouse and has a total length of 2.56 miles. The conveyance system from upstream to downstream consists of a steel pipeline, a headgate, a flume, a forebay, a tunnel, and 2 penstocks connecting to the powerhouse.

From the intake structure at the dam, the water flows through a 638–foot-long, 14-foot-diameter steel pipeline, supported on steel frames where it spans the Klamath River. The downstream end of the pipeline is equipped with a 14- by 14-foot automated fixed-wheel gate within a concrete headgate structure completed in 2002, which discharges into an open concrete-lined flume (the power canal).

The power canal is nearly 2.2 miles long and located along a bench cut in the slope of the river canyon (Figure 2.1-7). Depending on the terrain, the power canal either has walls on the down-slope side only or on both the down-slope and up-slope sides. The power canal is a concrete flume approximately 17 feet wide and 12 feet high, with shotcrete applied to the canyon walls where exposed. It has overflow structures at the upstream end (consisting of a siphon pipe) and at the downstream forebay (consisting of a gated overflow weir).

Figure 2.1-7 J.C. Boyle Power Canal (left) and Klamath River Bypass Reach (right)

The forebay is a somewhat enlarged area at the end of the power canal that connects to the tunnel, the next downstream component in the water conveyance system. The forebay has an overflow or spillway equipped with two float-operated automatic spill gates, which release water from the power canal during a hydraulic surge following any load rejection at the powerhouse. The released water discharges through a short, concrete-lined chute and returns to the bypass reach of the Klamath River (between the dam and powerhouse) via a large eroded channel (or scour hole) in the hillside (Figure 2.1-8). A forebay sluiceway pipe has been abandoned in place.

Figure 2.1-8 Forebay Overflow Chute and Upper Portion of Scour Hole

A 60-foot-wide and 17.9-foot-high trash rack with 2-inch bar spacing draws water for power generation from the forebay (Figure 2.1-9) into a 15.5-foot-diameter, concrete-lined, horseshoe-shaped tunnel, which is 1,644 feet long. The last 57-foot length of the tunnel before the downstream portal is steel-lined with the liner bifurcating into two 10.5-foot-diameter steel penstocks. A concrete anchor block encases the bifurcation and includes a 78-foot-high, 30-foot-diameter steel surge tank.

Figure 2.1-9 J.C. Boyle Forebay and Tunnel Trash Rack (rear)

Descending to the powerhouse, the penstocks reduce in two steps to 9 feet in diameter. Ring girders seated on concrete footings support each 956-foot-long penstock (Figure 2.1-10). The downstream end of each penstock includes a 108-inch-diameter butterfly valve.

Figure 2.1-10 J.C. Boyle Penstocks

2.1.5 Powerhouse

A conventional outdoor-type reinforced concrete peaking powerhouse (Figure 2.1-11) is located on the right bank of the river and approximately 4.6 river miles downstream of the dam, at RM 226.0, and is the largest power generating development in the Lower Klamath Project. The two turbines are vertical-shaft, Francis-type units with a total rated discharge capacity of 2,850 cfs. The turbines are rated at 75,700 horsepower (hp) for Unit 1 (replaced in 1994) and 63,900 hp for Unit 2, with a net head of 440 feet. The system provides no bypass capacity. Four draft tube bulkhead gates and slots, with two hoists, are provided downstream of the units. A single 150-ton gantry crane is currently located at the J.C. Boyle powerhouse, but can also be used at the Iron Gate powerhouse.

Figure 2.1-11 J.C. Boyle Powerhouse

The generators are rated at 53 megavolt-amperes (MVA) for Unit 1, with a 0.95 power factor (50 megawatts (MW)), and 50 MVA for Unit 2, with a 0.95 power factor (48 MW). The power from the powerhouse is transmitted a very short distance to the adjoining J.C. Boyle substation. Two three-phase transformers step up the generator voltage for transmission interconnection. Line No. 58 (to Lone Pine) and Line No. 59 (to Klamath Falls) extend from the J.C. Boyle substation to a line tie. There is also a third line that pre-dates the substation. The 0.24-mile 69-kV transmission line (PacifiCorp Line No. 98) connects the J.C. Boyle powerhouse to a tap point on PacifiCorp's Line No. 18, but based on field observation and aerial photos this line appears to have been removed.

2.1.6 Site Access

Oregon Route 66 (OR66, Green Springs Highway) and Topsy Grade Road provide site access via a network of unpaved project access roads. A small timber bridge crosses the Klamath River downstream of the dam.

2.1.7 Recreation Facilities

Recreation facilities include Topsy Campground and boat launch (managed by the Bureau of Land Management, BLM), Pioneer Park east and west units and boat launches (managed by PacifiCorp), Spring

Island whitewater boating launch (managed by BLM), and numerous smaller dispersed shoreline recreation sites, including two picnic areas, thirteen campsites, and eleven shoreline access points. Section 7.6 provides additional detail on the facilities.

2.2 Copco No. 1 Dam and Powerhouse

The Copco No. 1 Development consists of a reservoir, concrete dam, gated spillway, diversion tunnel, intake structure, and powerhouse located on the Klamath River between approximately RM 209.0 and RM 202.2, in Siskiyou County, California. Refer to Figure 2.2-1 (C) for plan views of these features.

Figure 2.2-1 Copco No. 1 and Copco No. 2 Dams Existing Features (Appendix C)

Siskiyou Power and Light Company then California-Oregon Power Company constructed Copco No. 1 Dam between 1911 and 1922 at RM 202.2, and which is downstream of J.C. Boyle Dam and upstream of Copco No. 2 Dam. The primary purpose of the development is to generate hydroelectric power. Structures at the site include an occupied residence with small garage, a vacant house, and a maintenance building.

2.2.1 Reservoir

Copco No. 1 Dam impounds a reservoir (Copco Lake) of approximately 972 acres based on 2010 aerial imagery (Woolpert 2010), and according to a 2003 bathymetric survey (Eilers and Gubala 2003), provides approximately 33,724 acre-feet of total storage capacity at RWS elevation 2611.0.[2] The maximum and minimum reservoir operating levels are between RWS elevations 2611.0 and 2604.5, a vertical operating range of 6.5 feet, although the reservoir is normally maintained at RWS elevation 2609.5, or 1.5 feet below the top of the spillway gates.

2.2.2 Dam, Spillway, and Diversion Tunnel

The dam is composed of a concrete gravity arch which also functions as a spillway, diversion culverts, and intakes to the powerhouse. Figure 2.2-2 shows the dam.

2 All elevations in this Definite Plan are in NAVD88 vertical datum. Previously reported elevations were in project datum. See Table 1.3-1 for conversion factors.

Figure 2.2-2 Copco No. 1 Dam (right) and Powerhouse (left)

The dam is a concrete gravity arch structure approximately 133 feet tall from the pre-dam river bed elevation to the top of the spillway deck, with a 492-foot radius at the upstream face. The crest length between the rock abutments is approximately 410 feet at elevation 2616.5. The upstream face of the dam is vertical at the top, then battered at 1 horizontal to 15 vertical. The downstream face is stepped, with risers generally about 6 feet in height.

A 224-foot-long, ogee-type overflow spillway is located on the crest of the dam, and is divided into 13 bays controlled by 14- by 14-foot radial (Tainter) gates, with a spillway crest at elevation 2597.0 (Figure 2.2-3 (B)). Three traveling gate hoists are provided for operating the spillway gates, and stoplog slots are provided upstream of each opening.

Figure 2.2-3 Cross Section of Copco No. 1 Spillway (Appendix B)

As originally designed, the spillway crest was approximately 115 feet above the original river bed. After construction began, the river gravel was found to be over 100 feet deep at the dam site, and was excavated and then backfilled with concrete, making the total structural height of the dam 230 feet, measured from the lowest depth of excavation to the spillway crest, or 250 feet to the top of the spillway deck (Figure2.2-4

(B)). The estimated spillway discharge capacity at RWS elevation 2611.0 with all 13 gates fully open is 35,000 cfs.

Figure 2.2-4 Cross Section of Copco No. 1 Dam (Appendix B)

A 16- by 18-foot diversion tunnel was excavated through the left abutment for streamflow diversion during construction, but was later sealed by the construction of a concrete plug approximately 200 feet upstream from the downstream tunnel portal (Figure 2.2-5). A gated concrete intake structure, which regulated flows during construction, is located at the upstream end of the tunnel and has three 72-inch-diameter flap (or clack) valves, three 72-inch-diameter butterfly regulating valves, and three 12-inch-diameter filling lines with valves. All valves were manually-operated using gate stems and wire ropes from hoists located on a concrete deck upstream of the left abutment of the dam. The current condition of the valves and upstream tunnel is unknown as they are submerged by reservoir sediment. The existing hoists, stems, and wire ropes were abandoned in place and are not currently operational.

Figure 2.2-5 Copco No. 1 Diversion Tunnel Downstream Portal

2.2.3 Water Conveyance to Powerhouse

The intakes for the three penstocks, two 10–foot-diameter and one 14–foot-diameter (Figure 2.2-6), are located at the right abutment at approximately invert elevation 2,578.5.[3] Each penstock includes two cast-iron slide gates with electric motor hoists located in two concrete gatehouses. The two 10-foot-diameter (reducing to 8-foot-diameter) steel penstocks closest to the river feed Unit No. 1 in the powerhouse, and the 14-foot-diameter (splitting and reducing to two 8-foot-diameter) steel penstock feeds Unit No. 2. Trash racks with bar spacing of 3 inches proceed each intake.

A third generating unit at the powerhouse was planned, but never built. Some conveyance facilities (two slide gates and a short penstock section) were built to the right of the existing penstocks for this possible future expansion.

Figure 2.2-6 Copco No. 1 10-ft (left and middle) and 14-ft (right) Penstocks

3 PacifiCorp's Supporting Technical Information Document and the Detailed Plan show the intakes having an invert of 2,578.5 feet (NAVD88). 1921 as-built drawings for the 14-foot penstock show an invert of 2,575.5 feet (NAVD88).

2.2.4 Powerhouse

The Copco No. 1 Powerhouse (Figure 2.2-7) is a reinforced-concrete substructure with a concrete and steel superstructure located at the base of Copco No. 1 Dam, on the right bank of the river. It operates as peaking powerhouse. The two turbines are horizontal-shaft, double-runner Francis-type units with a total rated discharge capacity of 3,650 cfs. The turbines have a rated output of 21,759 hp and 18,600 hp for unit 1 and 2, respectively, with a net head of 125 feet. The system provides no bypass capacity.

The generators are each rated at 12,500 kilovolt-amperes (kVA) with a 0.8 power factor (10 MW). Unit 1 has three indoor, single-phase 5,000-kVA, 2,300/72,000-volt (V) transformers, and Unit 2 has three indoor, single-phase 4,165-kVA, 2,300/72,000-V transformers, to step up the generator voltage for transmission interconnection.

The Copco No. 1 Powerhouse has four associated 69-kV transmission lines. PacifiCorp Line Nos. 26-1 and 26-2 are each approximately 0.07 mile long and connect the Copco No. 1 Powerhouse to the Copco No. 1 switchyard, located on the right abutment upslope of the powerhouse. PacifiCorp Line No. 15 is approximately 1.23 miles long and connects the Copco No. 1 switchyard to the Copco No. 2 Powerhouse, and Line No. 3 is approximately 1.66 miles long and connects the Copco No. 1 switchyard to the Fall Creek powerhouse.

Figure 2.2-7 Copco No. 1 Powerhouse

2.2.5 Site Access

Copco Road from Interstate 5 provides site access, and access continues via a steep and narrow access road to the dam right abutment and powerhouse. Copco Road provides access to the north side of the reservoir. Ager-Beswick Road provides access to the south side of the reservoir, and is an extension of the Topsy Grade Road in Oregon.

2.2.6 Recreation Facilities

Recreation facilities include Mallard Cove and Copco Cove each with boat launches (both managed by PacifiCorp), and smaller dispersed shoreline recreation sites. Additional detail on the facilities is provided in Section 7.6.

2.3 Copco No. 2 Dam and Powerhouse

The Copco No. 2 Development consists of a small reservoir, concrete diversion dam, embankment section, gated spillway, water conveyance system, and powerhouse located on the Klamath River between approximately RM 202.2 and RM 200.3, in Siskiyou County, California. Refer to Figure 2.2-1 (C) for plan views of these features.

California-Oregon Power Company completed the dam in 1925 approximately 0.4 mile downstream of Copco No. 1 Dam at RM 201.8, while the powerhouse is located at RM 200.3, just upstream of Iron Gate Reservoir. The purpose of the development is to generate hydroelectric power.

Structures near the powerhouse include a control center building, maintenance building, and oil and gas storage building. The nearby PacifiCorp-owned Copco Village includes a former cookhouse/bunkhouse, modern bunkhouse, garage/storage building, bungalow with garage, three occupied modular houses, four older ranch-style houses, and a school house/community center, all of which are within the FERC project boundary.

2.3.1 Reservoir

The reservoir created by Copco No. 2 Dam is approximately 0.3 miles long (unnamed), and has a total storage capacity of approximately 70 acre-feet at the normal operating RWS elevation 2486.5.[4]

2.3.2 Dam and Spillway

The dam is composed of a concrete gravity section which also functions as a spillway, an earthen embankment section, a small penetration for bypass flows, and a water conveyance intake for the powerhouse. Figure 2.3-1 shows the dam.

4 All elevations in this Definite Plan are in NAVD88 vertical datum. Previously reported elevations were in project datum. See Table 1.3-1 for conversion factors.

Figure 2.3-1 Copco No. 2 Dam from Downstream Side

The dam is a concrete gravity structure with a gated side intake to a water conveyance tunnel at the left abutment, a central 145-foot-long spillway section with five 26- by 11-foot radial (Tainter) gates, and a 100-foot-long earthen embankment with gunite cutoff wall on the right abutment (Figures 2.3-2 (B), 2.3-3 (B), and 2.3-4 (B)). The dam is 32 feet high, with an overall crest length of 305 feet and a crest width of 9 feet at elevation 2496.5.

Figure 2.3-2 Layout of Copco No. 2 Dam Features (Appendix B)

Figure 2.3-3 Cross Section of Copco No. 2 Dam (Appendix B)

Figure 2.3-4 Elevation of Copco No. 2 Dam (Appendix B)

A manually-operated slide gate controls a small sluiceway adjacent to the intake, but is not currently believed to be operational. A small corrugated metal half-pipe provides approximately 5 cfs of flow to the bypass reach below the dam. The concrete gravity spillway crest is at elevation 2476.5, with a downstream apron at elevation 2459.5, between two concrete retaining walls. The estimated spillway discharge capacity at RWS elevation 2486.5 is 13,500 cfs with the five spillway gates fully open.

The remnant of a cofferdam is located upstream of the dam below the normal waterline. An old rock-filled timber crib is located high above the left abutment of the dam (Figure 2.3-5).

Figure 2.3-5 Copco No. 2 Dam from Upstream Side Showing Intake (at water level) and Crib Wall (high) on Left Abutment

2.3.3 Water Conveyance to Powerhouse

Water conveyance to the powerhouse is via the intake at the dam to a first tunnel, then through a wood-stave penstock, a second tunnel, and into a pair of steel penstocks to the powerhouse.

The intake structure incorporates a large trash rack and a 20- by 20-foot roller-mounted (caterpillar) gate at invert elevation 2459.5. The trash rack is 36.5 by 48 feet with 4-inch bar spacing.

The water conveyance system for the powerhouse includes 2,500 feet of concrete-lined tunnel (including an adit and an air vent shaft), 1,330 feet of wood-stave pipeline (Figure 2.3-6), an additional 1,110 feet of concrete-lined tunnel, an underground surge tank (including an air vent and overflow spillway), and two steel penstocks. The diameter of the tunnel and wood stave pipeline sections is 16 feet. The two penstocks, one 405 feet long and one 410 feet long, range from 16 feet in diameter at the upstream ends to 8 feet in diameter at the turbine spiral casings. A 138-inch butterfly valve is provided near the downstream end of each penstock.

Figure 2.3-6 Copco No. 2 Wood-Stave Penstock

2.3.4 Powerhouse

The Copco No. 2 Powerhouse (Figure 2.3-7) is a reinforced-concrete structure located 1.6 miles downstream of Copco No. 2 Dam on the left bank of the river. It operates as peaking powerhouse. The two turbines are vertical-shaft, Francis-type units with a total rated discharge capacity of 2,786 cfs. Each turbine has a rated output of 26,285 hp and 20,000 for Units 1 and 2, respectively, with a net head of 145 feet and 140 feet for Units 1 and 2, respectively. No bypass capacity is provided.

The synchronous generators are each rated at 15,000 kVA with a 0.9 power factor (13.5 MW). There are three outdoor, single-phase 10/20-MVA, 6,600/72,000-V transformers for each generator to step up the voltage. There are also three outdoor, single-phase 10/20-MVA, 73,800/230,000-V step-up transformers for interconnection to the transmission system.

A 69-kV transmission line (also Line No. 15) is approximately 0.20 miles long and connects the Copco No. 2 Powerhouse to the Copco No. 2 switchyard. A distribution line approximately 0.21 miles long connects to Copco No. 2 Dam. Line No. 62 runs along the north side of Iron Gate reservoir for approximately 6.32 miles, from the Iron Gate powerhouse to the Copco No. 2 switchyard. Drawings provided by PacifiCorp also note Lines 1, 2, 4, 14, 18, 19, and 67 connecting to the Copco No. 2 switchyard.

Figure 2.3-7 Copco No. 2 Powerhouse

2.3.5 Site Access

Copco Road from Interstate 5 provides site access. Access to the dam is via a steep and narrow access road; the same access road as for Copco No. 1. Access to the powerhouse is via the Daggett Road crossing of the Klamath River on a single-lane bridge.

2.3.6 Recreation Facilities

Two water access points exist directly upstream of the Copco No. 2 dam, but they are not publically accessible.

2.4 Iron Gate Dam and Powerhouse

The Iron Gate Development consists of a reservoir, embankment dam, side-channel spillway, diversion tunnel, intake structures, and powerhouse located on the Klamath River between RM 200.3 and RM 193.1, about 17 miles northeast of Yreka, California, in Siskiyou County. Refer to Figure 2.4-1 (C) for plan views of these features.

Figure 2.4-1 Iron Gate Dam Existing Features (Appendix C)

California-Oregon Power Company completed the development in 1962 at RM 193.1. It is the farthest downstream hydroelectric development of the Project. The primary purpose of the Iron Gate development is to generate hydroelectric power. Structures at the site include a communications building, a restroom building, a maintenance shop, two occupied residences, and a fish spawning building.

2.4.1 Reservoir

Iron Gate Dam impounds a reservoir of 942 acres (Iron Gate Reservoir) and according to a 2003 bathymetric survey (Eilers and Gubala 2003), provides approximately 50,941 acre-feet of total storage capacity at RWS elevation 2331.3.[5] The maximum and minimum operating levels are between RWS elevations 2331.3 and 2327.3, a vertical operating range of 4 feet.

2.4.2 Dam, Spillway, and Diversion Tunnel

The dam is composed of a side channel spillway, earthen embankment section, diversion tunnel, intake to Iron Gate hatchery water supply, and intake to the powerhouse (from right abutment to left abutment, looking downstream) (Figure 2.4-2). A fish ladder and trapping and holding facilities are located at the downstream base of the dam.

The dam is a zoned earthfill embankment with a current height of 189 feet from the rock foundation (elevation 2157.5) to the dam crest at elevation 2346.3. The dam crest is 20 feet wide and approximately 740 feet long (Figure 2.4-3 (B)). The embankment includes a central impervious clay core, with filter zones and a downstream drain, and is flanked by compacted pervious shells. The upstream face has a 2H:1V slope above elevation 2331.3, a 2½H:1V slope between elevations 2331.3 and 2303.3, and a 3H:1V slope below elevation 2303.3, with a 29-foot-wide bench at elevation 2278.3. The upstream face includes a 10-foot-thick riprap layer for slope protection (Figure 2.4-4 (B)).

The downstream face has a 1.75H:1V slope above and a 2H:1V slope below elevation 2326.3, with a 10-foot-wide bench at elevation 2278.3. The downstream face includes a 5-foot-thick riprap layer for slope protection. The dam is founded on a sound basalt rock foundation, with a grout curtain beneath the impervious core.

5 All elevations in this Definite Plan are in NAVD88 vertical datum. Previously reported elevations were in project datum. See Table 1.3-1 for conversion factors.

Figure 2.4-2 Iron Gate Dam, Spillway (left), and Powerhouse (right)

Figure 2.4-3 Elevation of Iron Gate Dam (Appendix B)

Figure 2.4-4 Cross Section of Iron Gate Dam (Appendix B)

PacifiCorp completed modifications in 2003 to raise the dam crest five feet from elevation 2341.3 to elevation 2346.3 by over-steepening the upstream and downstream slopes and decreasing the crest width from 30 feet to 20 feet. A sheet pile wall was also driven upstream of the dam centerline to extend five feet above the dam crest to provide freeboard in addition to the 5-foot crest raise. The top of the sheet pile wall is at elevation 2351.3. Additional riprap materials were placed on the upstream face of the dam to protect those areas inundated by the higher reservoir elevations during large flood events.

The spillway is excavated in rock on the right abutment, and consists of an ungated side-channel spillway crest with a concrete-lined chute. The spillway crest is at elevation 2331.5, or 15 feet below the raised dam crest. The spillway crest is 727 feet long and consists of a concrete ogee crest and slab placed over the excavated rock ridge. Concrete partly lines the upper part of the channel. The downstream end of the spillway crest includes a 10- by 8-foot hinged trash/sluice gate for sluicing sediments and debris.

A flip-bucket terminal structure is located at the downstream end of the spillway chute. The spillway has an estimated discharge capacity of 22,350 cfs at RWS elevation 2336.3. The modifications completed in 2003 included shotcrete protection at the top of the spillway crest and chute.

The diversion tunnel used during construction of the dam was driven through bedrock in the right abutment and terminates in a reinforced concrete outlet structure near the downstream toe of the dam (Figure 2.4-5). The diversion tunnel intake is a reinforced concrete structure equipped with four 10- by 33-foot trash racks and is located approximately 520 feet upstream from the dam axis near the upstream toe. A two-piece concrete slide gate located in a gate shaft approximately 119 feet upstream of the dam axis controls flow in the tunnel. A reinforced concrete tower accessible by footbridge from the dam crest houses the slide gate hoist and controls. Operation of the upper sluice gate is limited to an opening of 23.5 inches at RWS elevation 2331.3, with a corresponding discharge capacity of 1,750 cfs; under emergency conditions, a full gate opening of 57 inches would produce a release of 2,700 cfs.[6] The lower diversion gate is currently welded in place. Recent modifications added a 9-foot-diameter hinged blind flange and concrete ring approximately 20 feet downstream of the concrete slide gate (designed for full reservoir head) to permit underwater inspection of the gate.

Figure 2.4-5 Iron Gate Diversion Tunnel Outlet (center-right, in shadow)

2.4.3 Water Conveyance to Powerhouse

Water conveyance to the powerhouse consists of an intake structure and penstock.

The intake structure for the powerhouse is a 45-foot-high, free-standing, reinforced-concrete tower, located in the reservoir immediately upstream of the left abutment and accessible by footbridge from the abutment. It houses a 12- by 17-foot wheel-mounted slide gate, which controls the flow into a 12-foot-diameter, welded-steel penstock. The penstock is concrete-encased where it penetrates the dam approximately 35 feet below the normal maximum reservoir level. Concrete supports down the dam abutment support the penstock. There is a 17.5- by 45-foot trash rack at the penstock intake with 4-inch bar spacing.

6 From PacifiCorp – Iron Gate Dam – Diversion Tunnel Gate Rating Curve dated February 26, 2008.

2.4.4 Powerhouse

The Iron Gate Powerhouse is an outdoor-type development located at the downstream toe of the dam on the left bank (Figure 2.4-6), and consists of a single vertical-shaft, Francis-type turbine with a rated discharge capacity of 1,735 cfs. The turbine has a rated output of 25,000 hp with a net head of 154 feet. In the event of a turbine shutdown, a synchronized Howell-Bunger bypass valve located immediately upstream of the turbine diverts water around the turbine to maintain flows downstream of the dam. The synchronous generator is rated at 18,975 kVA with a 0.95 power factor (18 MW).

There is a single outdoor, three-phase 19-MVA, 6,600/69,000-V step-up transformer at the powerhouse for interconnection to the transmission system. A 69-kV transmission line is approximately 0.21 miles long and connects the Iron Gate switchyard to Tower P 2/007. A second 69-kV transmission line is approximately 0.33 miles long and connects the Iron Gate switchyard to the Iron Gate Hatchery tie-in. Two distribution lines totaling 0.21 miles provide local distribution around the dam and powerhouse area.

Figure 2.4-6 Iron Gate Powerhouse

2.4.5 Fish Trapping and Holding Facilities

There are fish trapping and holding facilities (Figure 2.4-7) located on “random fill” [7] at the downstream toe of the dam. The top of the random fill area is at elevation 2192.3. The fish facilities at the dam include six

7 This is the type of material shown on the construction drawings used to fill in the area.

fish holding tanks, a spawning building, a fish ladder, and an aerator for the hatchery water supply. High- (elevation 2313.3) and low- (elevation 2253.3) level intakes for the fish facility cold water supply are incorporated in the dam on the left abutment.

Figure 2.4-7 Iron Gate Fish Holding Tanks and Spawning Building

2.4.6 Iron Gate Fish Hatchery

The Iron Gate fish hatchery was constructed in 1966 and is located on the left bank downstream of Iron Gate Dam, adjacent to the Bogus Creek tributary. The hatchery complex includes an office, warehouse, hatchery/incubator building, four fish rearing ponds, a fish ladder with trap, visitor information center, and four employee residences. Up to 50 cfs of water is diverted from the Iron Gate reservoir to supply the 32 raceways and fish ladder. The hatchery provides the capacity to capture, hold, and spawn adult returning Chinook salmon, steelhead trout, and Coho salmon and to hatch and rear fish until their release. The California Department of Fish and Wildlife (CDFW) operates the hatchery, with a large portion of the operations and maintenance costs currently funded by PacifiCorp. See Section 8.11 for a more detailed description of the existing facility and operation.

2.4.7 Site Access

Site access is provided from Interstate 5 via Copco Road and then by Lakeview Road to the dam crest and reservoir area, or by a project access road to the powerhouse. The single-lane Lakeview Road Bridge crosses the Klamath River downstream of the dam.

2.4.8 Recreation Facilities

Recreation facilities include Fall Creek day-use area and boat launch, Jenny Creek campground, Wanaka Springs day-use area and campground, Camp Creek campground and boat launch, Juniper Point campground, Mirror Cove campground, Overlook Point day-use area, and Long Gulch campground and boat launch (each managed by PacifiCorp), and smaller dispersed shoreline recreation sites. Among the referenced facilities there exist a visitors' center at Iron Gate hatchery, two interpretive displays, five boat launches, one fishing platform, two picnics areas, six campgrounds (with sixty-six campsites), five dispersed camping areas (with 20 campsites), and four other water access points. Section 7.6 provides additional detail on each of the facilities.

Chapter 3: FERC Compliance and Dam Safety

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3. FERC COMPLIANCE AND DAM SAFETY

This section explains KRRC's proposed program to comply with FERC dam safety requirements and Engineering Guidelines.

KRRC is developing a dam safety program to allow removal of the Project to be undertaken in a manner that minimizes risk to people, structures, infrastructure, and the natural resources of the Klamath River Basin. Such removal will fully comply with FERC's dam safety requirements, and will be consistent with FERC Engineering Guidelines (FERC 2017). Additionally, KRRC will seek the review and recommendations of the Oregon Water Resources Department and the California Department of Water Resources, Division of Dam Safety to the full extent of any state agency jurisdiction over the decommissioning and removal of the hydroelectric facilities that comprise the Lower Klamath Project.

3.1 Board of Consultants

On October 5, 2017, FERC issued a directive to PacifiCorp and KRRC to convene an Independent Board of Consultants (BOC) to review and assess various aspects of the proposed dam removal process. The BOC was approved on May 22, 2018 The BOC is a six-member fully independent body that includes three members with experience in civil engineering (with specialized experience in dam construction and removal of both concrete and embankment dams, hydrology, hydraulics, and stream diversion) and geotechnical engineering. In addition, the BOC includes members with experience in aquatic and terrestrial biology, and a heavy civil construction cost estimator with experience in dam removal and restoration activities.

KRRC anticipates that the BOC will commence its review of the Definite Plan in August 2018. Initially, FERC has requested that the BOC review and provide recommendations regarding the adequacy of available funding and reasonableness of updated cost estimates for the most probable cost and maximum cost for implementation of the Definite Plan. FERC has also requested that the BOC review and provide recommendations regarding the adequacy of amounts and types of insurance coverage and bonding arrangements for dam removal, and to review and provide recommendations regarding other technical aspects of the Definite Plan to better define and understand the plans, schedules, specifications, staging, and sequencing for taking on the responsibilities for dam removal and decommissioning of the Lower Klamath Project.

The BOC recommendations will be incorporated into a revised Definite Plan and will provide FERC with a greater level of detail of the various project elements proposed in the Definite Plan. These recommendations will build upon and improve the Definite Plan and assist KRRC in maintaining compliance with the Federal Power Act, and in particular, FERC dam safety requirements and engineering guidelines.

In advance of their review, the BOC will be provided project documents including the Potential Failure Mode Analyses, Part 12D Independent Consultant Inspection Reports and the Supporting Technical Information Documents, to understand project-specific aspects that could be significant to the dam removal process. KRRC will also provide the BOC copies of monthly construction reports, and any additional information or analysis requested by the BOC within the scope of their review. The BOC will play a significant role in reviewing the dam safety program described below and in evaluating project risks.

3.2 Part 12 Requirements

KRRC proposes a general schedule and approach for compliance with these requirements below.

3.2.1 Potential Failure Modes Analysis Background

The KRRC will complete a Potential Failure Modes Analysis (PFMA), which is a dam and project safety evaluation tool developed by FERC to be used in the Part 12, Subpart D program of dam and safety evaluations for FERC regulated projects. Since initiation of the PFMA program, a PFMA has been performed for all FERC regulated dams that are required to undergo Independent Consultant Safety Inspections as defined in 18 CFR Part 12, Subpart D. Iron Gate, Copco No. 1, and J.C. Boyle fall under these regulations, and Part 12D Reports and PFMAs have been performed accordingly. As Copco No. 2 does not meet the requirements for a Part 12D Independent Consultant's inspection, PacifiCorp has not performed a PFMA for this dam.

The following sections outline the process and steps the KRRC will go through to complete the PFMA for the Project.

3.2.2 Supplemental PFMA

FERC's Engineering Guidelines indicate that Supplemental PFMAs shall be conducted for dams that will be undergoing major modifications, remedial work or are scheduled to have substantial changes, including removal. One purpose of this Supplemental PFMA is to evaluate the recommended dam removal plan prior to demolition. Thus, KRRC will perform supplemental PFMAs for Iron Gate, Copco No. 1, and J.C. Boyle, and for the previously unevaluated Copco No. 2.

The KRRC has reviewed dam safety submittals for the Powerdale (FERC Project No. 2659) and Condit (FERC Project No. 2342) decommissioning projects, which involved recent FERC regulated dams in the region that share similarities based on size, type, and location. For both examples, a separate Core Team was assembled, and a supplemental PFMA workshop was held. KRRC will assemble a PFMA Core Team for the Project.

For the PFMA to be comprehensive, consistent, and complete, the following outline describes the dam safety approach the KRRC will employ when carrying out the Supplemental PFMA.

Step 1: Collection of Background Data

The KRRC will collect all data, removal plans, studies and information on the investigation, design, construction, analysis, performance and operation of the Project in preparation for review by the PFMA Core Team. A listing will be made of the data available for review and considered in the PFMA. The list will be included in any PFMA documentation. Data requests made of PacifiCorp in April of 2017 will provide the fundamental background information for the Core Team. Additionally, KRRC will make the Definite Plan available to the PFMA Core Team members for review prior to the PFMA session. If any dam safety incident reports exist, KRRC will also make them available to the PFMA Core Team for review.

Based on the estimated time to gather all the data, 60 days for FERC Regional Office review, and the time to perform the PFMA workshops, the process should begin 1 year prior to the planned construction contract award date, and/or negotiation of the guaranteed maximum price. The goal of the proposed PFMA schedule is to complete the session in accordance with FERC Guidelines, provide FERC with adequate time to complete their review and provide any comments to the KRRC without impacting the project schedule.

Studies conducted in preparation for development removal are relevant to the activities of the PFMA Core Team. In particular, the PFMA report will incorporate:

- Updated slope stability analysis and any recent surveys of new or previously unidentified landslides along the reservoir rims.
- An evaluation of the rock in the area of the planned dam removal and breaching.
- A structural evaluation of any facilities needed to support heavy equipment (e.g., cranes) to verify support for anticipated loads.

Step 2: Selection of the PFMA Core Team

The PFMA Core Team members will have knowledge and experience related to dam safety evaluations and will consist of the applicants' Technical Representatives, FERC Inspector, Facilitator, Independent Consultant (if available), and a geologist or geotechnical engineer. FERC's participation and involvement will be guided by FERC's ex parte rule, as applicable. Considering that the Project is in both Oregon and California, KRRC will invite the state dam safety organizations located in those states to participate. In addition to the PFMA Core Team members, key project staff will be available during the PFMA session so they may answer questions from the PFMA Core Team, to clarify operating rules, and provide key site-specific information.

The BOC, discussed in Section 3.1, will have a role in PFMA proceedings. This group is distinct from the Core Team in that they are to provide independent, expert opinions on matters related to their subject area. The Supplemental PFMA process is an opportune time to educate the BOC about the Project and discuss risks; KRRC will provide more detail on their role when the KRRC finalizes their plan for the BOC.

Step 3: Site Visit

Typically, the PFMA Core Team is assembled at the time of the review, and depending on the PFMA Core Team's familiarity with the Project, a site visit may be requested. For a site visit, the Team Leader will prepare an advanced review package for the participants to get familiarized with the Project. At the site, the Facilitator will review the basic concepts of the PFMA process for the PFMA Core Team, the objectives, and answer any questions the participants may have. The PFMA Core Team will complete the site visit just before it conducts a comprehensive review of the background material.

Step 4: Comprehensive Review

The PFMA Core Team begins the PFMA session with review of the gathered data on the developments. The review will take place at a convenient location that allows the PFMA Core Team to review all the necessary data and have collaboration on items that may need clarification. KRRC has not yet identified this location.

Step 5: PFMA Session

The Facilitator begins the session by outlining the goals and ground rules, ensures the PFMA Core Team follows the process and performs the PFMA following the FERC Engineering Guidelines. The session will then move on to a brief review of the existing PFMAs compiled from previous PFMA sessions with an emphasis on dam removal. The group will then focus on potential new failure modes that could occur as part of dam removal.

Step 6: Evaluation of Surveillance and Monitoring

The Core Team members will assess the dam safety surveillance and monitoring plan (DSSMP) for the dams considering potential failure modes and develop a DSSMP for any “highlighted” potential failure modes and any selected “not highlighted” potential failure modes.

Step 7: Documentation

The KRRC will document the Major Findings and Understandings and prepare the draft PFMA Report which documents the PFMA session, surveillance and monitoring, and/or risk reduction opportunities identified by the PFMA. The PFMA report will be prepared following the outline contained in FERC’s Engineering Guidelines. KRRC will send a draft report to the PFMA Core Team members for review and comment. After receiving the PFMA Core Team’s comments, KRRC will finalize the report and provide it to the BOC. KRRC will address and incorporate BOC recommendations and provide them to FERC.

3.3 FERC Required Plans and Submittals

Table 3.1-1 indicates the plans and submittals to be provided by the KRRC to the BOC and then to FERC.

Table 3.3-1 FERC Required Plans and Submittals

Plan Name
Coffer Dams
• Coffer Dam Design
• Coffer Dam Certification
Temporary Construction Emergency Action Plan
Quality Control Inspection Program (QCIP)
Dam Stability Analysis (Iron Gate and J.C. Boyle)
Blasting Plan
Reservoir Rim Stability Analyses
Flood Routing Analysis and Inundation Study
Rock quality evaluation in the areas of planned breaching

The KRRC will develop and submit specific plans and schedules for compliance at FERC's direction, and consistent with any further recommendations as may be provided by the BOC.

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Chapter 4: Reservoir Drawdown and Diversion Plan

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4. RESERVOIR DRAWDOWN AND DIVERSION PLAN

4.1 Introduction

KRRC proposes the following reservoir drawdown and streamflow diversion plan to facilitate the Project while minimizing flood risks and downstream impacts due to the release of impounded reservoir sediments. This plan results in drawdown of the reservoirs impounded by J.C. Boyle, Copco No. 1, and Iron Gate dams by March 15, 2021, to minimize downstream impacts resulting from the natural release and transport of impounded sediments. Section 2: Existing Hydrology Conditions in USBR's *Hydrology, Hydraulics, and Sediment Transport Studies for the Secretary's Determination on Klamath River Dam Removal and Basin Restoration Klamath River, Oregon and California* (USBR 2012c) provides historical daily and monthly streamflow data downstream of each of the dams.

Drawdown of the reservoirs will generally take place between January 1 and March 15, 2021. However, the proposed plan includes early drawdown of Copco No. 1 and delayed cessation of power generation at Copco No. 2. KRRC proposes early drawdown of Copco No. 1 for the reservoir drawdown to be completed by about March 15 (prior to spring salmonid migration). To offset lost revenue from shutting Copco No. 1 down prior to January 1, the KRRC proposes that generation of power at Copco No. 2 Dam (with sediment-laden flow) will continue for up to four months after January 1, 2021 (or until May 1, 2021). This assumes the Copco No. 2 generating equipment will be capable of operating under such conditions. The KRRC proposes that power generation at Copco No. 1 Dam will end after the reservoir reaches the minimum operating level at reservoir water surface (RWS) elevation 2604.5, which would be nearly 2 months before January 1, 2021. Reservoir drawdown below the minimum operating level will commence at each dam when power generation has ceased at that dam. The proposed plan assumes power generation at each of the dams will end as shown in Table 4.1-1.

The following sections describe the reservoir drawdown facilities (and infrastructure modifications required to facilitate drawdown), flood frequency flows, the anticipated drawdown rates (i.e., rate of elevation change and discharge rates) and timing of drawdown, and the portion of discharge associated with specific structures (spillways, diversion tunnels, etc.). Appendix F provides additional information and results beyond those presented here.

Table 4.1-1 End Date for Power Generation

Location	End Date
J.C. Boyle	January 1, 2021
Copco No. 1	November 1, 2020
Copco No. 2	May 1, 2021
Iron Gate	January 1, 2021

The bulleted list below provides a roadmap for specific information related to drawdown:

- Description of structures used for drawdown operation and associated flows is provided in Section 4.2
- Physical modifications to the dams to facilitate drawdown are summarized in Section 4.2
- Additional information concerning the retrofit of the diversion tunnels is provided in Section 4.2
- Total anticipated discharge (cfs) associated with drawdown for each reservoir is discussed in Section 4.4
- Proposed duration and timing of drawdown operations is discussed in Sections 4.4 and 4.5
- Schedule and sequence for drawdown of all Lower Klamath Project dams is provided in Sections 4.4 and 4.5
- Proposed reservoir elevation change per day is provided in Section 4.5
- Strategies for managing drawdown under low, medium and high flow conditions are provided in Section 4.5
- Slope stability monitoring during and after reservoir drawdown is discussed in Section 4.6
- Studies conducted to verify reservoir drawdown rates are protective of slope stability and potential flooding are discussed in Section 4.7
- Description of measures associated with possible tunnel failure is provided in Section 4.7.1
- Measures to implement if slope stability issues are identified are discussed in Sections 4.7.2 and 4.7.3

4.2 Diversion Facilities

Table 4.2-1 shows facilities that KRRC will use for drawing down the reservoirs and diverting Klamath River flows around J.C. Boyle, Copco No. 1, and Iron Gate dams. The major drawdown facilities at J.C. Boyle are the spillway, power intake, and diversion culverts beneath the dam. At Copco No. 1, drawdown facilities are the spillway and a modified diversion tunnel. [8] At Iron Gate, the drawdown will occur via the spillway and a modified diversion tunnel. The penstocks at Copco No. 1 and Iron Gate provide only a minor amount of

[8] KRRC analyzed two options for diversion at Copco No. 1 Dam, as described later in this section. Option 1 used the spillway, diversion tunnel, and dam notches, and Option 2 used the spillway and a modified diversion tunnel. Option 2 is the proposed action, and Option 1 is only discussed for comparison purposes.

potential additional diversion, and KRRC assumes they will be closed when power generation ceases, so they are not included in the drawdown modeling.

Table 4.2-1 Facilities to be Used for Reservoir Lowering and Diversion

	(a)	(b)	(c)
Location	**Diversion Facility**	**Invert Elevation**	**Notes**
J.C. Boyle Dam			Normal operating elevation 3796.7
	Spillway	3785.2	
	Power Intake	3771.7	
	Power Canal, Tunnel, and Turbines	–	Pass power intake flows through turbines without generating power
	Diversion Culvert – Bay 1	3755.2	
	Diversion Culvert – Bay 2	3755.2	
Copco No. 1 Dam			Normal operating elevation 2609.5
Option 1	Spillway	2597.0	For comparison purposes only
	Modified Diversion Tunnel	2485.5[1]	
	Notches in Dam	Varies	
Option 2	Spillway	2597.0	Proposed action
	New Gate in Diversion Tunnel	2485.5[1]	
Iron Gate Dam			Normal operating elevation 2331.3
	Spillway	2331.3	
	New Gate in Diversion Tunnel	2176.3[2]	

1. Estimated from Drawing 1475.
2. Drawing 8860 shows the invert at 2173 feet NGVD (2176.3 feet NAVD); Drawing 8862 shows invert at 2175 feet NGVD (2178.3 feet NAVD).

The removal of Copco No. 1 and Iron Gate dams requires the successful completion of modifications to restore and increase the discharge capacity of the existing diversion tunnels for low-level releases. Both require underwater work that KRRC will need to perform the year prior to reservoir drawdown. The design and fabrication of large gates that are the major component of both modifications will also require a significant lead time (up to 10 months for design and fabrication) ahead of installation. KRRC does not expect impacts to power generation for the modification work.

The following sections describe the diversion facilities and any modifications required prior to reservoir drawdown.

4.2.1 J.C. Boyle Reservoir

Water releases for reservoir drawdown at J.C. Boyle will be made through the gated spillway (crest elevation 3785.2), the power canal (intake invert elevation 3771.7), and through the two 9.5- by 10-foot diversion culverts (invert elevation 3755.2) located below the gated spillway (see Figure 4.2-1(B). Modifications of these facilities are not required prior to drawdown. Figure 4.2-2 shows discharge rating curves for the J.C. Boyle facilities, as well as the stage-storage curve for J.C. Boyle Reservoir.

Figure 4.2-1 J.C. Boyle Diversion Facilities (Appendix B)

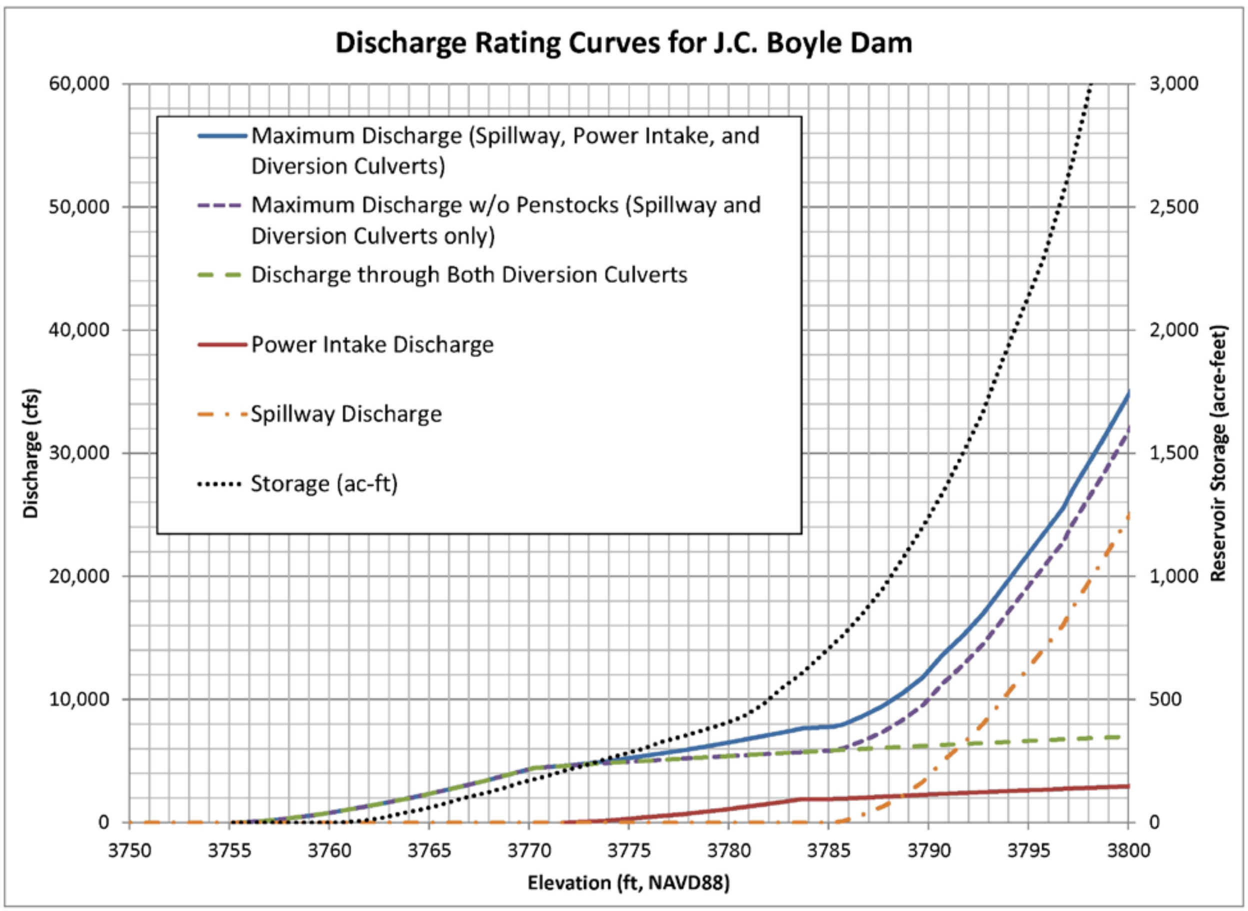

Figure 4.2-2 Discharge Rating Curve and Stage-Storage Curve for J.C. Boyle

4.2.2 Copco Lake

KRRC analyzed two options for reservoir drawdown at Copco No. 1. Option 2 is the action proposed by KRRC, but Option 1 was also included in the drawdown analysis because it was the method originally proposed in the Detailed Plan.

Option 1 (for comparison only) includes making releases through a combination of the diversion tunnel modified to restore operation through three existing 6–foot-diameter pipes in the diversion tunnel intake structure, in addition to a series of notches sequentially excavated in the dam. Option 2 would make releases solely through the diversion tunnel modified to restore full use of the tunnel by installing a new large gate at the downstream end of the tunnel and removing the intake structure at the upstream end. Figure 4.2-3 shows discharge rating curves for the diversion facilities for the two Copco No. 1 options, as well as the stage-storage curve for Copco Lake.

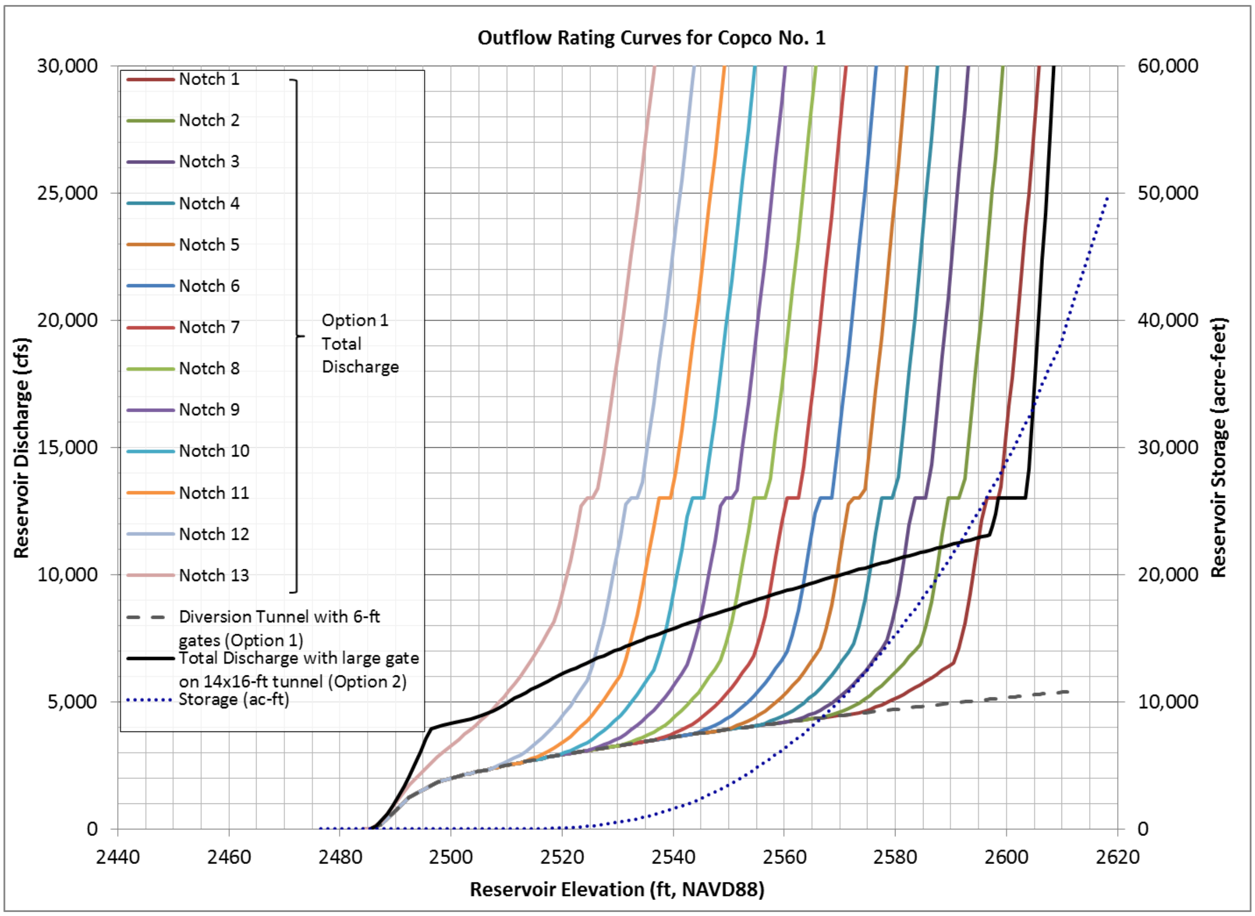

Figure 4.2-3 Discharge Rating Curve and Stage-Storage Curve for Copco No. 1

The following sections provide a more detailed description of the diversion tunnel modifications analyzed for Option 1 and Option 2. KRRC will perform the Option 2 modification prior to reservoir drawdown, in 2020.

Option 1 (for comparison only) – Diversion Tunnel Modification to Restore Release Capacity

1. Design, fabricate, and deliver three new 6- by 6-foot slide gates.
2. Mobilize barge-mounted crane onto Copco Lake (assume normal RWS elevation 2609.5). Remove deposited sediment from diversion tunnel intake using clamshell or suction dredge, as required.

3. Remove three existing 72-inch flap gates on the upstream face of diversion intake structure (invert elevation 2485.5) under balanced head and no flow conditions, using hard hat divers (124-foot depth) (Figure 4.2-4 (B)). Upstream tunnel should be full of water (due to valve leakage since tunnel was plugged), but should be confirmed.
4. Install three new 6- by 6-foot slide gates with hydraulic operators and remote controls at upstream face of diversion structure using hard hat divers (see Figure 4.2-4(B)).
5. With new upstream slide gates and diversion intake closed, drill drain and air vent holes through concrete tunnel plug from downstream side to unwater tunnel (see Figure 4.2-5(B)). Remove concrete tunnel plug in dry conditions. Inspect the unlined diversion tunnel for possible reinforcement (lining with shotcrete or concrete) or repairs.
6. Remove (or open) three existing 72-inch butterfly valve disks from downstream side of inlet in dry conditions, after drilling drain and air vent holes through each disk. Determine need for air vent piping and provide as necessary for operation of upstream slide gates.
7. All work in the tunnel would be in compliance with local, state and federal codes and regulations (e.g., Title 29 of the Code of Federal Regulations (29 CFR 1926.800)) and would include safety provision of adequate ground control, flood control, air monitoring, ventilation, illumination, communication, personal protective equipment, access and egress procedures, mechanical equipment, and emergency procedures.

Figure 4.2-4 Copco No. 1 Diversion Modification, Intake Structure (Appendix B)

Figure 4.2-5 Copco No. 1 Diversion Modification, Tunnel (Appendix B)

Option 2 (proposed action) – Diversion Tunnel Modification to Increase Release Capacity

1. Design, fabricate, and deliver new 14- by 16-foot roller gate.
2. Construct new gate shaft with new gate structure and 14-foot by 16-foot roller gate at downstream end of diversion tunnel (see Figure 4.2-6 (B)).
3. Mobilize barge-mounted crane onto Copco Lake (assume normal RWS elevation 2609.5). Remove sediment from diversion tunnel (see Figure 4.2-4(B)) intake using clamshell or suction dredge, as required.
4. Remove three existing 72-inch flap (or “clack”) gates on upstream face of diversion intake structure (invert elevation 2485.5) under balanced head and no flow conditions, using hard hat divers (124-foot depth). Upstream tunnel should be full of water (due to valve leakage since tunnel was plugged), but should be confirmed. Install three new 6-foot blind flanges (see Figure 4-2.4(B)) using hard hat divers.
5. With new blind flanges in place, drill drain and air vent holes through concrete tunnel plug from downstream side to unwater tunnel (see Figure 4.2-5(B)). Remove concrete tunnel plug in dry conditions. Inspect the unlined diversion tunnel for possible reinforcement (lining with shotcrete or concrete) or repairs. Line tunnel with shotcrete or concrete, if determined to be necessary.

6. Remove three existing 72-inch butterfly valve disks from downstream side of inlet in dry conditions, after drilling drain and air vent holes through each disk.
7. Close new large gate and fill tunnel upstream of gate with water.[9] Under balanced head and no flow conditions, remove the 6-foot blind flanges at the inlet using hard hat divers.
8. Using hard hat divers, demolish intake structure and install grating to minimize potential for large debris entering the diversion tunnel.
9. Perform all work inside the tunnel in the same manner described for Copco No. 1 (Option 1).

Figure 4.2-6 Copco No. 1 Diversion Modification, New Gate Structure (Appendix B)

4.2.3 Iron Gate Reservoir

Reservoir drawdown at Iron Gate Dam will involve releases made solely through the diversion tunnel. KRRC will modify the diversion to restore full use of the tunnel by installing a new large gate in place of the current concrete bulkhead and gate. Figure 4.2-7shows discharge rating curves for the diversion facilities for Iron Gate Dam, as well as the stage-storage curve for Iron Gate Reservoir.

A detailed description of the Iron Gate diversion tunnel modifications includes the following:

1. Design, fabricate, and deliver new 14- by 16-foot roller gate.
2. With the existing gate closed, remove downstream stop-log structure and miscellaneous metalwork from downstream tunnel in the dry. Maintain air vent pipe in tunnel crown if needed for final operation. Securely bolt existing blind flange to the reinforced concrete ring downstream of the concrete sluice gates (see Figure 4.2-8(B)) to retain full reservoir head. A preliminary assessment indicates the existing features are capable of accommodating this loading condition and KRRC's contractor will verify this prior to construction.
3. Raise upper sluice gate slowly to fill portion of downstream tunnel between the gates and blind flange. Provide air vent and drain valve through downstream concrete ring as necessary. Close air vent when filling has been completed.
4. Mobilize a barge-mounted crane onto the reservoir in June 2020. Raise the upper sluice gate to top of control tower using the existing hoist and remove using barge-mounted crane. Send hard-hat divers to the bottom of wet-well shaft to install lifting device for lower diversion gate, and to cut welded connection along downstream seal of lower diversion gate.
5. Raise the lower diversion gate to the top of the control tower using existing hoist and remove using barge-mounted crane. Install new 16.5- by 18-foot roller gate into existing slots in gate shaft (with a 160-foot design head) using hard hat divers and barge-mounted crane. Install new gate operator with remote controls. Close new roller gate.

[9] Tunnel filling could be accomplished several ways such as by inserting a small valve into the blind flange or by drilling a small opening into the tunnel adjacent to the intake structure.

6. With new roller gate closed, drain downstream tunnel using air vent and drain valve provided at the blind flange. Remove blind flange and reinforced concrete ring.

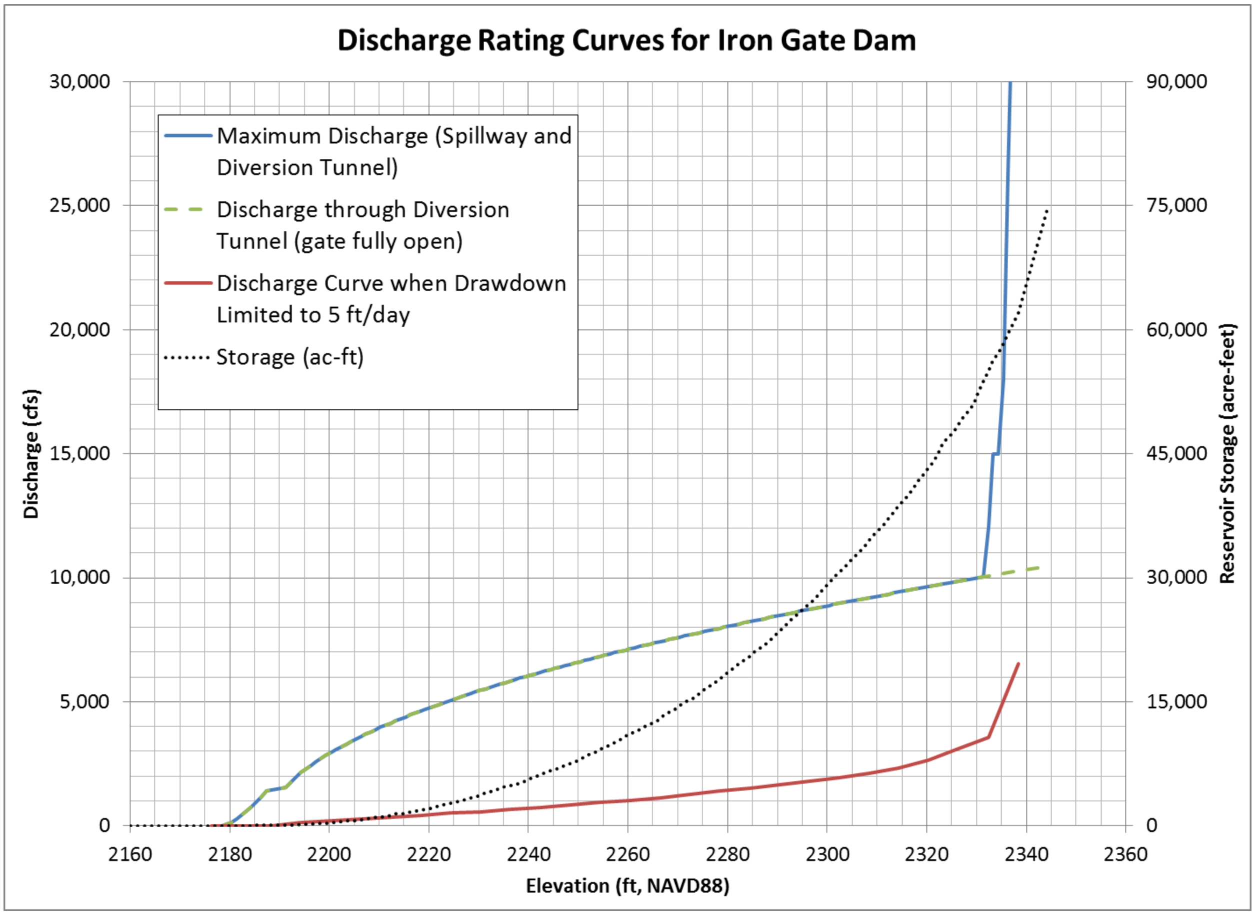

Figure 4.2-7 Discharge Rating Curve and Stage-Storage Curve for Iron Gate

7. Inspect the downstream portion of the diversion tunnel for possible reinforcement (lining with shotcrete or concrete) or repairs (see Figure 4.2-8 (B)).
8. Perform all work inside the tunnel in the same manner described for Copco No. 1 (Option 1) in Section 4.2.2.

Figure 4.2-8 Iron Gate Diversion Modification (Appendix B)

4.2.4 Drawdown Controls

KRRC's contractor will manage the drawdown of Copco No. 1 and Iron Gate reservoirs through automated gate control systems with operator oversight. Inputs to determine the amount of gate opening at each reservoir will include continuous measurement of reservoir levels by remote sensor. The gate control system will incrementally open (or close) the gate to increase (or decrease) flow through the diversion tunnel to maintain the reservoir drawdown at an approximate constant rate as the inflows vary due to watershed response to storms or due to changes in drawdown rates of upstream reservoirs.

Once the Copco No. 1 and Iron Gate reservoirs have reached full drawdown, the gates will remain in the full open position to limit reservoir refilling during subsequent storm events. Storm inflows large enough to cause refilling of the reservoir will pass through the spillway.

For this analysis, KRRC assumed that the gates on the diversion tunnels would temporarily be closed during a large storm event once outflow over the spillway reached a pre-determined discharge level. The gates fully open again once discharge over the spillway dropped back below the pre-determined level. At Copco No. 1, this was assumed to be 13,000 cfs (between the 10-year and 20-year events) to help prevent downstream flooding of the Copco No. 2 powerhouse. At Iron Gate Dam, the discharge level was set to 15,000 cfs, which is just above the 10-year peak flow.

The spillway and then the capacity of the power intake will control the initial drawdown on J.C. Boyle Reservoir. Once the reservoir stabilizes with the spillway and intake fully open, the diversion culvert concrete stop logs in the culverts will be blasted, and flow will only be controlled by the capacity of the culverts, which is about 6,000 cfs at the spillway elevation (between the 2 and 5-year events). For storm flows that refill the reservoir before deconstruction, higher discharge rates will be experienced over the spillway.

4.3 Flood Frequency Analysis

Flood frequency analyses were performed at four locations on the Klamath River using the USACE HEC-SSP software (V2.1), following the Bulletin 17B method for Log-Pearson Type III distributions (USGS 1982).[10] Table 4.3-1 provides details on the gauges. J.C. Boyle and Copco records correlate well with the Keno data. Therefore, KRRC extended the records at J.C. Boyle and Copco based on linear correlations with USGS gauge data at Keno to allow for a coincident period of analysis. Appendix F provides the correlations used to extend the data. KRRC could not obtain a good correlation with Keno data for Iron Gate gauge, likely due to significant tributary inflows. Therefore, KRRC used the historical period of record (1960 to 2017) for Iron Gate.

10 Log-Pearson Type III distributions are intended to fit the distribution of annual peak flows from natural watersheds (i.e., non-regulated watersheds). The Klamath Basin is highly regulated for irrigation water supplies and fishery flows, but the regulated flows primarily describe low flows (non-storm event flows) as there are no flood control reservoirs in the basin. We found that after ignoring the low flows in the data, the annual peak flow data fit well with the Log-Pearson Type III distribution.

Table 4.3-1 U.S. Geological Survey Streamflow Gaging Stations Analyzed

USGS Gaging Station No.	Station Name	Drainage Area (mi^2)	Latitude	Longitude	Gauge Elevation (feet, NGVD29)	Period of Record (Water Years)
11509500	Klamath River at Keno, OR	3,920	42°08'00"	121°57'40"	3,961	1905-1913 1930-2016
11510700	Klamath River below John C. Boyle Power Plant near Keno, OR	4,080	42°05'05"	122°04'20"	3,275	1959-2016
11512500	Klamath River below Fall Creek near Copco, CA	4,370	41°58'20"	122°22'05"	2,310	1924-1961
11516530	Klamath River below Iron Gate Dam, CA	4,630	41°55'41"	122°26'35"	2,162	1961-2016
11520500	Klamath River near Seiad Valley, CA	6,940	41°51'14"	123°13'52"	1,320	1913 – 2016
11523000	Klamath River at Orleans	8,475	41°18'13"	123°32'00"	355.98	1927 – 2016
11530500	Klamath River near Klamath, CA	12,100	41°30'40"	123°58'42"	5.60	1961 – 2016

Releases from Upper Klamath Lake and Link River Dam control flows in the Klamath River. The operations at Link River Dam could influence the flood frequency curves calculated using the USGS gauge data. KRRC compared plots of the flood-frequency curves before and after censoring peak flow data to determine if there was a low flow threshold below which flows did not fit the distribution. For all locations except J.C. Boyle, the data visually appeared to fit within the 95 percent confidence limit of the distribution. Therefore, KRRC only censored the J.C. Boyle data. KRRC censored flows below 3,400 cfs as low flow outliers. The Bulletin 17B procedures adjusted the probabilities to account for the censored data. Table 4.3-2 shows the results. Appendix F provides plots of the data and distributions.

Table 4.3-2 Annual Flood Frequency Results

Location	2-Year	5-Year	10-Year	20-Year	50-Year	100-Year	200-Year	500-Year
Keno	4,329	6,957	8,830	10,699	13,210	15,156	17,152	19,872
Blw J.C. Boyle [1,2]	4,736	7,719	9,438	10,862	12,405	13,370	14,194	15,104
Blw Fall Creek nr Copco[2]	5,974	9,114	11,340	13,567	16,580	18,937	21,377	24,742
Below Iron Gate	5,942	10,895	14,912	19,295	25,744	31,169	37,106	45,796
Seiad Valley	16,418	34,673	52,002	73,229	108,545	141,806	181,736	246,577

Orleans	61,712	114,819	157,209	202,710	268,332	322,432	380,576	463,907
Klamath	140,056	239,890	313,456	388,200	490,163	570,125	652,719	766,069

Notes:
1. Flows below 3,400 cfs were censored as low flow outliers due to the influence of Link River Dam.
2. The gauge record was extended to cover 1932 to 2017 based on the flows measured at the Keno gauge.

4.4 Summer Flow Frequency Analysis

This section describes the analysis of summer flows into J.C. Boyle and Iron Gate reservoirs. KRRC conducted a frequency analysis of summer flows to determine the flow rates associated with low frequency events such as the 1% probable event for the months May through September. KRRC then used these results to calculate the peak water surface elevations in the reservoir associated with these events. The analysis used USGS measured stream flow data for the two gauges shown in Table 4.4-1.

Table 4.4-1 USGS Gauge Data Used in the Summer Flows Frequency Analysis

USGS Gauge Number	Gauge Name	Annual Maximum and Daily Average Flow Period of Record	15 minute data, Period of Record[1]
11510700	Klamath River BLW John C Boyle Powerplant, Nr Keno OR	1/1/1959 -7/11/ 2017	5/1/1967 – 9/30/2017
11516530	Klamath River Below Iron Gate Dam, CA	10/1/1960 – 7/11/2017	5/1/1989 – 9/30/2017
[1] Date range only includes summer data (May through September)			

Annual maximum peak flow, average daily flow, and instantaneous (generally 15- to 30-minute intervals) flow data are available at both gauges. Since the maximum annual peak flow data generally occur in the winter, and peak summer flow data are required for this analysis, KRRC used the instantaneous flow data to estimate the annual peak flow for each month from May through September.

4.4.1 Iron Gate Reservoir

The Iron Gate gauge is located just downstream from Iron Gate Dam. It drains an area of 4,630 square miles. Bogus Creek is a small tributary located between Iron Gate Dam and the Iron Gate gauge. It drains an area of 52 square miles, which is approximately 1% of the Iron Gate gauge drainage area, so KRRC assumed it did not significantly affect the peak flow statistics for the Iron Gate gauge. Iron Gate reservoir is a run-of-the river reservoir used for power generation, and it is generally not used to store runoff. Therefore, it was assumed that the flow measured downstream of the dam is representative of the inflow to the reservoir, especially for infrequent events such as a 1% annual peak event (i.e., 100-year event).

Fifty-seven years (1961-2017) of average daily and instantaneous annual maximum flow rates are available at the Iron Gate gauge. In addition, 29 years (1989 – 2017) of 15-minute data are available. The Detailed Plan used the average daily flows to estimate the peak summer flows. Since instantaneous flows are larger than the average daily flows, the Detailed Plan used a correction factor based on comparing the annual maximum instantaneous flow to the average daily flow on the same day. Figure 4.4-1 compares the instantaneous flows to the daily average flow rates for the same day for the years 1961 to 2017. The comparison indicates that the annual maximum instantaneous flows are about 14% higher than the daily average flow for the same day using the relationship in Equation 4.4-1. For comparison, the Detailed Plan estimated instantaneous peaks from daily average values at the Iron Gate gauge using the relationship in Equation 4.4-2.

Equation 4.4-1

$$Q_{peak} = 1.1399\ Q_{average} - 161.08$$

Equation 4.4-2

$$Q_{peak} = 1.1408\ Q_{average} - 140.18$$

The difference between the relationships is the addition of 8 more years of data. As described below, KRRC used the 15-minute data for the flood frequency analysis. However, since the daily flow data has a longer period of record than was used in the Detailed Plan, results using the daily flow record are also presented in Figure 4.4-2 for comparison. KRRC calculated results using the regression equation shown in Figure 4.4-1 (Equation 4.4-1) for two periods: the same period as the 15-minute data (1989 – 2017) and the entire period of record (1961 – 2017). The results show that there is not much of a difference in the 100-year peak flows, regardless of the method or period of record used.

KRRC conducted a flood frequency analysis for each of the months from May through September using the peak flows based on the 15-minute data for each year within the period of record (1989 – 2017). Table 4.4-2 provides the flood frequency flows for the monthly peak flows for May through September. Table 4.4-3 provides the water surface elevations corresponding to the flows shown in Table 4.4-2. The diversion tunnel rating curve used in the drawdown study is the basis of these elevations. Note that the water surface elevations in the Detailed Plan were based on a slightly different rating curve.

The Detailed Plan used seasonal peak flow values for two seasons: June through October (representing June), and July through November (representing July). These periods were selected in the Detailed Plan because deconstruction of the Iron Gate and J.C. Boyle Dams will occur primarily from July 1 through November 30; and, the Detailed Plan did not permit any excavation of the embankment section of Iron Gate Dam until June 1 and required completion by September 30 to minimize hydrologic risk. For the Definite Plan, KRRC developed monthly flood frequency flows to better define the risk. However, Tables 4.4-2 and 4.4-3 also provide the seasonal flood frequency flows used in the Detailed Plan for comparison.

There were two very large storm events in the June data, one in 1993 (on June 5th) and one in 1998 (on June 1st). The 1993 peak flow in June was greater than any of the peak flows that occurred in May. In addition, there were a large number of low outliers in the May data (primarily in the first half of the month). Because of these large events in June and multiple low outliers in May, the extreme events in June (> 100-year) were greater than the similar extreme events in May.

The data indicate that there is a transition in the hydrology in June from winter to summer flows. Figure 4.4-2 shows the predicted 100-year event at Iron Gate for the period May through September (the predicted 100-year peak flows based on average daily values rather than 15-minute data are also provided for comparison since that method was used in the Detailed Plan). In May and the first half of June, the 100-year event is between approximately 8,000 and 10,000 cfs. It drops sharply in the second half of June through September when the 100-year event is between approximately 2,000 and 4,000 cfs.

Figure 4.4-3 plots the water surface elevations corresponding to the return periods shown in Table 4.4-3 for Iron Gate. Figure 4.4-3 clearly shows the reduced likelihood of higher reservoir levels starting in the middle of June.

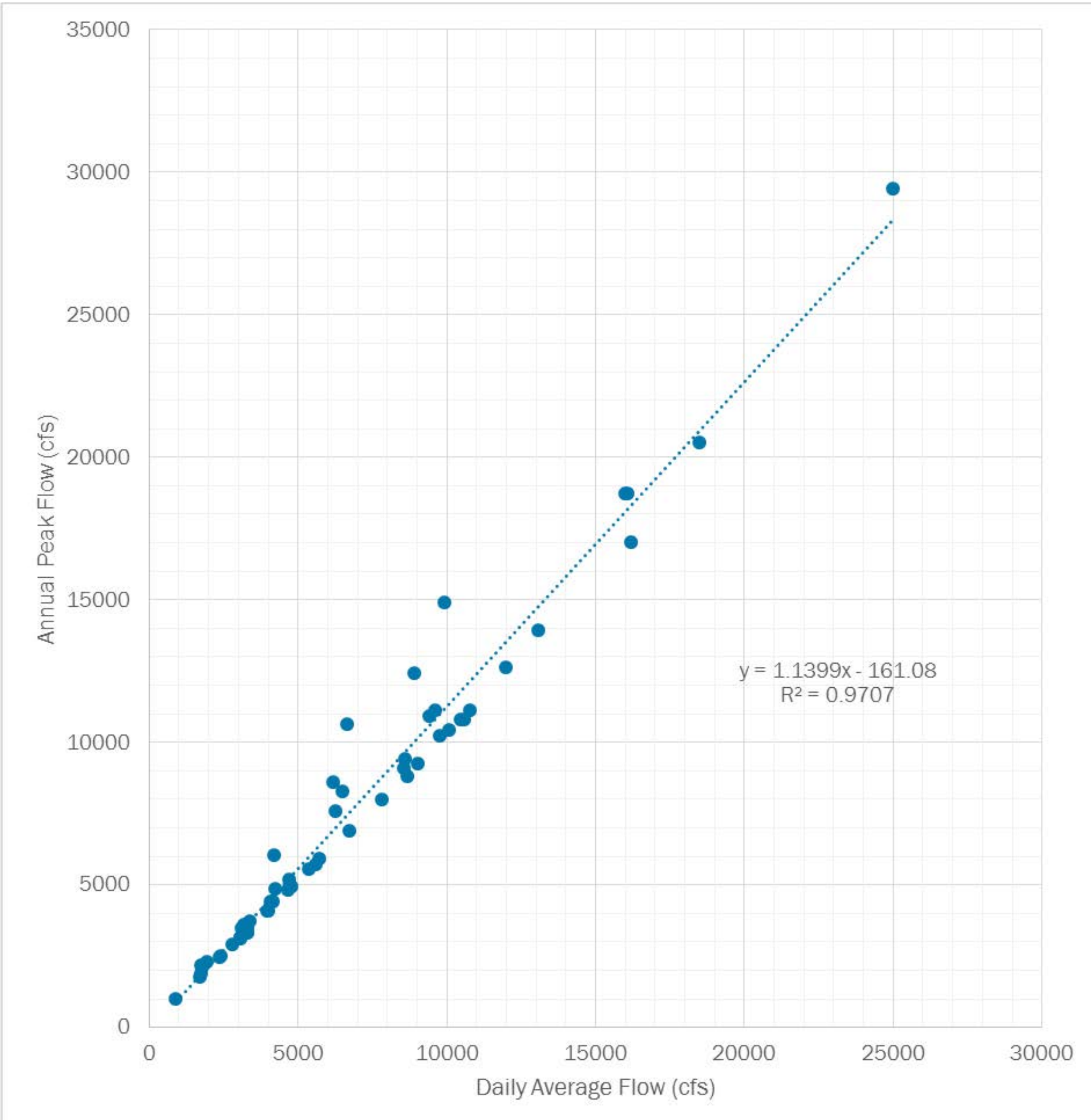

Figure 4.4-1 Relationship between Annual Maximum Flows and Daily Average Flow at the USGS Iron Gate Gauge

Table 4.4-2 Monthly Flood Frequency Flow at Iron Gate Reservoir

Exceed-ance Percent	Return Period	Maximum Peak Flow (cfs)							USBR Study[d] (cfs)			
	Years	May	June	June (1-15)	June (16-30)	July	Aug	Sept	Aug	Sept	Jun - Oct	Jul - Nov
0.2	500	11,339	17,948	15,406	5,830	3,498	2,448	2,363	NA	NA	NA	NA
0.5	200	10,212	12,549	11,348	4,837	3,081	2,237	2,201	NA	NA	NA	NA
1	100	9,321	9,526	8,932	4,172	2,778	2,080	2,077	2585	3386	9647	8387
2	50	8,394	7,192	6,965	3,573	2,485	1,924	1,951	2503	3221	7724[b]	7095[c]
5	20[a]	7,100	4,903	4,918	2,868	2,107	1,718	1,779	2416	3052	6110	5914
10	10	6,054	3,622	3,700	2,388	1,825	1,558	1,641	2291	2816	4364	4497
20	5	4,923	2,629	2,703	1,943	1,538	1,390	1,492	NA	NA	NA	NA
50	2	3,174	1,625	1,618	1,369	1,121	1,132	1,251	NA	NA	NA	NA

[a] Detailed plan is for the 25-year event.
[b] Detailed plan specifies to maintain a minimum flood release capacity of approximately 7,700 cfs in June (see Table 4.4-3 for elevation).
[c] Detailed plan specifies to maintain a minimum flood release capacity of approximately 7,000 cfs in July (see Table 4.4-3 for elevation).
[d] USBR Hydrology Studies for the Secretary's Determination on Klamath River Dam Removal and Basin Restoration (March 2011)

Table 4.4-3 Maximum Water Surface Elevation in Iron Gate Reservoir

Exceed-ance Percent	Return Period	Maximum Water Surface Elevation (ft, NAVD88)[a]							Detailed Plan[b] (ft, NAVD88)			
	Years	May	June	June (1-15)	June (16-30)	July	Aug	Sept	Aug	Sept	Jun - Oct	Jul - Nov
0.2	500	**2332.0**	**2335.3**	**2334.5**	2236.3	2205.3	2196.4	2195.8	NA	NA	NA	NA
0.5	200	2331.4	**2332.5**	**2332.0**	2221.2	2201.4	2195.0	2194.8	NA	NA	NA	NA
1	100	2311.7	2317.2	2301.6	2212.7	2198.9	2194.0	2194.0	2193	2196	2294	2267
2	50	2288.3	2261.6	2257.0	2206.1	2196.7	2193.1	2193.3	2193	2195	2254	2243
5	20	2259.7	2222.1	2222.3	2199.6	2194.2	2192.1	2192.4	2192	2195	2227	2224
10	10	2240.1	2206.6	2207.4	2196.0	2192.6	2191.3	2191.7	2192	2194	2205	2207
20	5	2222.4	2197.7	2198.3	2193.2	2190.8	2187.4	2189.7	NA	NA	NA	NA
50	2	2202.2	2191.6	2191.6	2187.2	2186.1	2186.2	2186.7	NA	NA	NA	NA

[a] Bold values overtop the spillway at elevation 2331.5 feet NAVD88.
[b] Elevations are from Appendix B in Detailed Plan – Iron Gate Diversion Capacities during Dam Removal. Values have been rounded up to nearest foot and converted from NGVD29 to NAVD88 by adding 3.3 feet.
[c] Detailed plan specifies to maintain a minimum flood release capacity of approximately 7,700 cfs in June which corresponds to an elevation of 2254 feet NAVD88.
[d] Detailed plan specifies to maintain a minimum flood release capacity of approximately 7,000 cfs in July which corresponds to an elevation of between 2242 and 2243 feet NAVD88.

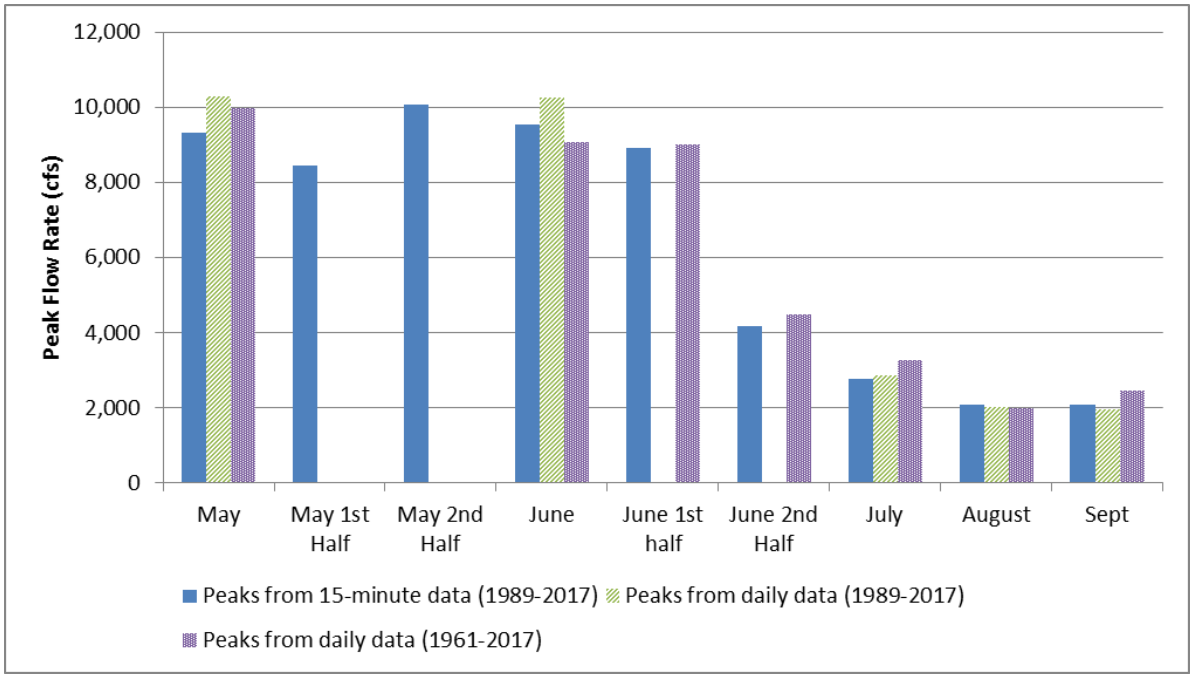

Figure 4.4-2 Predicted 100-year Flood Flow at Iron Gate for the Period May through September

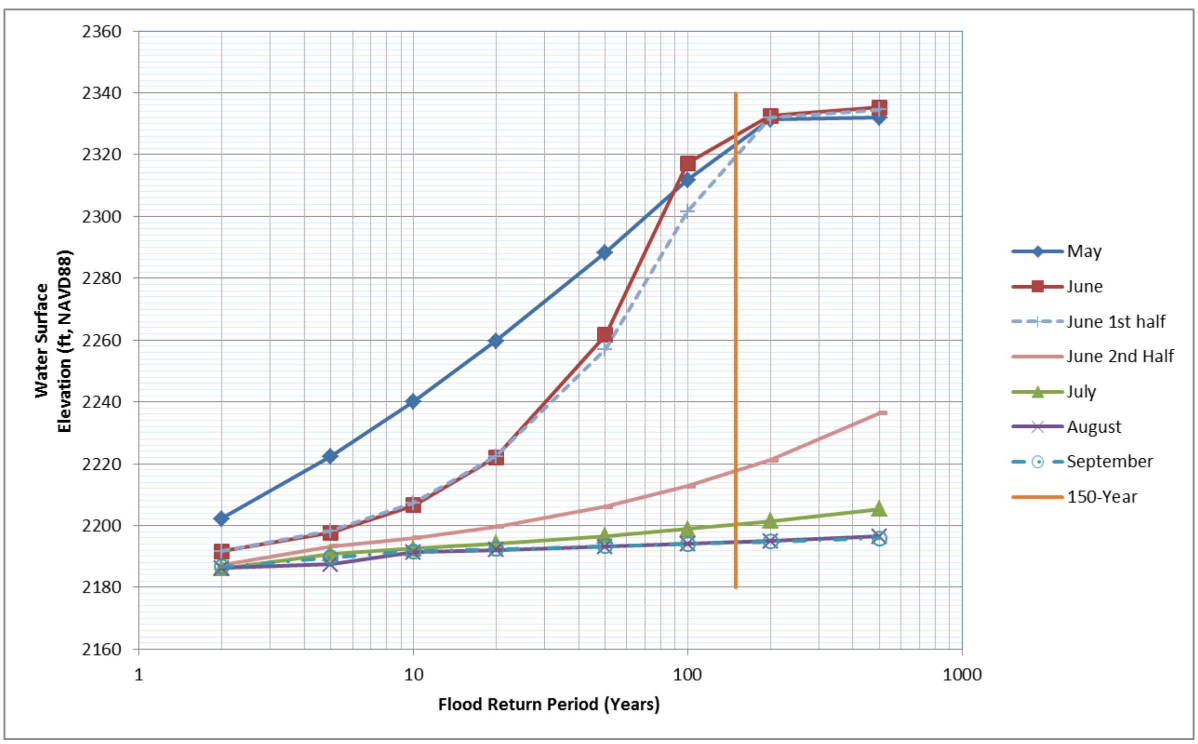

Figure 4.4-3 Frequency of Reservoir Levels at Iron Gate Dam for Summer Flows

4.4.2 J.C. Boyle Reservoir

The J.C. Boyle gauge is located 0.7 miles downstream from the J.C. Boyle powerhouse and 5 miles below the J.C. Boyle Dam. It drains an area of 4,080 square miles. There are no significant inputs to the river between the dam and the gauge. J.C. Boyle reservoir is a small run-of-the river reservoir used for power generation, and it does not store runoff. Therefore, it was assumed that the flow measured downstream of the dam is representative of the inflow to the reservoir, especially for infrequent events such as a 1% annual peak event (i.e., 100-year event).

Fifty nine years (1959-2017) of average daily and instantaneous annual maximum flow rates are available at the J.C. Boyle gauge. In addition, 30 years (1988 – 2017) of 15- to 30-minute data are available (data from 1967 are also available but were not used in the analysis). The Detailed Plan used the average daily flows to estimate the peak summer flows. Since instantaneous flows are larger than the average daily flows, the Detailed Plan used a correction factor based on comparing the annual maximum instantaneous flow to the average daily flow on the same day. Figure 4.4-4 compares the instantaneous flows to the daily average flow rates for the same day for the years 1959 to 2017 (the data only went to 2009 in the Detailed Plan). The comparison indicates that the annual maximum instantaneous flows are about 11% higher than the daily average flow for the same day using the relationship in Equation 4.4-3. For comparison, in the Detailed Plan estimated instantaneous peaks from daily average values at the J.C. Boyle gauge using the relationship in Equation 4.4-4.

Equation 4.4-3

$$Q_{peak} = 1.1142\ Q_{average} + 269.31$$

Equation 4.4-4

$$Q_{peak} = 1.0706\ Q_{average} + 863.66$$

For average daily flows less than about 3,200 cfs, the instantaneous peak flow is almost constant at about 2,800 cfs. This is likely due to flow controls from Upper Klamath Lake and Keno Dam. These values were not included in the regression relationship (i.e., data were censored). The Detailed Plan censored flows below 4,000 cfs when calculating the annual frequency distribution, but it did not state whether any censoring occurred as part of the seasonal frequency analysis. The regression plot [Figure 18 in the *Hydrology Studies for the Secretary's Determination on the Klamath River Dam Removal and Basin Restoration* (USBR 2011b; Hydrology Report)] has significantly fewer data points than are found in the table of values in Appendix A of the same report. There are also no average daily flows less than 2,000 cfs or greater than 10,000 cfs shown on the plot in the Hydrology Report, though there are values of those magnitudes in the table of values in the appendix to the Hydrology Report. It appears that some data were censored but it is unclear which data and why.

KRRC conducted a flood frequency analysis for each of the months from May through September using the peak flows based on the 15- to 30-minute data for each year within the period of record (1988 – 2017). Table 4.4-4 provides the flood frequency flows for the monthly peak flows for May through September. Table

4.4-5 provides the water surface elevations corresponding to the flows shown in in Table 4.4-4. The diversion tunnel rating curves used in the drawdown study are the basis for these elevations. Note that the water surface elevations in the Detailed Plan were based on a slightly different rating curve.

KRRC also conducted a flood frequency analysis using the maximum daily average flow for each of the months from May through September for comparison since that was the method used in the Detailed Plan. KRRC used the regression equation shown in Figure 4.4-4 with the monthly maximum daily average flows for two periods: the same period as the 15- to 30-minute data (1988 – 2017) and the entire period of record (1959 – 2017). Consistent with the results at Iron Gate, the results at J.C. Boyle also show that there is not much of a difference in the 100-year peak flows, regardless of the method or period of record used.

Similar to the results for Iron Gate, the data indicate that there is a transition in the hydrology in June from winter to summer flows. Figure 4.4-5 shows the predicted 100-year event at J.C. Boyle for the period May through September (the predicted 100-year peak flows based on average daily values rather than instantaneous data are also provided for comparison since that was used in the Detailed Plan). In May and the first half of June, the 100-year event is between approximately 7,000 and 11,000 cfs. It drops sharply in the second half of June through September when the 100-year event is between approximately 2,000 and 4,000 cfs.

Figure 4.4-6 plots the water surface elevations corresponding to the return periods shown in Table 4.4-5 for J.C. Boyle. Figure 4.4-6 clearly shows the reduced likelihood of higher reservoir levels starting in the middle of June.

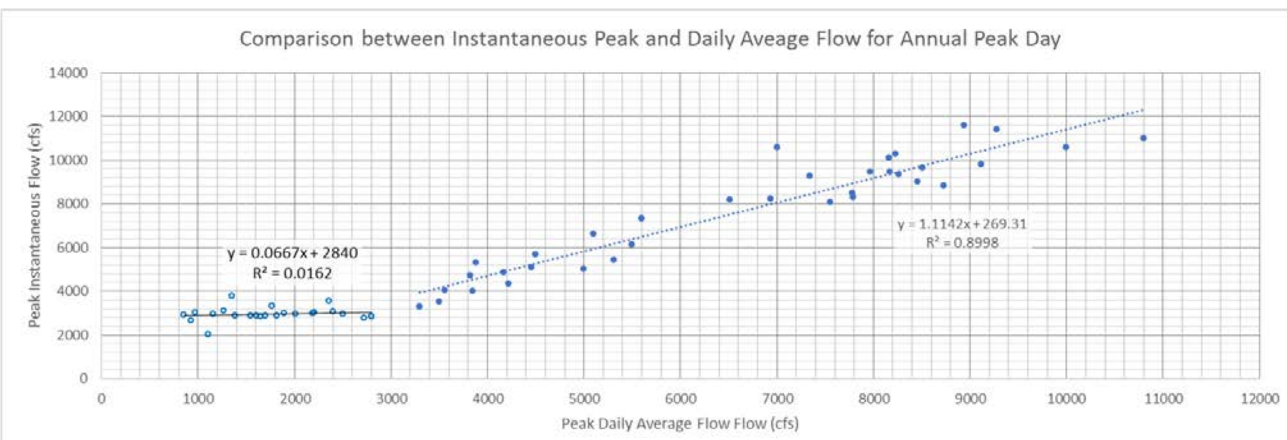

Figure 4.4-4 Relationship between Annual Maximum Flows and Daily Average Flow at the USGS J.C. Boyle Powerhouse Gauge

Table 4.4-4 Monthly Flood Frequency Flow at J.C. Boyle Reservoir

Exceed-ance Percent	Return Period	Maximum Peak Flow (cfs)							USBR Study[c] (cfs)			
	Years	May	June	June (1-15)	June (16-30)	July	Aug	Sept	Aug	Sept	Jun - Oct	Jul – Nov[b]
0.2	500	14,676	13,032	13,503	5,571	5,013	4,965	5,144	NA	NA	NA	NA
0.5	200	12,173	9,980	10,203	4,884	4,464	4,311	4,534	NA	NA	NA	NA
1	100	10,465	8,127	8,228	4,402	4,072	3,865	4,106	3,970	3,840	8,680	6,300
2	50	8,901	6,591	6,612	3,947	3,698	3,455	3,703	3,720	3,730	7,470	5,770
5	20[a]	7,025	4,955	4,914	3,382	3,225	2,962	3,203	3,460	3,590	6,370	5,250
10	10	5,728	3,956	3,893	2,974	2,877	2,620	2,843	3,080	3,340	5,070	4,560
20	5	4,508	3,117	3,049	2,574	2,529	2,297	2,491	NA	NA	NA	NA
50	2	2,919	2,180	2,125	2,016	2,032	1,874	2,002	NA	NA	NA	NA

[a] Detailed plan is for the 25-year event.
[b] Detailed plan specifies that removal of the embankment dam cannot begin until July 1.
[c] USBR Hydrology Studies for the Secretary's Determination on Klamath River Dam Removal and Basin Restoration (March 2011)

Table 4.4-5 Maximum Water Surface Elevation in J.C. Boyle Reservoir

Exceed-ance Percent	Return Period	Maximum Water Surface Elevation (ft, NAVD88)[a]							Detailed Plan[b] (ft, NAVD88)			
	Years	May	June	June (1-15)	June (16-30)	July	Aug	Sept	Aug	Sept	Jun - Oct	Jul - Nov
0.2	500	**3792.8**	**3791.9**	**3792.1**	3781.8	3775.8	3775.3	3777.2	NA	NA	NA	NA
0.5	200	**3791.3**	**3790.0**	**3790.1**	3774.5	3770.5	3769.9	3771.1	NA	NA	NA	NA
1	100	**3790.2**	**3788.5**	**3788.6**	3770.1	3769.4	3768.9	3769.5	3771	3770	**>3802**	**3786**
2	50	**3789.2**	**3786.6**	**3786.7**	3769.1	3768.5	3767.9	3768.5	3770	3770	**3797**	3782
5	20	**3787.2**	3775.2	3774.8	3767.7	3767.3	3766.7	3767.3	3769	3769	**3787**	3779
10	10	3783.6	3769.1	3769.0	3766.7	3766.5	3765.8	3766.4	3767	3768	3777	3774
20	5	3770.9	3767.1	3766.9	3765.7	3765.5	3764.9	3765.4	NA	NA	NA	NA
50	2	3766.6	3764.6	3764.4	3764.1	3764.1	3763.7	3764.0	NA	NA	NA	NA

[a] Bold values overtop the spillway at elevation 3785.2 feet NAVD88.
[b] Elevations are from Appendix B in Detailed Plan – Iron Gate Diversion Capacities during Dam Removal. Values have been rounded up to nearest foot and converted from NGVD29 to NAVD88 by adding 3.7 feet.
[c] Detailed plan specifies to maintain dam crest elevation no lower than 3767 to ensure minimum 100-year flood protection (with freeboard) in September for flows up to about 3,500 ft3/s through left abutment.

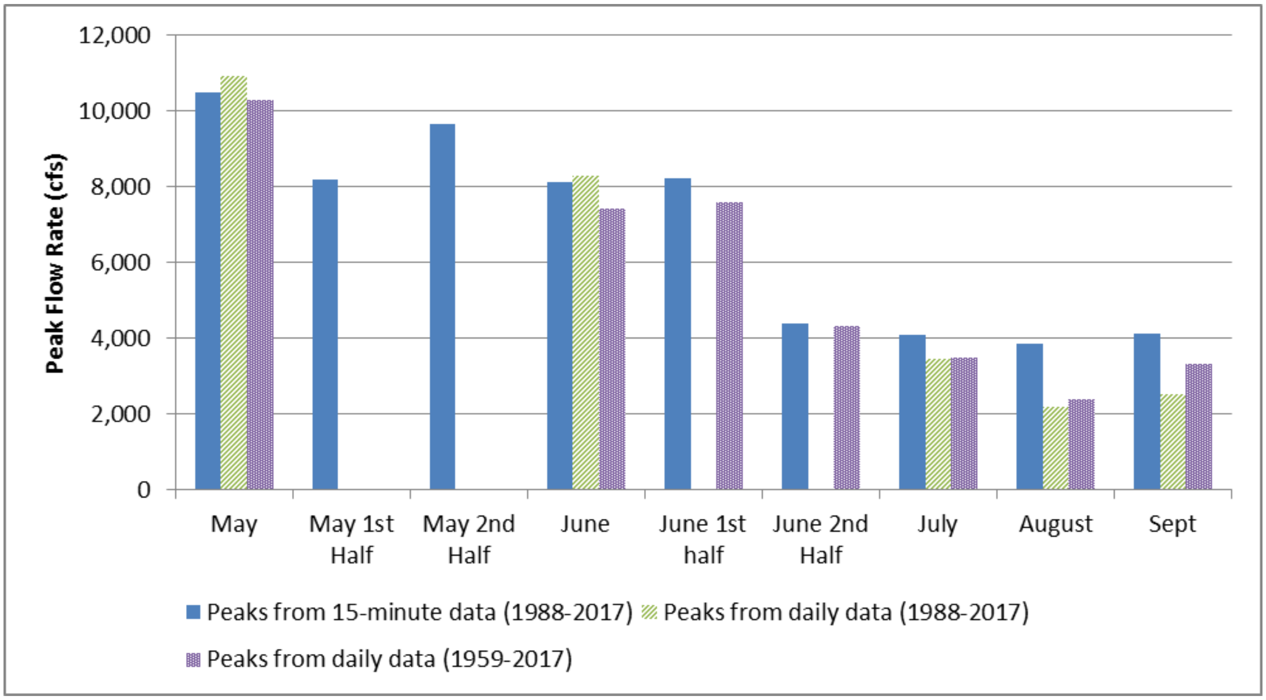

Figure 4.4-5 Predicted 100-year Flood Flow at J.C. Boyle for the Period May through September

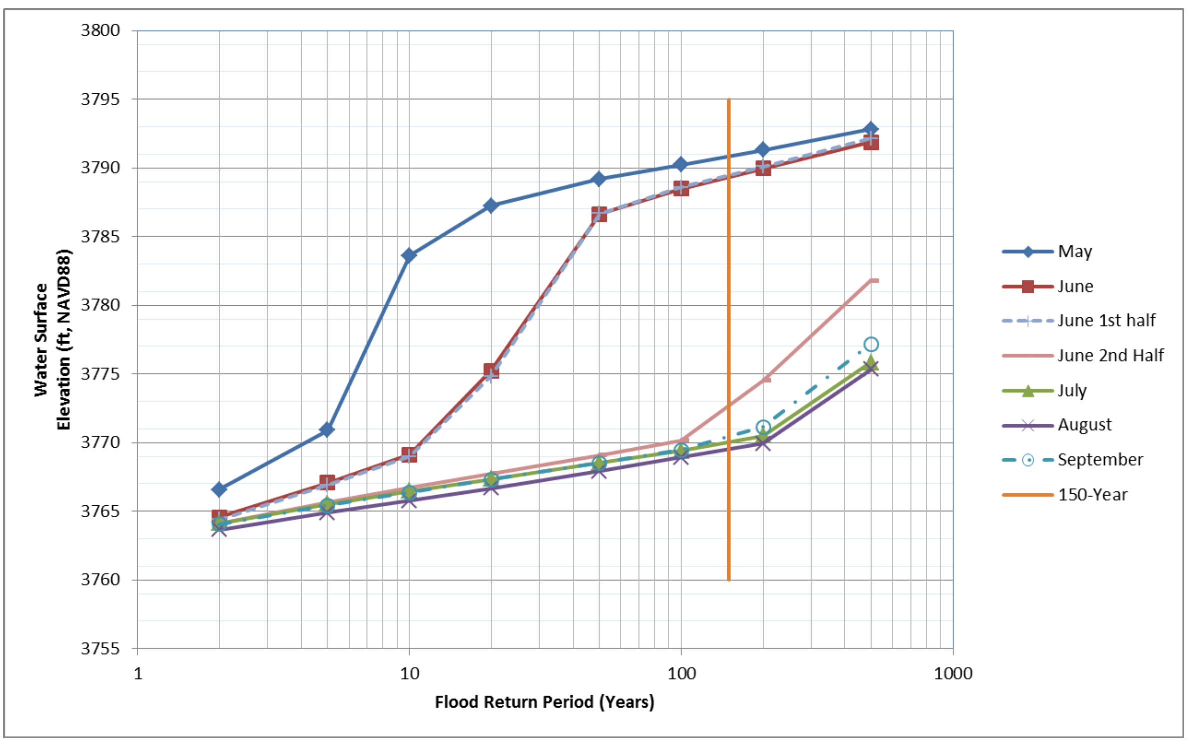

Figure 4.4-6 Frequency of Reservoir Levels at J.C. Boyle Dam for Summer Flows

4.5 Drawdown Timing

KRRC proposes the simultaneous removal of the four dams with the dewatering periods scheduled to minimize sediment release into downstream areas during critical times for important aquatic species and life stages (e.g., anadromous fish spawning, rearing, and in- and out-migration). The deconstruction period, including site preparation, dewatering, and facilities removal, will occur over about 20 months. The drawdown period could vary depending on water year type, with longer drawdowns occurring during wet years and shorter drawdowns during dry years.

To reduce the uncertainty regarding the length of time over which flows with high suspended sediment concentrations will occur and potentially negatively affect aquatic resources, the Definite Plan includes an updated approach to the drawdown at Copco Lake. This updated approach (Option 2 summarized in Section 4.2) dewaters the reservoir via an upgraded diversion tunnel, and no longer relies on dam notching to complete the drawdown. In contrast, the dam notching proposed in the 2012 EIS/R and Detailed Plan could have caused delays during wet water years. Specifically, the Contractor would need to wait in wet years for the water level to drop below the crest to enable equipment access to the notch area to complete the next notch. These delays can be seen in the modeling results discussed further in Section 4.6.

Therefore, relying on the diversion tunnel at Copco No. 1, rather than notching, significantly increases the likelihood that drawdown, or at least an initial drawdown, will occur by the end of February. Thus, the release of the majority of suspended sediment during that period will reduce the likelihood of high suspended sediment concentrations after March 15.

Due to the improvement of the probability of drawdown being completed within the January 1 to March 15 time period, the potential effects on downstream environmental resources by deconstruction implementation during a wet year is considered to be similar to potential effects in a normal water year. The updated drawdown approach at Copco No. 1 significantly reduces the probability of an increase in the cost of deconstruction of Copco No. 1 due to the occurrence of a wet year because drawdown is much less likely affected by high flows.

In the proposed construction schedule, the embankment removals at Iron Gate Dam and J.C. Boyle Dam and the concrete dam removal at Copco No. 1 Dam within the river channel will all start between May and July and be completed by October, months when high flows have receded in most years. The embankment removal schedules assume that the minimum embankment height maintained through removal will accommodate a 0.01 chance (100-year) storm plus 3 feet of freeboard in any given month. If a wet year were to delay the start of embankment or concrete removal to July, KRRC's Contractor will increase productivity to complete the removal on time.

Based on the discussions and analyses summarized above, the current drawdown schedule minimizes the release of sediment during the previously identified critical times for important species and life stages.

4.6 Reservoir Drawdown Releases

The following sections describe how KRRC will use the diversion facilities to draw down the reservoirs and release sediment, the timing of the discharges, the range of discharge rates anticipated, the portion of discharge associated with specific structures, and the change in reservoir elevation per day.

Copco No. 2 Dam does not impound a significant volume of sediment, and KRRC will remove it during the same year as the three larger dams. Drawdown of Copco No. 2 Reservoir will not be necessary until after Copco No. 1 Dam has been breached to final grade. No drawdown rate limitations will apply to the removal of Copco No. 2 Dam.

Analyses of the embankment and reservoir rims demonstrate the Project will maintain adequate factors of safety to prevent embankment slope instability provided the drawdown rate is controlled (see Appendices D and E). Based on analyses in Appendix E, the reservoir rim stability is independent of drawdown rate. Reservoir drawdown rates at Iron Gate, Copco No. 1, and J.C. Boyle (until diversion culverts are opened) will be limited to 5 feet per day; however, the actual drawdown rates may be less (or negative) during storm periods because of increased inflows to the reservoirs. For the modeling, KRRC assumed the starting elevations of Iron Gate and Copco No. 1 were at the spillway crest on January 1.[11] KRRC assumed the starting elevation at J.C. Boyle was the normal operating elevation on January 1.

To provide information on the range of flows that are likely to be released from the reservoirs during drawdown, a detailed analysis of the reservoir drawdown for water years 1961 through 2009 was completed. The purpose of this analysis was to provide information on the following points.

1. Anticipated discharges from each reservoir to the Klamath River in cfs associated with reservoir drawdown operations.
2. Description of structures used for reservoir drawdown operations including the flow (cfs) anticipated for each structure during drawdown operations.
3. Timing of reservoir drawdown operations.
4. For each reservoir, confirmation on proposed reservoir elevation change per day.

Section 4.6.1 describes the detailed analysis. Table 4.6-1 provides the range of approximate additional outflow due to minimum and maximum reservoir drawdown rates. The maximum drawdown rate is set at 5 feet per day until drained, and the minimum drawdown rate assumes it takes 59 days to drain the reservoir (January 1 to February 28). These flows will be in addition to the flows in the river from Keno Reservoir releases and tributary contributions. For comparison, Table 4.6-1 also provides the average release flows as a percentage of 2-year and 10-year peak flows in the Klamath River.

For J.C. Boyle, KRRC expects the increase in flow to the river due to drawdown to be from less than 1% up to 3%. For Copco No. 1, KRRC expects the increase to be between 3% and 13%, and for Iron Gate, KRRC

[11] Copco Lake drawdown from normal operating elevation is assumed to begin on November 1 (prior to the January 1 drawdown process). The period from November 1 to January 1 is assumed sufficient to draw down from normal operating elevation to the spillway crest elevation (approximately 12.5 feet) with a maximum historic drawdown of 2 feet per day. The Copco Lake modeling starts on January 1 with the reservoir elevation at the spillway crest.

expects the increase to be between 3% and 14%. Note the minimum drawdown rate will likely occur during periods with large storm events, so the increase in flow will be closer to the <1% to 3% range during a storm event at the three reservoirs (see Column 8 in Table 4.6-1).

During dry periods the reservoirs can be drawn down quicker, resulting in a larger percent increase in flow to the river, but since the river flows are relatively small, the impacts are not necessarily greater (see column 10 in Table 4.6-1). For comparison, the 2-year flood downstream of J.C. Boyle is 4,700 cfs and at Iron Gate is 5,900 cfs. The 5-year flood event downstream of J.C. Boyle is 7,700 cfs and at Iron Gate is 10,900 cfs. Compared to these flood events, the incremental increase in flow due to reservoir drawdown is minimal.

Table 4.6-1 Range of Release Flows from Reservoirs due to Drawdown

Reservoir	Initial WSE (ft, NAVD)	Invert Elevation of Diversion Structure (ft, NAVD)	Total Depth (feet)[1]	Total Volume (acre-feet)[2]	Min Avg Release Flow (cfs)[3]	Min Avg as % of 2-Year Flow in Klamath River[4]	Min Avg as % of 10-Year Flow in Klamath River[5]	Max Avg Release Flow (cfs)[6]	Max Avg as % of 2-Year Flow in Klamath River[4]	Max Avg as % of 10-Year Flow in Klamath River[5]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
J.C. Boyle	3796.7	3755.2	41.5	2,267	19.4	0.4%	0.2%	138	3%	1%
Copco	2597	2485.5	111.5	33,724	288	5%	3%	762	13%	7%
Iron Gate	2331.3	2176.3	155	50,941	435	7%	3%	828	14%	6%

Notes:

1. Depth calculated as difference between normal operating level (J.C. Boyle) or spillway elevation (Copco and Iron Gate) and invert elevation of diversion structure.
2. These are total volumes based on a 2003 bathymetric survey (Eilers and Gubala 2003). See Sections 2.1.1, 2.2.1, and 2.4.1 for total volumes associated with each reservoir.
3. Minimum assumes 59 days to drain reservoir.
4. Based on flood frequency results in Table 4.3-2 for 2-year flow (4,736 cfs for J.C. Boyle; 5,974 cfs for Copco; and 5,942 cfs for Iron Gate).
5. Based on flood frequency results in Table 4.3-2 for 10-year flow (9,438 cfs for J.C. Boyle; 11,340 cfs for Copco; and 14,912 cfs for Iron Gate).
6. Maximum assumes continuous drawdown of 5 feet per day for total reservoir depth.

4.6.1 Detailed Modeling

KRRC conducted detailed analysis of the drawdown using the USACE Hydrologic Engineering Center River Analysis System (HEC-RAS) model (version 5.0.3). KRRC used the model to calculate flows and water levels due to the drawdown of J.C. Boyle Reservoir, Copco Lake, and Iron Gate Reservoir. For modeling stability purposes, KRRC divided the Klamath River into two modeling reaches. Reach 1 covers the J.C. Boyle Reservoir and extends from approximately 1 mile upstream of J.C. Boyle Reservoir to approximately 0.4 mile downstream of J.C. Boyle Dam. Reach 2 extends from approximately 1.5 miles upstream of Copco Lake to approximately 0.6 mile downstream of Iron Gate Dam.

The HEC-RAS model requires inputs for topography/bathymetry, inflow rates, and rating curves for dam outlets. The following sections discuss input sources and data.

Topography/Bathymetry

KRRC generally obtained the cross-section bathymetry in the HEC-RAS model from the SRH1-D model provided by the USBR. The data were representative of Scenario 8 in USBR (2012). The bathymetry data extended from above J.C. Boyle to Happy Camp, CA, however KRRC only used the data for the two reaches listed above.

Inflow Rate

KRRC used inflow data based on the Klamath Basin Restoration Agreement (KBRA) flows as river flows (Keno flows).[12] KRRC obtained these flows from the SRH1-D model input files (USBR 2012c). The data were compared to the measured flows at the USGS gauge at Keno (gauge no. 11509500, Klamath River at Keno, OR). Figure 4.6-1 compares the USGS measured data at Keno to the SRH1-D data used in the model. As seen in the figure, the Keno flows closely follow the measured flows at the USGS Keno gauge but some of the variability has been "smoothed" out during non-storm periods when the Keno flows are relatively constant by month. During large storms the Keno flows data occasionally have a sharp peak that exceeds the USGS measured flows. These sharp peaks generally last a few days. During the winter (January – April), including the months when drawdown will occur, the flow frequency curve for the flows used in the model and the measured USGS flows are very similar. The data prior to 1969 appears to be time shifted or mislabeled by approximately 1 year.

KRRC simulated water years 1961 through 2009 in the model. Results are presented for 6 years representative of the various conditions that could occur during construction (results for the other years are provided in Appendix F). All simulations started on January 1 with J.C. Boyle at normal operating elevation and Copco Lake and Iron Gate reservoirs full to the spillway crest elevation. It is possible that during construction, water levels could be lower or higher depending upon the hydrologic conditions that occurred in the preceding December. The 6 years selected for discussion are summarized below:

- 1965: Largest storm of record occurred between December 1964 and April 1965 (Corresponds to water year 1966 in the SRH1-D and HEC-RAS output)
- 1970: Years drier than 1970 (based on ranking the maximum 15-day volume of flow between January and May at Keno) drained by March 1
- 1973: The median year based on ranking the maximum 15-day volume of flow between January and May at Keno
- 1979: Representative dry year
- 1986: Representative wet year
- 2006: Representative wet year

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12 The 2013 Joint Biological Opinion for USBR's Klamath Irrigation Project (NMFS and USFWS 2013) modified the flows from the 2010 KBRA. The 2013 Joint Biological Opinion slightly increases the annual average water supply by about 9,000 acre feet when compared with the KBRA Flows, and it maintains higher minimum summer flows in dry years. The changes to flows in January and February (during drawdown) are negligible. The small changes to flows in the 2013 Joint Biological Opinion will not affect the drawdown of the reservoirs, nor the level of flows released during drawdown. NMFS and USFWS are working on a new Joint Biological Opinion to be released in 2019, which may again alter flows released by USBR's Klamath Irrigation Project.

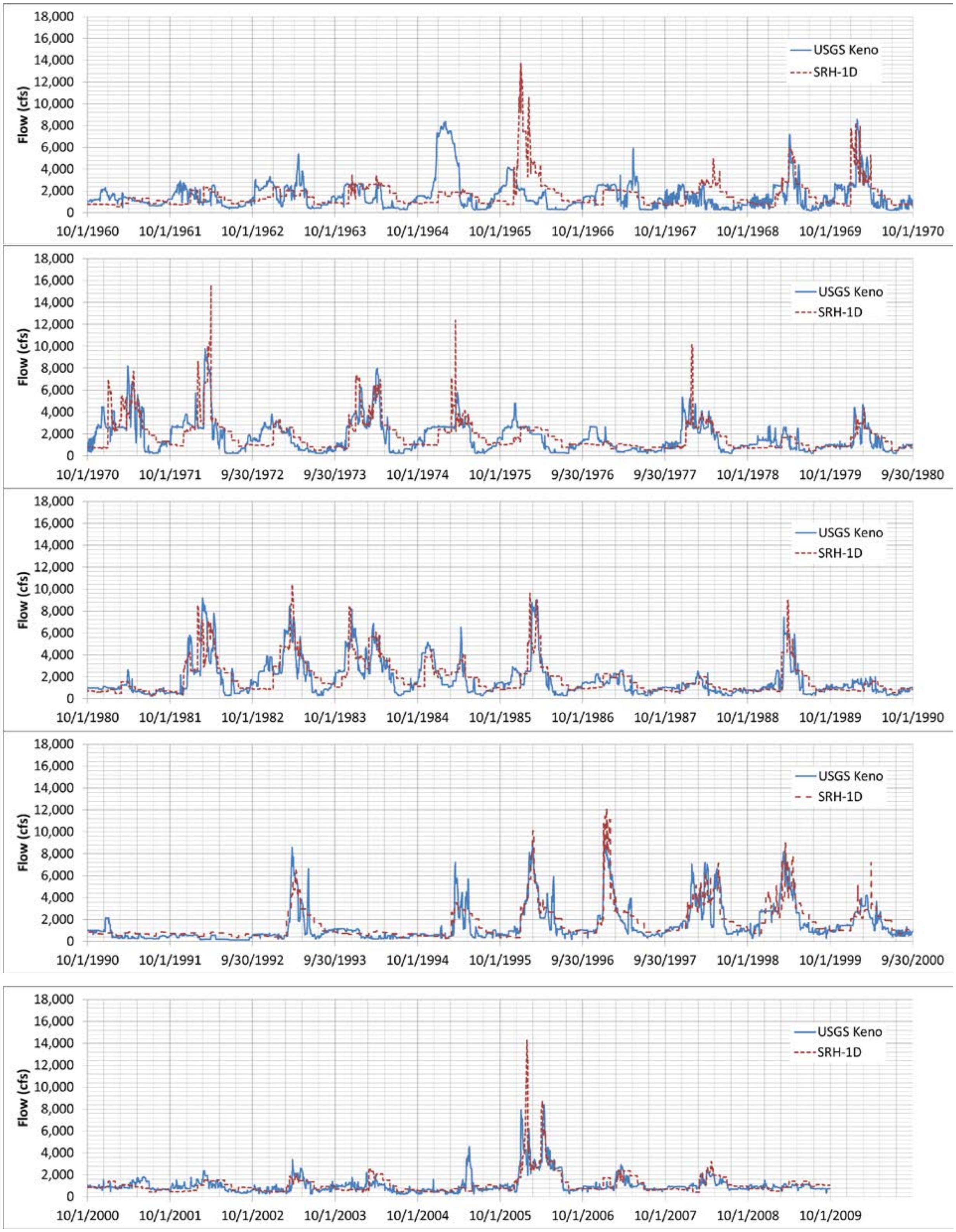

Figure 4.6-1 Comparison of Gauged Flows at Keno to Modeled Flows in SRH-1D

4.6.2 J.C. Boyle Reservoir

Drawdown Procedure

The following numbered list summarizes the drawdown procedure at J.C. Boyle:

1. Reservoir drawdown will begin on January 1, 2021 by making controlled releases through the gated spillway (crest elevation 3785.2) and the power intake (invert elevation 3771.7). Additional discharges to the river during drawdown using the spillway and power canal will be on the order of the values shown in Table 4.6-1 but these will be short-term. Once the reservoir drawdown elevation (dependent on base inflow) stabilizes with both the spillway and power intakes fully open, KRRC's contractor will hold the reservoir elevation for about a week. However, because of the minimal storage available above the power intake invert, the water level in the reservoir will fluctuate in concert with the changing inflow. The maximum flow through the power intake is about 2,800 cfs. About 25% of the analyzed years for drawdown have an average flow in January greater than 2,800 cfs and almost 40% have a maximum flow greater than 2,800 cfs. Flows above about 2,800 cfs will go over the spillway.
2. With the reservoir at the lowest possible level (depending upon inflow) using spillway and power intake, drawdown will continue by removing the concrete stoplogs from one 9.5- by 10-foot bay of the 2-bay diversion culvert (invert elevation 3755.2) by blasting, if necessary.[13] There is relatively little storage below the spillway crest elevation compared to storm volumes, so the elevation will change rapidly with changes in inflow rate. Additional drawdown releases will rapidly increase to a maximum of about 3,000 cfs for a short duration dropping back to near the inflow value over a period of a few hours. For reference, the 2-year and 5-year flow events downstream of J.C. Boyle Dam are 4,736 cfs and 7,719 cfs, respectively. The reservoir elevation will be allowed to stabilize and be held for one to two weeks to allow dissipation of pore pressures in the embankment and the reservoir rim.
3. With the reservoir at the lowest possible level (depending upon inflow), drawdown will continue by removing the concrete stoplogs from the remaining two 9.5- by 10-foot diversion culverts (invert elevation 3755.2) by blasting, if necessary.[14] Additional drawdown releases will rapidly increase to a maximum of 1,000 to 2,000 cfs for a short duration, dropping back to the inflow value over a period of about an hour or less. This will provide the maximum reservoir drawdown possible prior to removal of the dam embankment section, except for the natural drawdown resulting from the subsequent reduction of streamflow. The reservoir drawdown should be completed by January 31, 2021 to minimize potential impacts at the downstream dam removal sites. KRRC assumes the potential formation of reservoir ice in January at this site will not impact reservoir drawdown significantly during this period. Reservoir releases at the dam will be maintained below any ice cover.
4. The timing of the removal of the stoplogs from either diversion culvert will take into consideration inflow conditions with a possibility of shifting stoplog removal to avoid contributing additional flow during very high flow conditions. The power intake gate will be closed once the reservoir is drawn

[13] For modeling purposes, KRRC assumes the 1st culvert opens on January 14.
[14] For modeling purposes, KRRC assumes the 2nd culvert opens on February 1.

down below the intake invert or following removal of the stoplogs from the second bay of the diversion culvert, whichever is earlier, and the power canal will be drained through the powerhouse turbines, not through the forebay spillway.

Results

Figures 4.6-2 through 4.6-7 show results from the HEC-RAS analysis for the six representative years discussed above. Because of the small size of the J.C. Boyle Reservoir, the reservoir will refill partially or completely during a storm until dam removal is complete. The capacity of the two diversion culverts for water levels below the spillway elevation is about 5,700 cfs. The results show about 15% of the years have a maximum January or February flow that exceeds 5,000 cfs and will result in reservoir refilling and associated flows over the spillway.

During the representative drier years (1973 and 1979, see Figures 4.6-6 and 4.6-7), the reservoir easily draws down in January, and it did not refill after that point.

During the representative wetter years of 1966[15], 2006 and 1986 (see Figures 4.6-2, 4.6-3 and 4.6-4), the reservoir completely draws down early (January to mid-February), but quickly refills later in the year when storms occur. The majority of the accumulated sediment will mobilize during the initial drawdown, and subsequent reservoir filling and drawdown is expected to cause only moderate increases in high suspended sediment (relative to background) (USBR 2012c).

For all water years, any increase in peak flows with drawdown compared to peak flows without drawdown is small due to the relatively limited amount of attenuation associated with the existing reservoir.

KRRC does not anticipate that sediment concentrations resulting from the proposed drawdown procedure and associated hydraulics will differ from those previously estimated (USBR 2012c).

15 Largest storm of record occurred between December 1964 and April 1965 in WY1965, but due to the data shift noted in Section 4.6.1, this corresponds to WY1966 in the modeling.

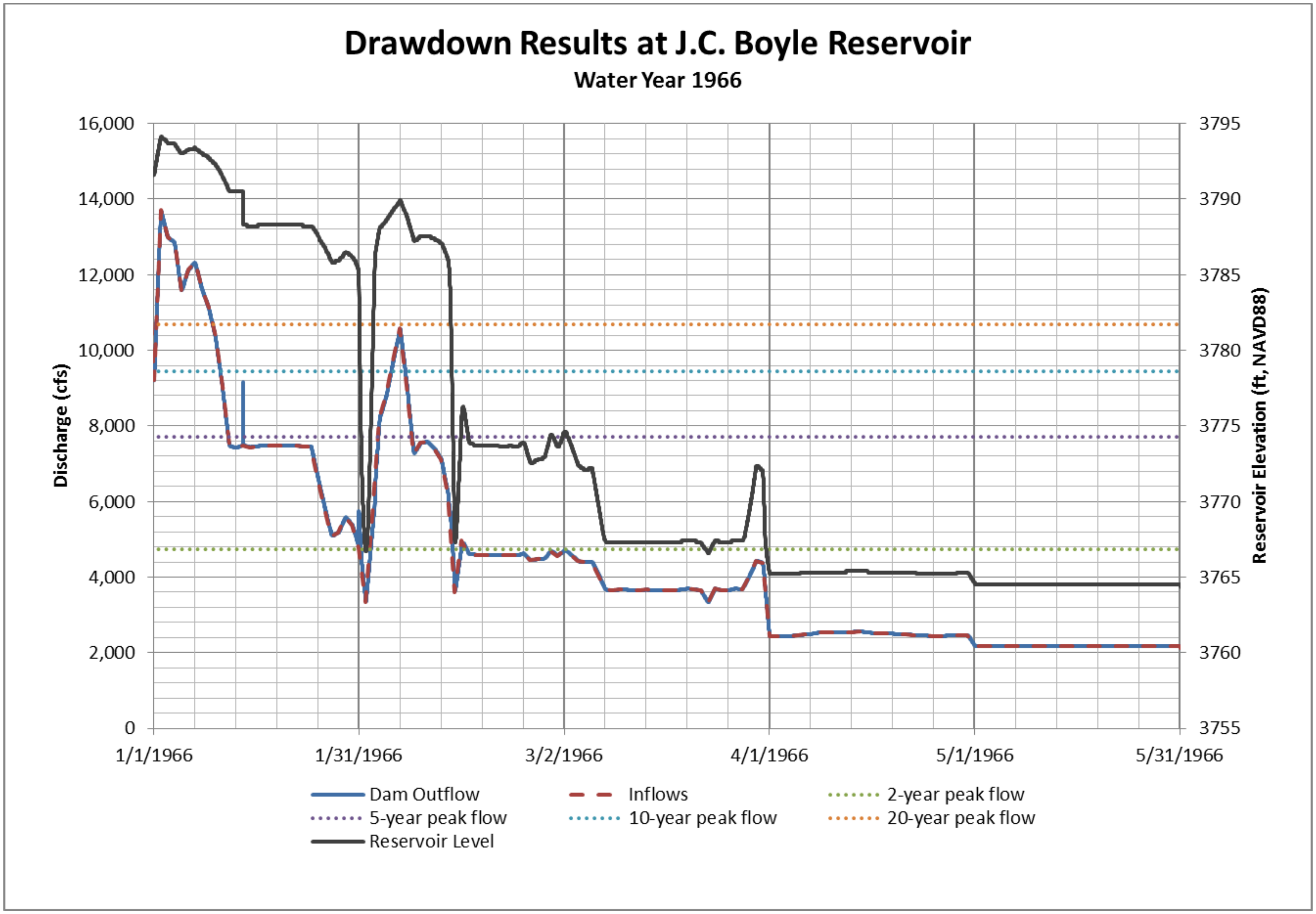

Figure 4.6-2 J.C. Boyle Reservoir Drawdown, Water Year 1966 (Wettest Year)

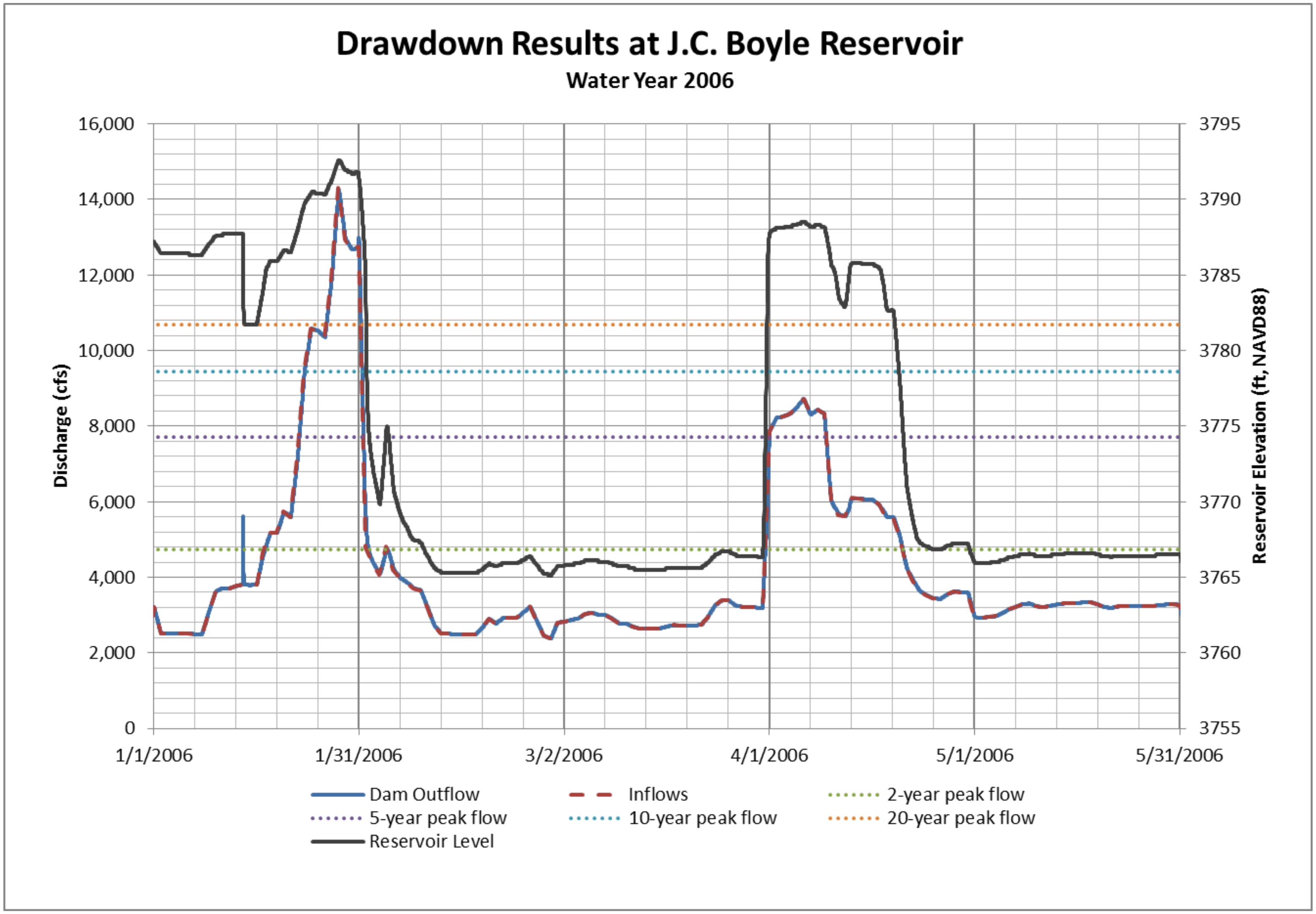

Figure 4.6-3 J.C. Boyle Reservoir Drawdown, Water Year 2006 (Wet Year)

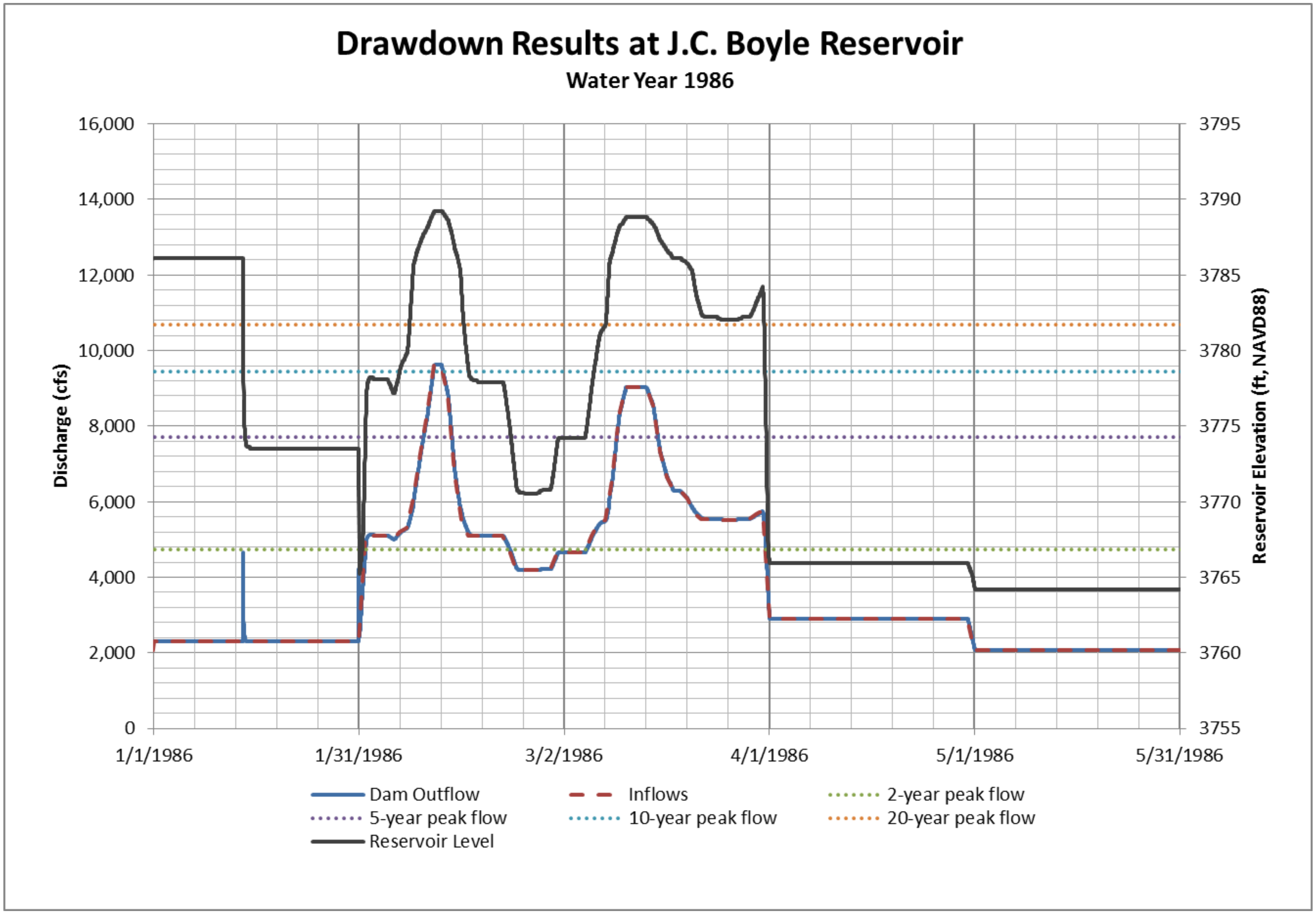

Figure 4.6-4 J.C. Boyle Reservoir Drawdown, Water Year 1986 (Wet Year)

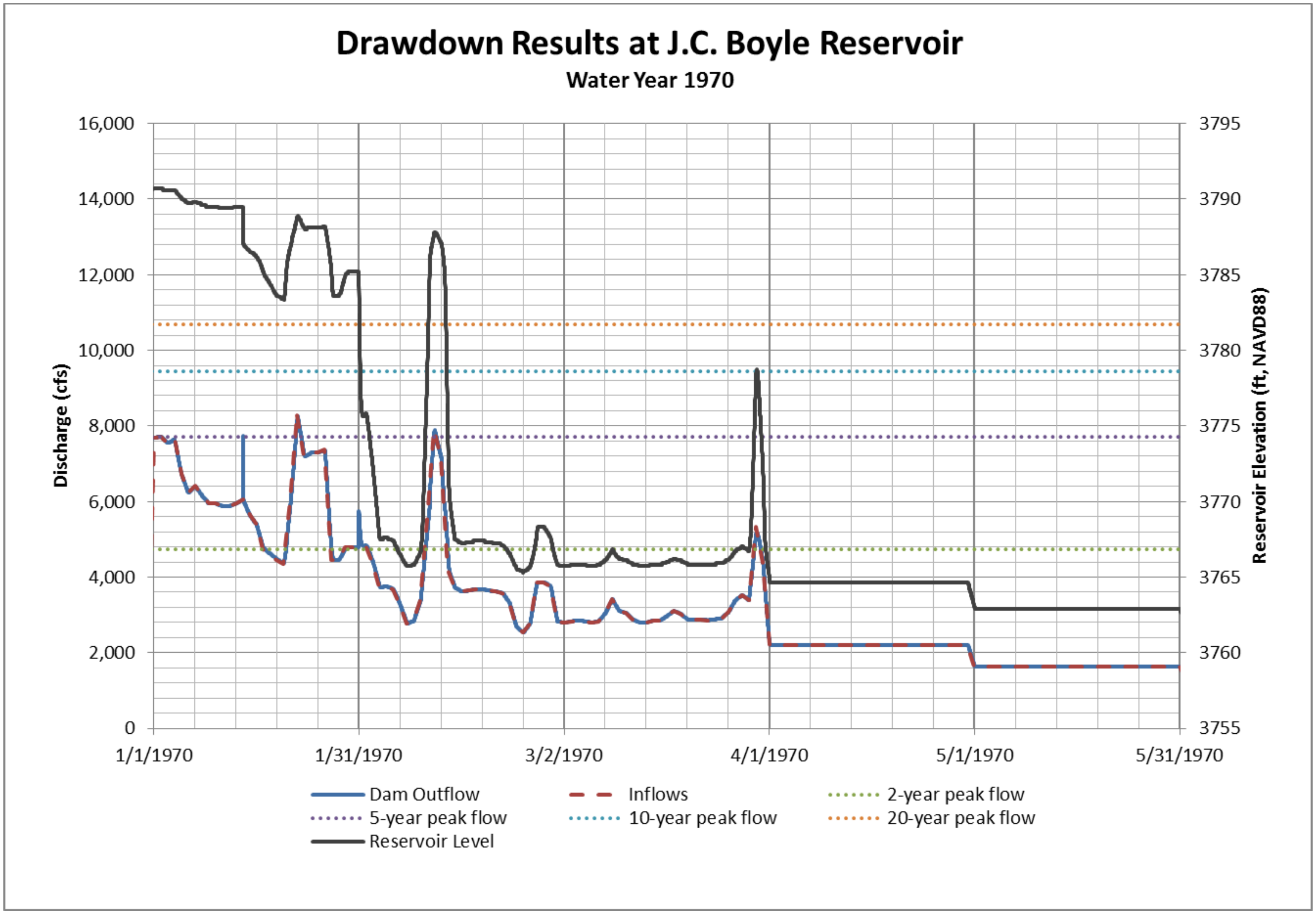

Figure 4.6-5 J.C. Boyle Reservoir Drawdown, Water Year 1970 (Above Normal Year)

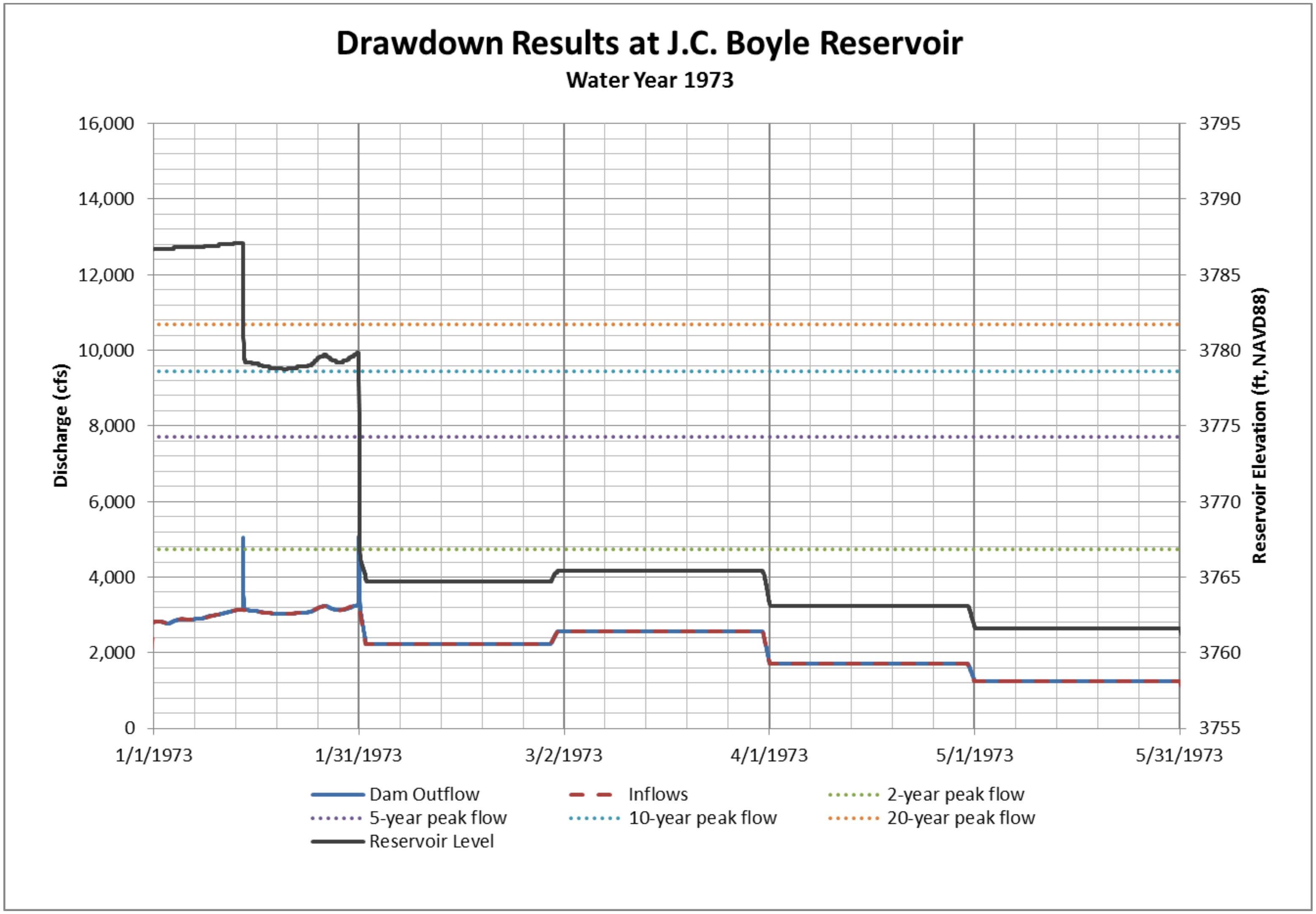

Figure 4.6-6 J.C. Boyle Reservoir Drawdown, Water Year 1973 (Normal Year)

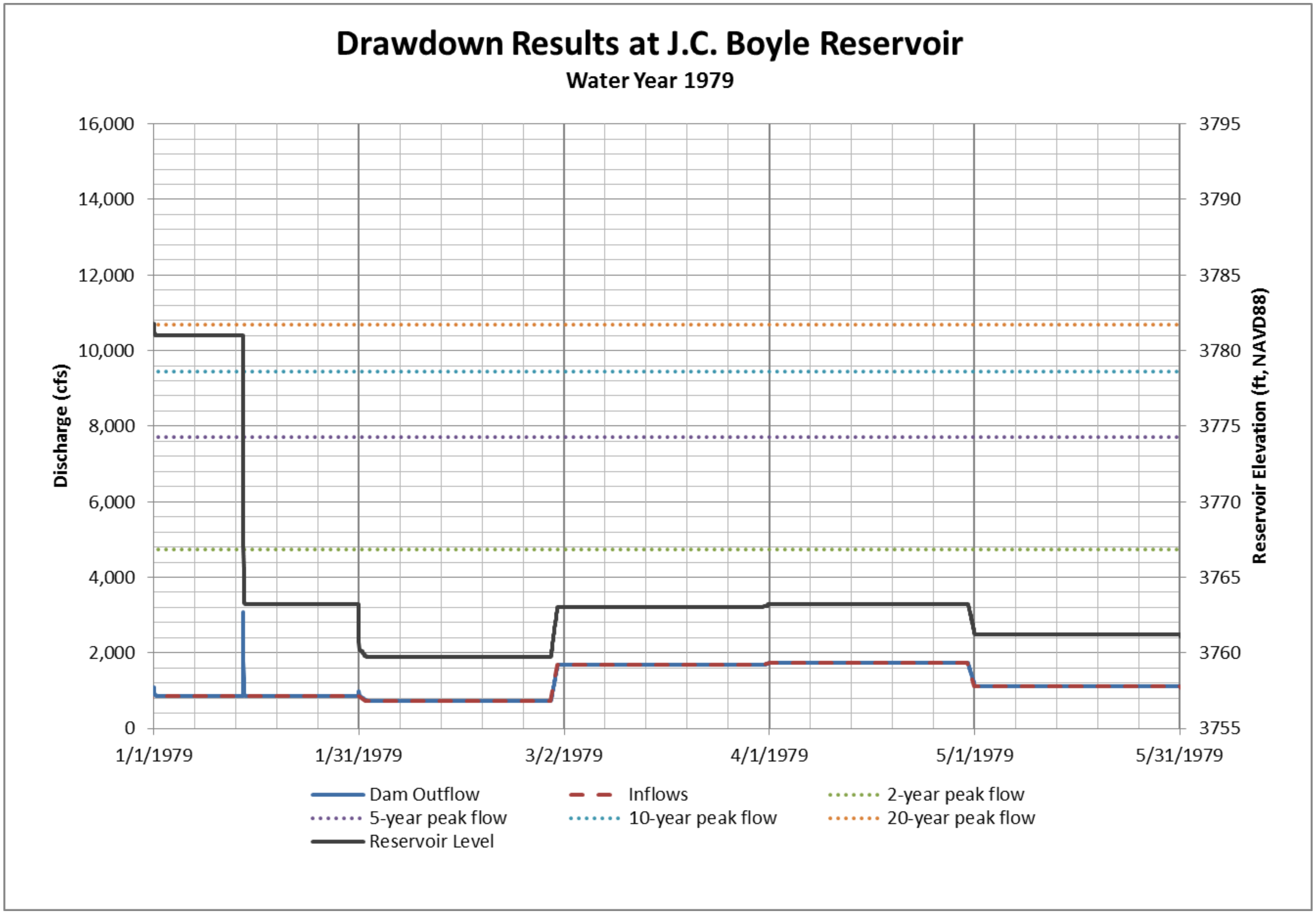

Figure 4.6-7 J.C. Boyle Reservoir Drawdown, Water Year 1979 (Dry Year)

4.6.3 Copco Lake

Drawdown Procedure

Drawdown of Copco Lake is discussed separately for the two tunnel modification options KRRC analyzed and described in Section 4.2.2.

Option 1 (for comparison only) – Diversion Tunnel Modified to Restore Capacity and Dam Notching:

The numbered list below summarizes the drawdown procedure at Copco Lake for Option 1:

1. Begin reservoir drawdown from normal operating elevation 2609.5 feet on November 1 in the year prior to the main drawdown by making controlled releases through the gated spillway (crest elevation 2597.0) and from the modified diversion tunnel. Continue releases to the powerhouse for power generation for as long as possible (minimum operating elevation 2604.5), although plant shutdown on November 1 has been assumed. Limit initial reservoir drawdown to the maximum historical drawdown rate of about 2 feet per day. KRRC expects no significant sediment release for this upper range of reservoir levels and rate of drawdown.
2. Once drawdown has begun, remove spillway features using a barge mounted crane (see Section 5.3).
3. Starting January 1, 2021, make controlled releases from the modified diversion tunnel. Limit reservoir drawdown to a maximum of 5 feet per day to maintain reservoir rim slope stability and to control drawdown releases from both reservoirs upstream of Iron Gate. Due to the limited capacity of the diversion tunnel modified to reuse the three 6-foot openings in the intake structure, the reservoir drawdown rate and reservoir elevation will be highly dependent on reservoir inflows, with full reservoir drawdown by March not possible for about 50 percent of historical flows between 1961 and 2008 (USBR 2012c).
4. To fully draw down the reservoir, notch the concrete dam with a series of 13 notches: an initial 24.5-foot notch, followed by 11 18–foot-deep notches (measured from lowered dam crest to notch elevation; sequentially lowering the notches in 6-foot increments), then a final notch of 22 feet down to the channel bed elevation. Proceed with lowering the dam crest in 6-foot lifts as the notching progresses. Bottom width of all notches is 8 feet. Locate the notches at the left abutment of the dam. Control instantaneous reservoir releases and drawdown rates during notching by excavating the notches in stages or by controlling the diversion tunnel discharge. The elevation of the first notch would be 2,572.5 feet. The elevation of the final notch would be at elevation 2484.5 (regardless of water year) with the lowered dam crest at elevation 2518.5. Target drawing down the reservoir to RWS elevation 2486.5 (reservoir level maintained by Copco No. 2 Dam) by March 15, 2021, to minimize downstream impacts due to sediment release. Retain Copco No. 2 Reservoir to permit continued power generation at the Copco No. 2 powerhouse.
5. Maximum additional discharge downstream of the dam due to drawdown activities is about 4,000 cfs immediately following opening of a notch (assuming an 18-foot-deep notch with a bottom width of 20 feet) with the additional flow due to drawdown decreasing as the reservoir level drops in

the notch. For reference, the 10-year, 20-year, 50-year, and 100-year flow events downstream of Copco No. 1 are about 11,300 cfs, 13,500 cfs, 16,560 cfs, and 18,950 cfs, respectively.

6. Successful reservoir drawdown using Option 1 is highly dependent on successful dam demolition and notching during January and February. There are several risks associated with Option 1 that should be considered:
   a) Safety of construction workers operating on very narrow, steep access roads during winter months with wet and icy conditions.
   b) Weather impacts to production that are likely to be worse in the wettest years when reservoir drawdown will rely on notching more than in dry years.
   c) During wet years, complete drawdown may not occur until notching is complete. If notching is delayed, drawdown will be delayed by an equal amount. [16]

Option 2 (proposed action) – Diversion Tunnel Modified to Increase Capacity

The numbered list below summarizes the drawdown procedure at Copco Lake for Option 2:

1. Begin reservoir drawdown from normal operating elevation 2609.5 feet on November 1 in the year prior to the main drawdown by making controlled releases through the gated spillway (crest elevation 2597.0) and from the modified diversion tunnel. Continue releases to the powerhouse for power generation for as long as possible (minimum operating elevation 2604.5), although plant shutdown on November 1 has been assumed. Limit initial reservoir drawdown to the maximum historical drawdown rate of about 2 feet per day. No significant sediment release is expected for this upper range of reservoir levels and rate of drawdown.
2. Once drawdown has begun, remove spillway features using a barge mounted crane (see Section 5.3).
3. Starting January 15, 2021, make controlled releases from the new gate structure. With Option 2, drawdown releases are delayed two weeks after drawdown releases begin at Iron Gate Dam (January 1) to create additional reservoir capacity at Iron Gate, [17] which will better handle drawdown releases from Copco Lake and help attenuate outflows from Iron Gate Reservoir due to storms. Limit reservoir drawdown to 5 feet per day to maintain reservoir rim slope stability and control drawdown releases from both reservoirs upstream of Iron Gate Reservoir.
4. Maximum additional discharge downstream of the dam due to drawdown activities is about 6,000 cfs when the gate is opened on January 15. During other times the increase is generally 1,000 to 2,000 cfs. The total discharge capacity of the new gate structure with the reservoir at the spillway crest elevation 2597.0 feet is nearly 12,000 cfs. As water levels increase above the spillway crest, the gate will be closed down to limit the total discharge to 13,000 cfs to avoid high water levels that will impact power production at Copco No. 2 powerhouse.
5. For reference, the 10-year, 20-year, 50-year, and 100-year flow events downstream of Copco No. 1 are 11,300 cfs, 13,500 cfs, 16,560 cfs, and 18,950 cfs, respectively.

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16 For modeling, it was assumed a notch would be delayed if the water level was less than 1 foot below the lowered crest.

17 Without this delay, Iron Gate Reservoir would often remain full until Copco Lake is drawn down and outflows are decreasing because the increased Copco diversion tunnel capacity is similar to the Iron Gate diversion tunnel capacity.

Results

Figures 4.6-8 through 4.6-13 show the drawdown results for Copco No. 1 for both drawdown options.

In general, Option 1 with notching performs worse than Option 2 in terms of minimizing peak flows and drawdown duration, particularly in wet years. Therefore, KRRC proposes to proceed with Option 2 for Copco No. 1 drawdown, and the remainder of the results discussion will focus on Option 2.

During the representative dry years (1973 and 1979, see Figures 4.6-12 and 4.6-13), the reservoir easily draws down by the end of February, and does not refill after that point.

For Option 2 during the wetter years of 1966, 2006, 1986, and 1970 (see Figures 4.6-8 and 4.6-11), the reservoir completely draws down by the end of Febrary, but in some cases partially refills later in the year when storms occur. The majority of the accumulated sediment will mobilize during the initial drawdown, and subsequent reservoir filling and drawdown is expected to cause only moderate increases in high suspended sediment (relative to background) (USBR 2012c).

For Option 2 during the wetter years of 1966, 2006, 1986, and 1970 (see Figures 4.6-8 and 4.6-11), flows are higher than what will be expected via the spillway alone (i.e., without drawdown), but the increases are limited to those periods when flows are below the 10-year flood elevation. As discussed above (see Figure 4.6-1), the peak inflows used in the model are occasionally greater than the measured USGS peak flow for that year. In those cases, the peak outflow from the reservoir during drawdown may exceed the peak flow recorded by USGS for that year. This is due to the use of larger inflows rather than due to an increase in flow in the river due to drawdown.

KRRC does not anticipate that sediment concentrations resulting from the proposed drawdown procedure and associated hydraulics will differ from those previously estimated (USBR 2012c).

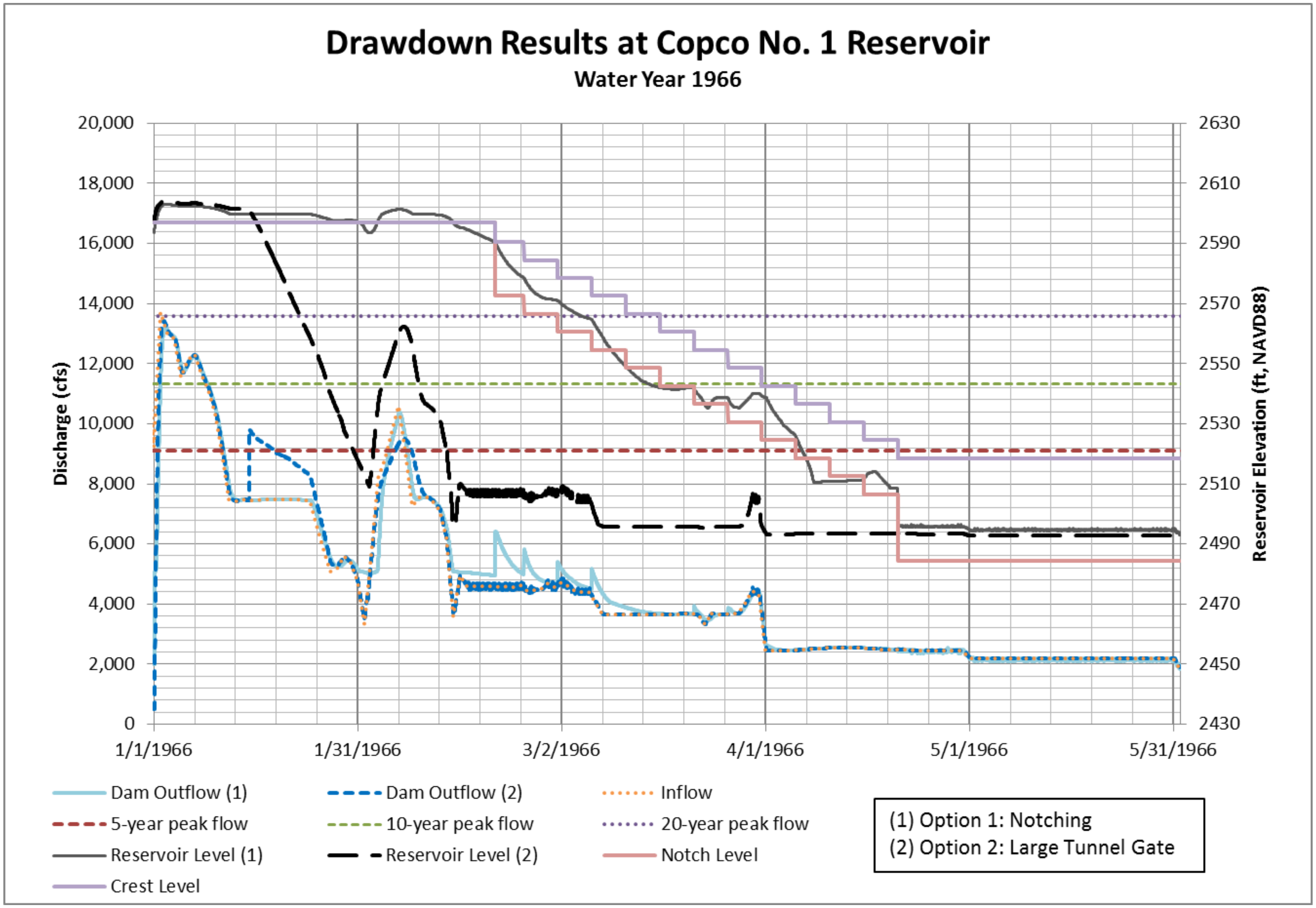


Figure 4.6-8 Copco No. 1 Reservoir Drawdown, Water Year 1966 (Wettest Year)

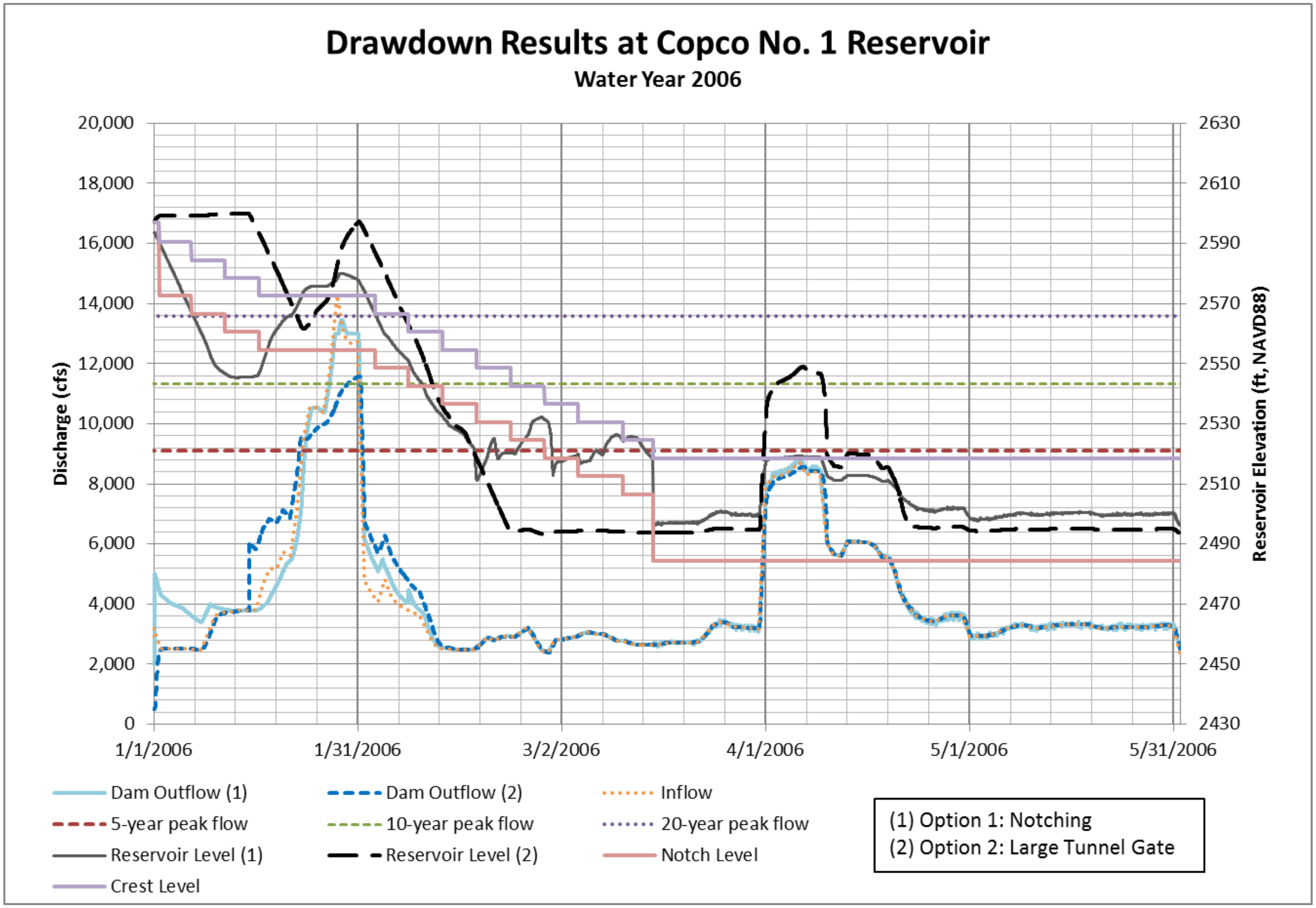


Figure 4.6-9 Copco No. 1 Reservoir Drawdown, Water Year 2006 (Wet Year)

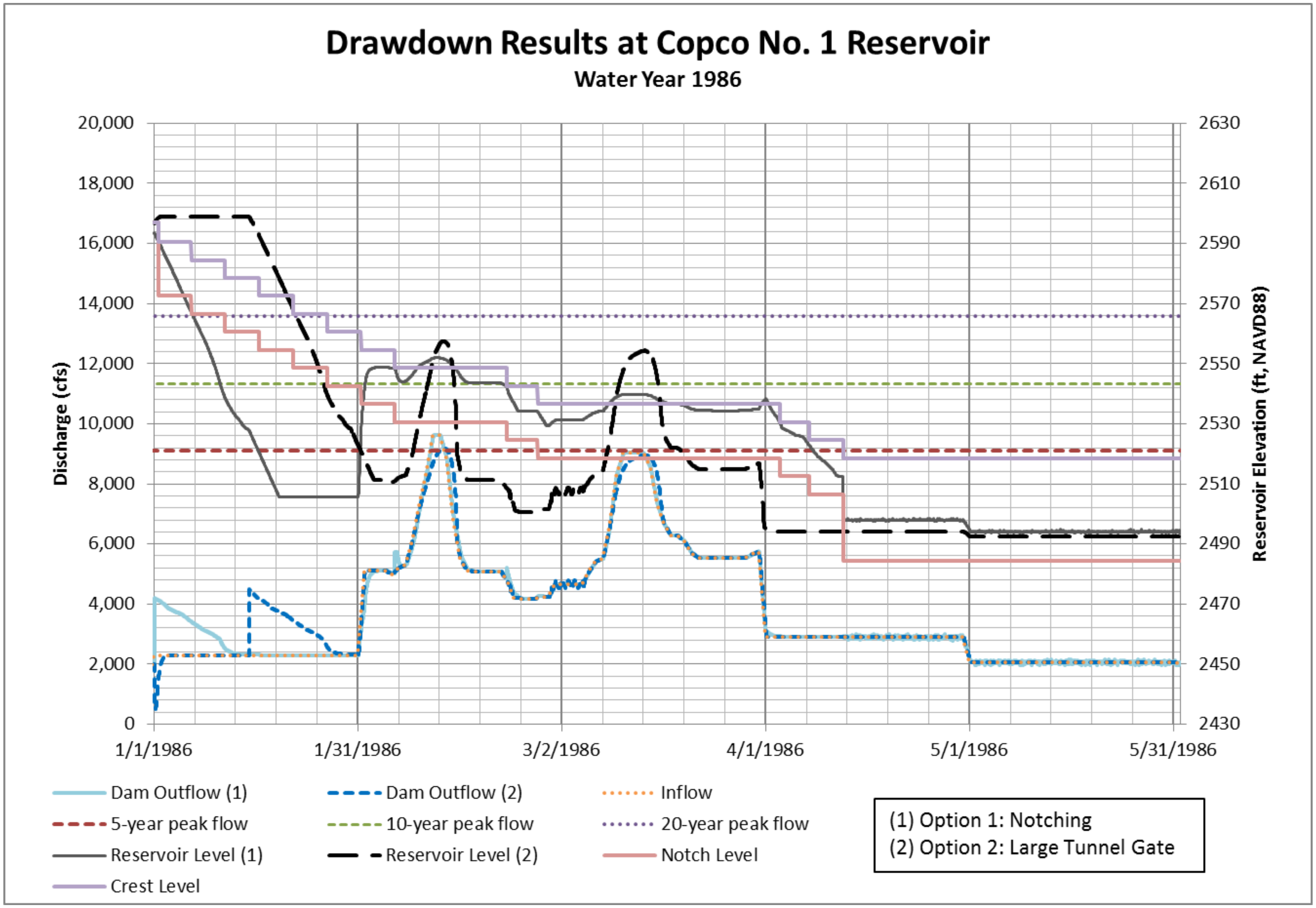


Figure 4.6-10 Copco No. 1 Reservoir Drawdown, Water Year 1986 (Wet Year)

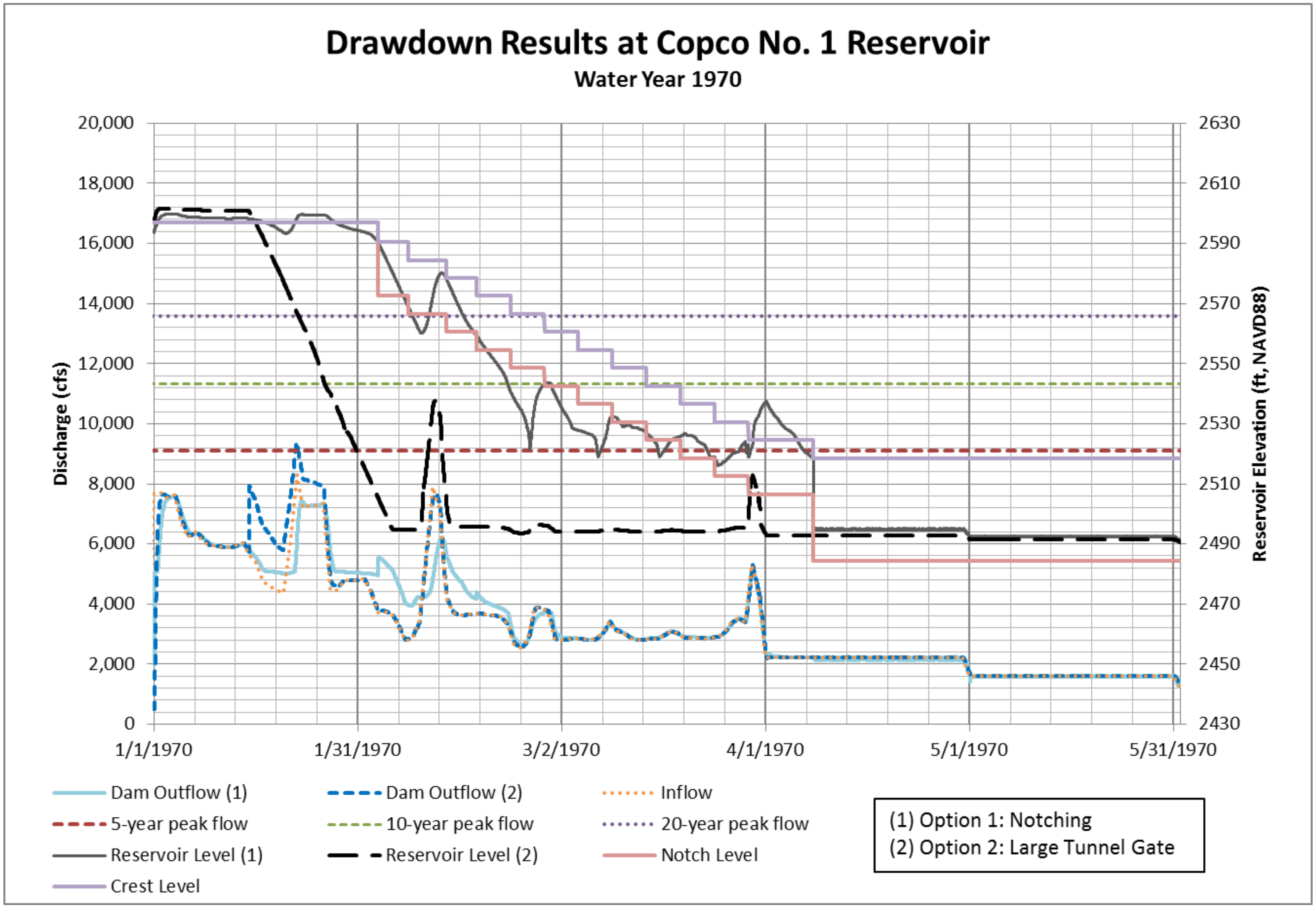


Figure 4.6-11 Copco No. 1 Reservoir Drawdown, Water Year 1970 (Above Normal Year)

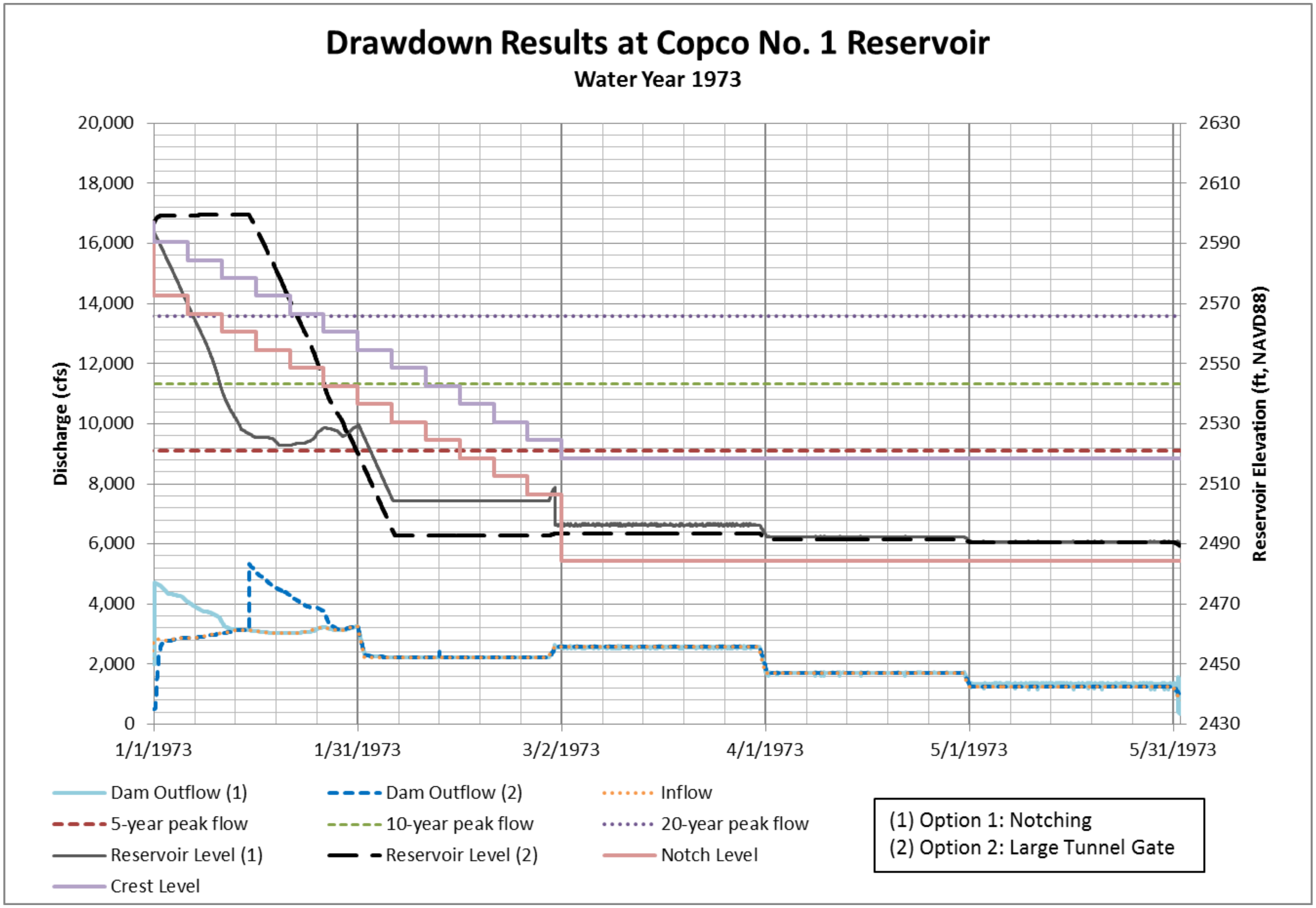


Figure 4.6-12 Copco No. 1 Reservoir Drawdown, Water Year 1973 (Median Year)

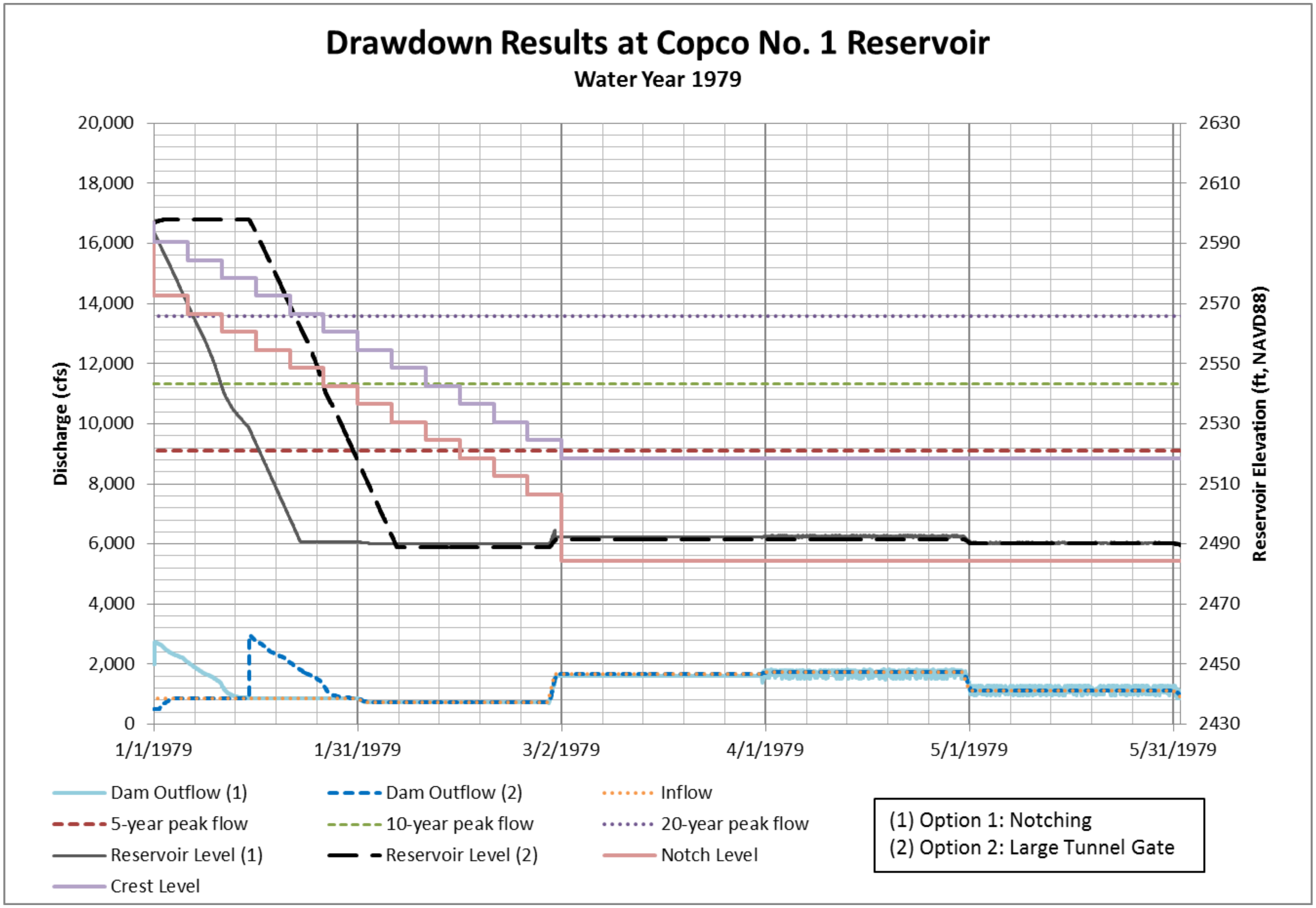


Figure 4.6-13 Copco No. 1 Reservoir Drawdown, Water Year 1979 (Dry Year)

4.6.4 Iron Gate Reservoir

Drawdown Procedure

Begin reservoir drawdown from normal operating elevation 2331.3 feet on January 1, 2021 by making controlled releases through the modified diversion tunnel. Limit reservoir drawdown to a maximum of 5 feet per day to maintain reservoir rim slope stability. Maximum additional discharge downstream of the dam due to drawdown activities is about 4,000 cfs. The total discharge capacity of the modified diversion tunnel with the reservoir at spillway crest elevation 2331.3 is about 10,000 cfs. For reference, the 5-year flow event downstream of Iron Gate Dam is 10,900 cfs.

Results

Due to their close proximity, KRRC modeled the Iron Gate Reservoir drawdown in conjunction with the Copco Lake drawdown. Figures 4.6-14 through 4.6-19 show results from the HEC-RAS analysis for the six representative years. There are different results at Iron Gate Reservoir depending on which drawdown option at Copco No. 1 Dam is incorporated. References to Options 1 and 2 in the plots in this section are the resulting effects at Iron Gate based on either Option 1 or 2 being implemented at Copco No. 1 Dam. Since KRRC proposes Option 2 for the Project, the remaining results discuss only Option 2.

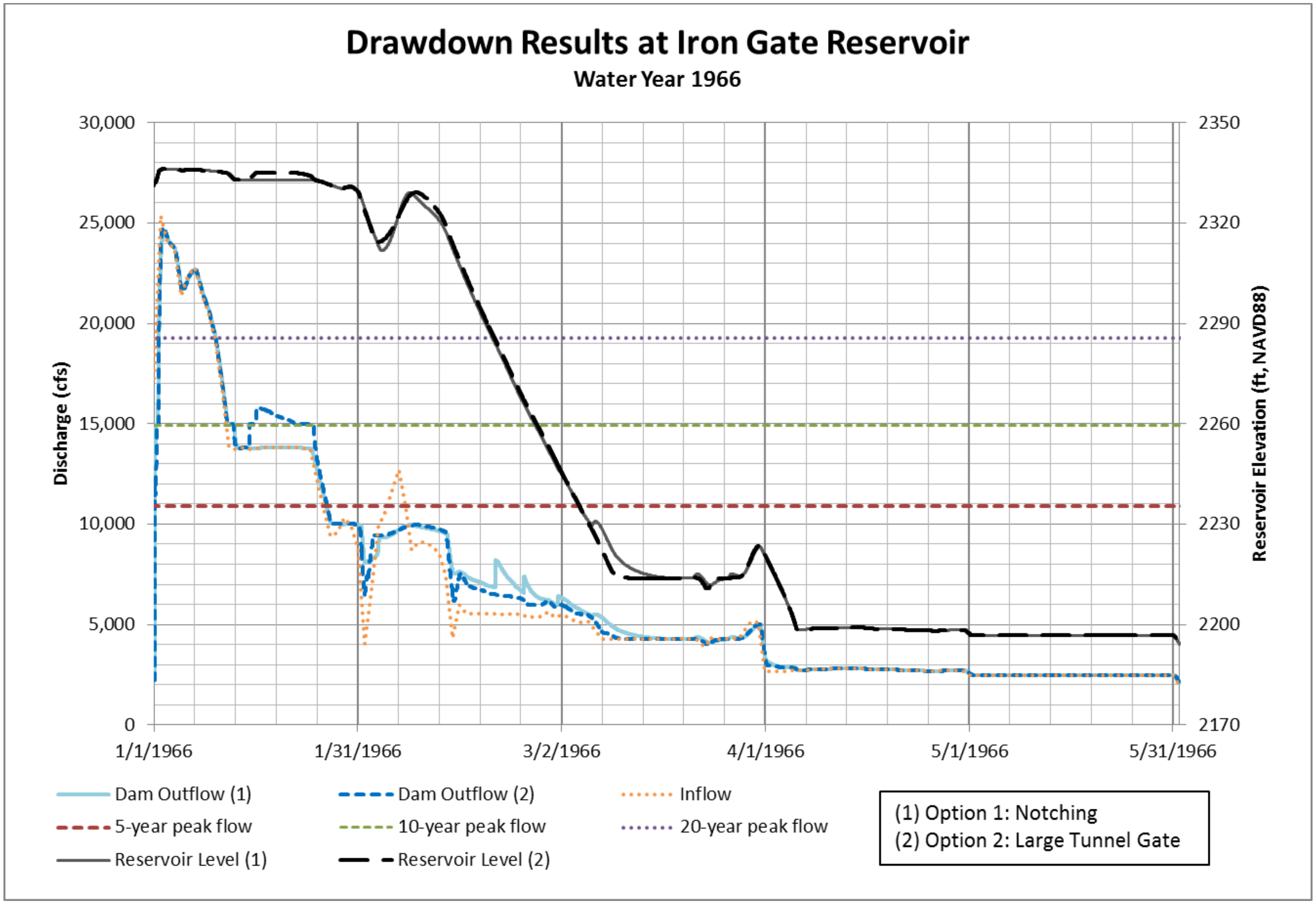
During the representative drier years (1973 and 1979, see Figures 4.6-18 and 4.6-19), the reservoir easily draws down by early February, and it did not refill after that point.

During the wetter years of 2006 and 1986 (see Figures 4.6-15 and 4.6-16), the reservoir draws down by the end of February, but partially refills later in the year when storms occurred. The majority of the accumulated sediment will mobilize during the initial drawdown, and subsequent reservoir filling and drawdown is expected to cause only moderate increases in high suspended sediment (relative to background) (USBR 2012c).

For the wettest year (1966, see Figure 4.6-14) the reservoir draws down by early March, but the probability of a storm of this magnitude occurring in the drawdown year is low.

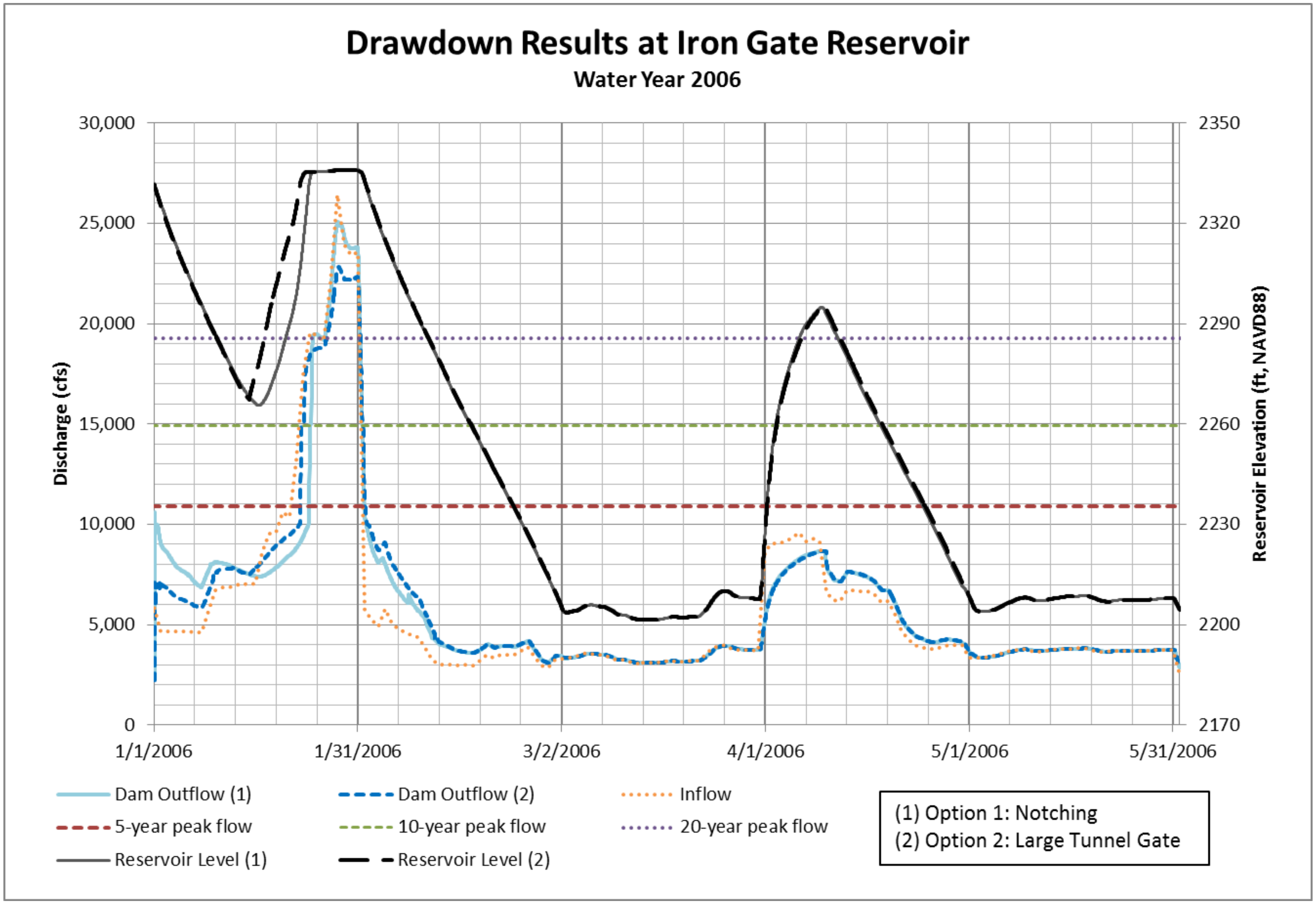
During the wetter years of 1966, 2006, 1986, and 1970 (see Figures 4.6-14 and 4.6-17), flows are higher than what will be expected via the spillway alone (i.e., without drawdown), but the increases are mainly limited to those periods when flows are below the 10-year flood elevation. As discussed above (see Figure 4.6-1), the peak inflows used in the model are occasionally greater than the measured USGS peak flow for that year. In those cases, the peak outflow from the reservoir during drawdown may exceed the peak flow recorded by USGS for that year. This is due to the use of larger inflows rather than due to an increase in flow in the river due to drawdown.

KRRC does not anticipate that sediment concentrations resulting from the proposed drawdown procedure and associated hydraulics will differ from those previously estimated (USBR 2012c).



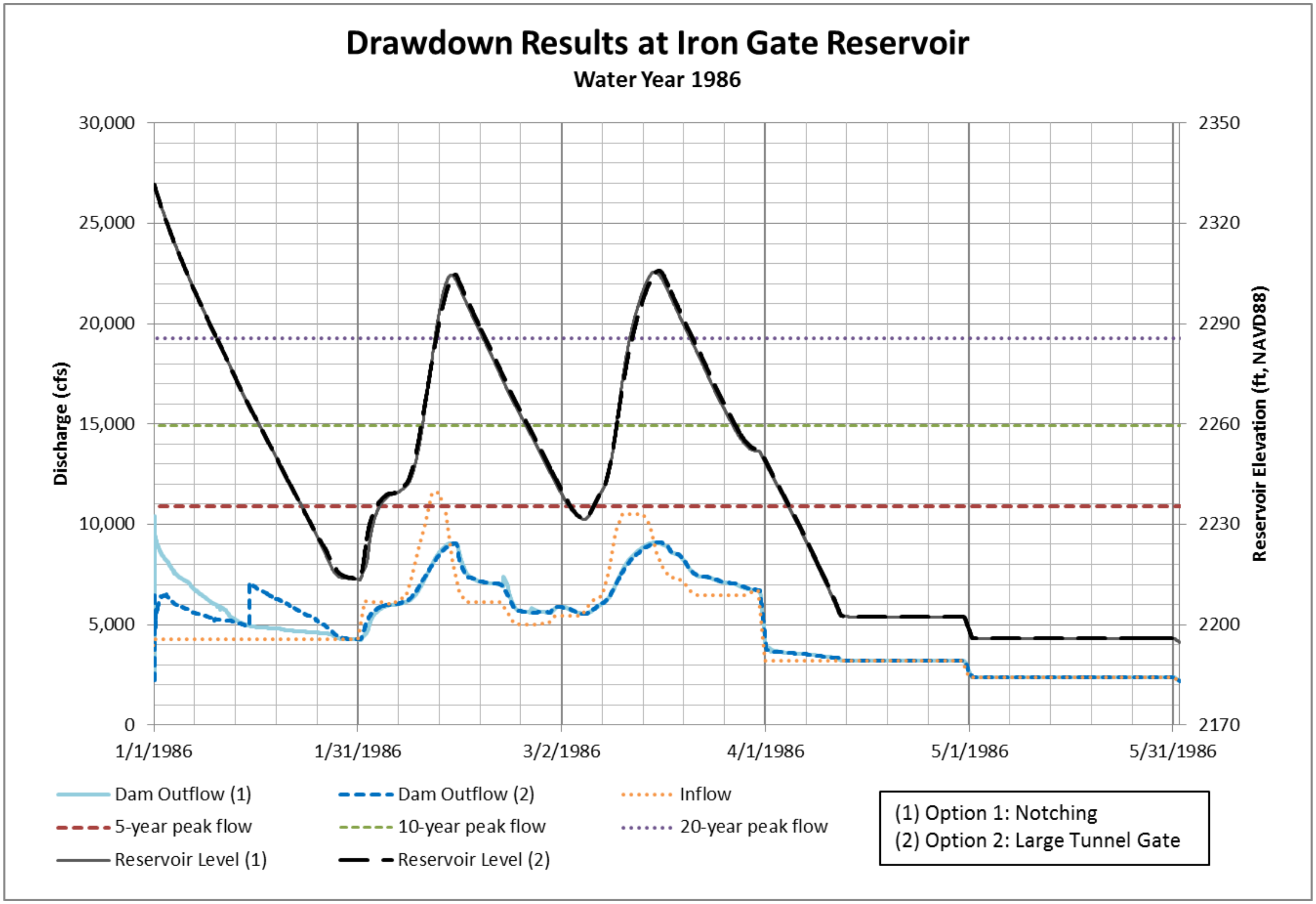
References to Options 1 and 2 in the plots are the resulting effects at Iron Gate based on either Option 1 or 2 being implemented at Copco No. 1 Dam.

Figure 4.6-14 Iron Gate Reservoir Drawdown, Water Year 1966 (Wettest Year)



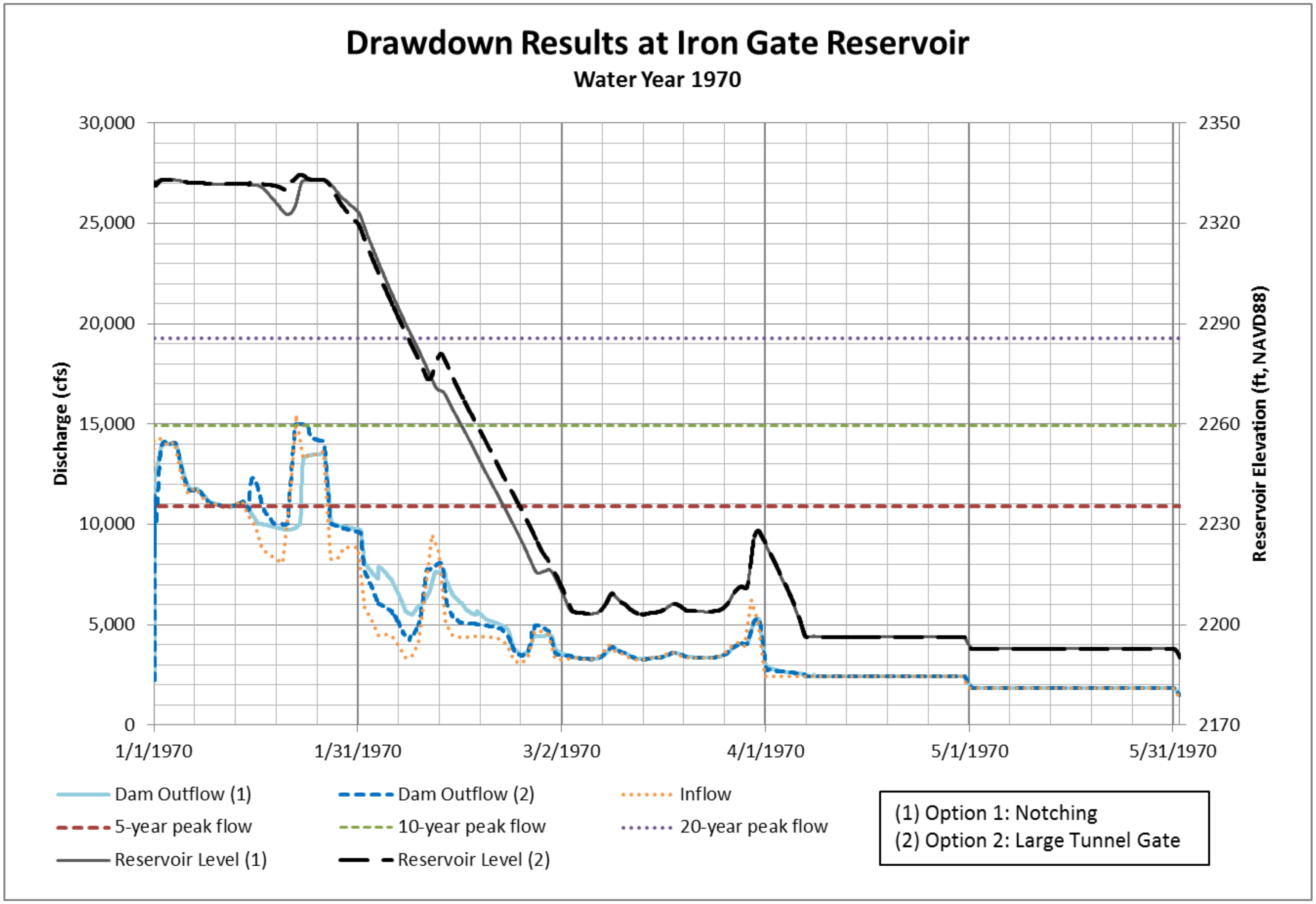
References to Options 1 and 2 in the plots are the resulting effects at Iron Gate based on either Option 1 or 2 being implemented at Copco No. 1 Dam.

Figure 4.6-15 Iron Gate Reservoir Drawdown, Water Year 2006 (Wet Year)



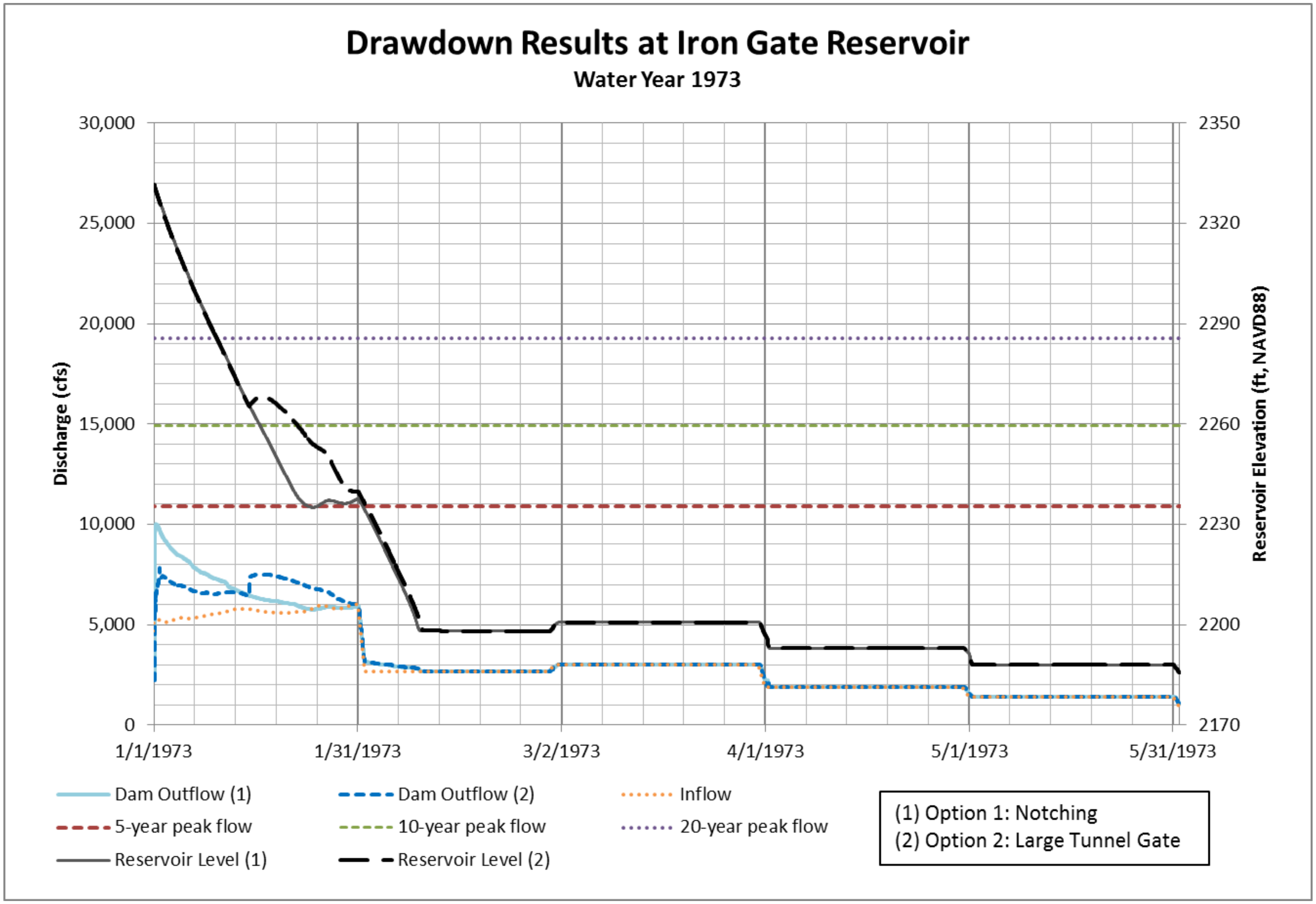
References to Options 1 and 2 in the plots are the resulting effects at Iron Gate based on either Option 1 or 2 being implemented at Copco No. 1 Dam.

Figure 4.6-16 Iron Gate Reservoir Drawdown, Water Year 1986 (Wet Year)



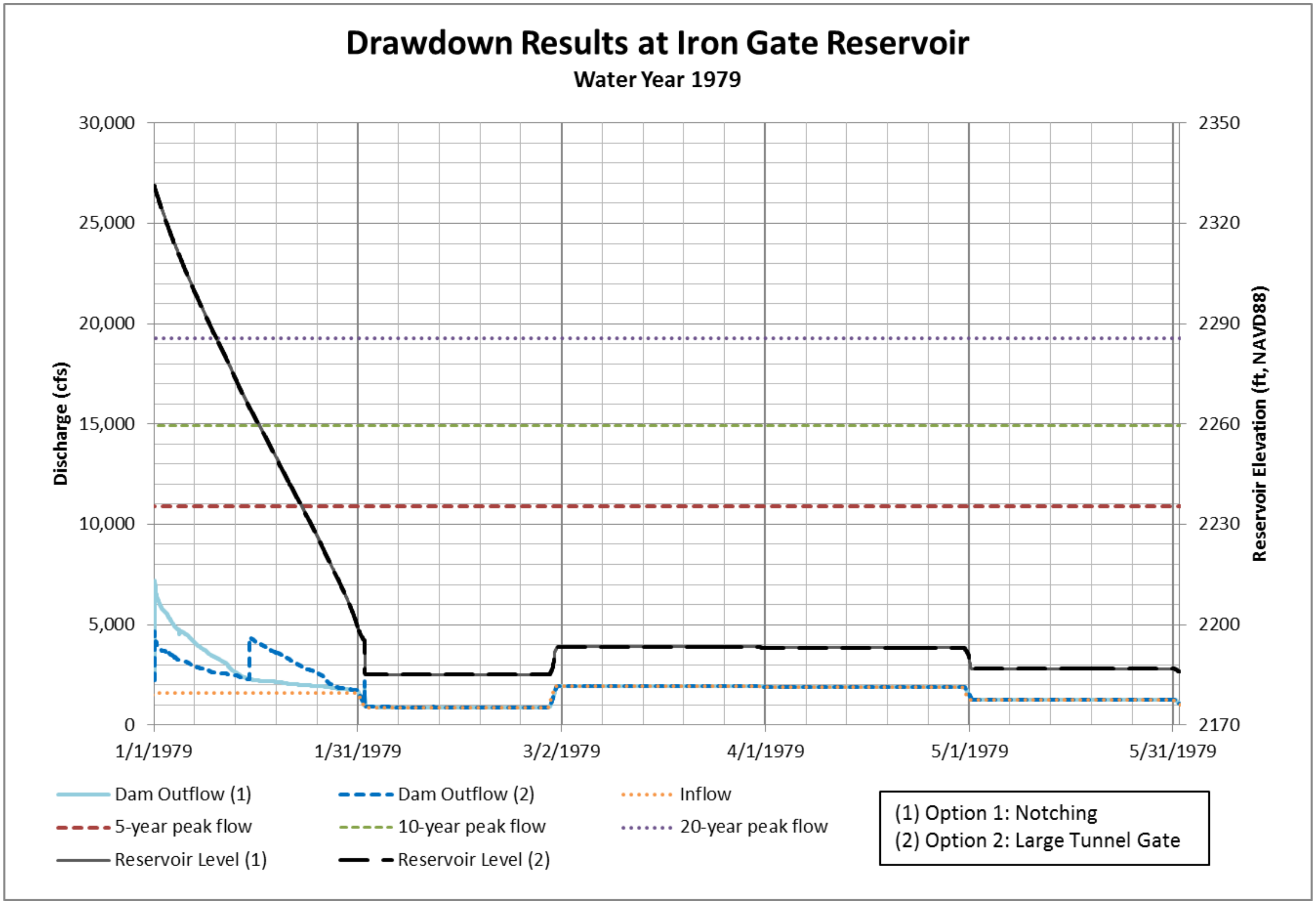
References to Options 1 and 2 in the plots are the resulting effects at Iron Gate based on either Option 1 or 2 being implemented at Copco No. 1 Dam.

Figure 4.6-17 Iron Gate Reservoir Drawdown, Water Year 1970 (Above Normal Year)



References to Options 1 and 2 in the plots are the resulting effects at Iron Gate based on either Option 1 or 2 being implemented at Copco No. 1 Dam.

Figure 4.6-18 Iron Gate Reservoir Drawdown, Water Year 1973 (Median Year)



References to Options 1 and 2 in the plots are the resulting effects at Iron Gate based on either Option 1 or 2 being implemented at Copco No. 1 Dam.

Figure 4.6-19 Iron Gate Reservoir Drawdown, Water Year 1979 (Dry Year)

4.6.5 Downstream of Iron Gate

KRRC analyzed the response of the river flows at Seiad Valley, Orleans, and Klamath USGS gauge station locations to the flows discharged during the reservoir drawdown. The analysis shows that the drawdown has negligible effect on peak downstream flows during wet and above normal years for several reasons:

- The proportion of flow contributed by the Klamath River at Iron Gate is smaller than the flows contributed by tributaries downstream.
- The drawdown distributes the flow over a longer time span than a typical storm event and provides attenuation in the reservoir once drawdown is underway.
- The capacity of the Iron Gate spillway, which is activated during storm events in the gauge record, is much higher (30,000 cfs and greater) than the capacity of the diversion tunnel being used to control drawdown (10,000 cfs maximum).

For normal years (based on flow rate), the analysis showed that the drawdown can increase flows downstream, especially when the recorded peak flow at Iron Gate is less than the discharge capacity available during drawdown. The increase in flow in normal water years is small compared to the flow magnitude and does not cause flows to exceed the 5-year return interval flow at Iron Gate.

KRRC completed the analysis using model output from the drawdown model described in Section 4.6.1 along with the recorded gauge data for the Iron Gate, Seiad Valley, Orleans, and Klamath USGS gauges and then comparing the hydrographs for the following water years:

- 1964 (normal)[18]
- 1965 (wettest year on record)[19]
- 1970 (above normal)
- 1974 (above normal)
- 1980 (normal)
- 1985 (normal)
- 1986 (wet)
- 1997 (wet)
- 2000 (normal)
- 2006 (wet)

The determination of wet, above normal, and normal water years was based on ranking the annual maximum 15-day volume of flow at the Keno gauge during the January to May months for the years 1961 to 2009 (similar to the rating described in Section 4.6.1).

18 Water Year 1964 is model year 1965 due to the data shift described in Section 4.6.1.
19 Water Year 1965 is model year 1966 due to the data shift described in Section 4.6.1.

Analysis Timing

During a storm event, the worst flooding occurs during the peak flow, the highest flow in the river channel. To understand the full effects the drawdown could have on downstream flows and floods, KRRC analyzed the effects of drawdown during peak flows of the flood events. For the analysis, KRRC aligned the timing of the drawdown peak discharge from the model with the peak recorded at the Iron Gate gauge in most of the analysis years. KRRC completed the alignment by altering the dates of the drawdown model output until the drawdown peak flow occurred on the same day as the recorded peak flow. KRRC used this approach because future flood events could occur with timing different than in the historical gauge record, and the worst-case flooding effects will occur with coincident peak flows. It is important to capture the effects that peak drawdown could have on the peak river flow when referring to flooding effects.

In most of the analysis years, the annual peak flow recorded at Iron Gate occurred concurrently with the annual peaks recorded at Seiad Valley, Orleans, and Klamath USGS gauges. In two of the normal years, 1985 and 2000, the annual peak at Iron Gate occurred during a separate and unrelated event from the peaks recorded at Seiad Valley and downstream. In these 2 years, the recorded annual peaks at Iron Gate occurred months later. Therefore, KRRC aligned the timing of the drawdown peak discharge from the model with the peak recorded at the Seiad Valley gauge for these 2 years.

Analysis Setup

The analysis involved comparing, on a daily basis, the recorded hydrograph for each year and each location to a synthetic hydrograph created using the drawdown model output. KRRC downloaded the daily flows and the annual peak flows for each gauge location from the USGS National Water Information System for the analysis years. To generate more representative hydrographs, KRRC substituted the recorded annual peak for the daily flow value on the day that the peak occurred. This generated the recorded hydrograph.

KRRC created the synthetic hydrographs as follows. For the Iron Gate USGS gauge location, KRRC used the drawdown model output to represent the flows during drawdown. For Seiad Valley, Orleans, and Klamath USGS gauge locations, KRRC created the synthetic hydrographs by taking the gauge record of each location, subtracting the flow recorded at the Iron Gate gauge on that day, and adding the flow from the drawdown model for the same day (after the date shift described above). KRRC then plotted the recorded and synthetic hydrographs for each gauge together to show the effect of drawdown.

Results

Table 4.6-2 and Figures 4.6-20 to 4.6-29 provide the results of the analysis.

The water operations model prepared by USBR (2012) generates the input flows to the drawdown model, but these flows are not the same as the USGS record flows (refer to Figure 4.6-1). In a number of years, the operations model has higher peak flows than occurred in the record (analyzed water years 1965, 1986, 1997, 2000, and 2006). This is because of the way the operations model interprets the operations rules as well as that the upstream facilities may not have been operated according to the same rules during the record event. This difference has an effect on the results of the analysis in this section, and KRRC considered this when reviewing the results. As discussed below, the comparison between record flows downstream of Iron Gate and the modeled discharge during drawdown typically results in a decrease in flow; when increased peak flows are noted, they are mostly related to the difference between the record and modeled input flows at Keno Dam and not to drawdown.

The results of the analysis show that in wet and above normal years, drawdown typically decreases or does not change flows downstream of Iron Gate Dam. The largest percent increases occurred in 1997 and 2006 with flow increases at Iron Gate of 10% and 98%, respectively. Water year 1997 had 2% or less increases seen further downstream at Seiad Valley and Orleans, while 2006 had larger increases of 18% at Seiad Valley and 6% or less at Orleans and Klamath. For 1997, the increase at Iron Gate shifts the return interval from a 20-year event up to between a 20- and 50-year event. For 2006, the increase at Iron Gate shifts the return interval from between a 10- and 20-year to a 50-year event, and the increase at Seiad Valley in 2006 shifts the return interval from about a 20-year event to between a 20- and 50-year event.

Rather than these increases being the result of the drawdown operation, they are an artifact of the operations model input flows. The operations model shows higher flows in 1997 and 2006 than in the record (Figure 4.6-1) with an increase at Keno of 32% and 80%, respectively[20]. This means that the increase in flows shown in this analysis is related to the larger input flows from the operations model upstream, not from the effect of drawdown releases.

Even with the largest increases in flow at Iron Gate of 26% in 1964 and 40% in 2000, the drawdown releases remain below a 5-year event, well within the river channel capacity. Water year 2000 is also affected by the increase in inflows from the operations model as compared to the record, a 74% increase in 2000 at Keno. [21]

In all cases, the percent change in flows seen at Iron Gate decreases in the downstream direction. At Orleans, the largest change was a 7% increase in 2000 to a less than 2-year event, and at Klamath the largest change was a 4% increase in 2006 to an event having between a 10- and 20-year return period.

[20] Keno 1997 recorded peak flow is 9,200 cfs, but the operations model has a peak of 12,188 cfs. Keno 2006 recorded peak flow is 7,930 cfs, while the operations model has a peak of 14,307 cfs.

[21] Keno 2000 recorded peak flow is 4,200 cfs, while the operations model has a peak of 7,230 cfs.

Table 4.6-2 Comparison of Flows Downstream of Iron Gate Dam with and without Drawdown

Water Year	Water Year Type	Iron Gate Peak Flow					Seiad Valley Peak Flow					Orleans Peak Flow					Klamath Peak Flow				
		Record (cfs)	With Drawdown (cfs)	% Increase ♦	Record Return Interval*	With Drawdown Return Interval*	Record (cfs)	With Drawdown (cfs)	% Increase ♦	Record Return Interval*	With Drawdown Return Interval*	Record (cfs)	With Drawdown (cfs)	% Increase ♦	Record Return Interval*	With Drawdown Return Interval*	Record (cfs)	With Drawdown (cfs)	% Increase ♦	Record Return Interval*	With Drawdown Return Interval*
1964	Normal	4,850	6,121	26%	2-yr	2-yr	20,100	21,371	6%	3-yr	3-yr	59,900	61,171	2%	2-yr	2-yr	162,000	163,271	1%	2-yr	2-yr
1965	Wettest on Record	29,400	24,236	-18%	80-yr	40-yr	165,000	165,598	0%	150-yr	151-yr	307,000	301,836	-2%	82-yr	77-yr	557,000	557,598	0%	89-yr	90-yr
1970	Above normal	14,900	15,000	1%	10-yr	10-yr	56,000	56,804	1%	11-yr	12-yr	175,000	175,804	0%	13-yr	13-yr	331,000	331,804	0%	12-yr	12-yr
1974	Above normal	18,700	15,000	-20%	18-yr	10-yr	126,000	122,300	-3%	72-yr	67-yr	279,000	275,300	-1%	57-yr	55-yr	529,000	525,300	-1%	70-yr	68-yr
1980	Normal	8,580	7,004	-18%	3-yr	2-yr	41,400	40,495	-2%	7-yr	6-yr	121,000	124,706	3%	6-yr	6-yr	234,000	233,095	0%	5-yr	5-yr
1985	Normal	7,970	7,703	-3%	3-yr	3-yr	13,800	15,783	14%	< 2-yr	< 2-yr	64,400	66,383	3%	2-yr	2-yr	149,000	150,983	1%	2-yr	2-yr
1986	Wet	13,900	9,341	-33%	8-yr	4-yr	43,100	41,210	-4%	7-yr	6-yr	278,000	276,110	-1%	57-yr	55-yr	459,000	457,110	0%	38-yr	37-yr
1997	Wet	20,500	22,526	10%	24-yr	32-yr	117,000	119,026	2%	60-yr	62-yr	258,000	260,026	1%	43-yr	45-yr	n/a †	n/a †	n/a †	n/a †	n/a †
2000	Normal	5,190	7,286	40%	2-yr	3-yr	11,300	14,486	28%	< 2-yr	< 2-yr	46,800	49,986	7%	2-yr	2-yr	141,000	139,783	-1%	2-yr	2-yr
2006	Wet	12,400	24,560	98%	6-yr	42-yr	74,000	86,966	18%	20-yr	29-yr	213,000	225,160	6%	23-yr	27-yr	342,000	354,966	4%	13-yr	15-yr

Notes:

♦ Flow increases in 1997, 2000, and 2006 are an artifact of the operations model input flows. The increase in flows is entirely or mostly related to larger input flows from the operations model upstream, rather than from the effect of drawdown releases.

* Return intervals are approximate whole years based on a regression of the data shown in Table 4.3-2.

† No daily data available at the Klamath gauge for Water Year 1997.

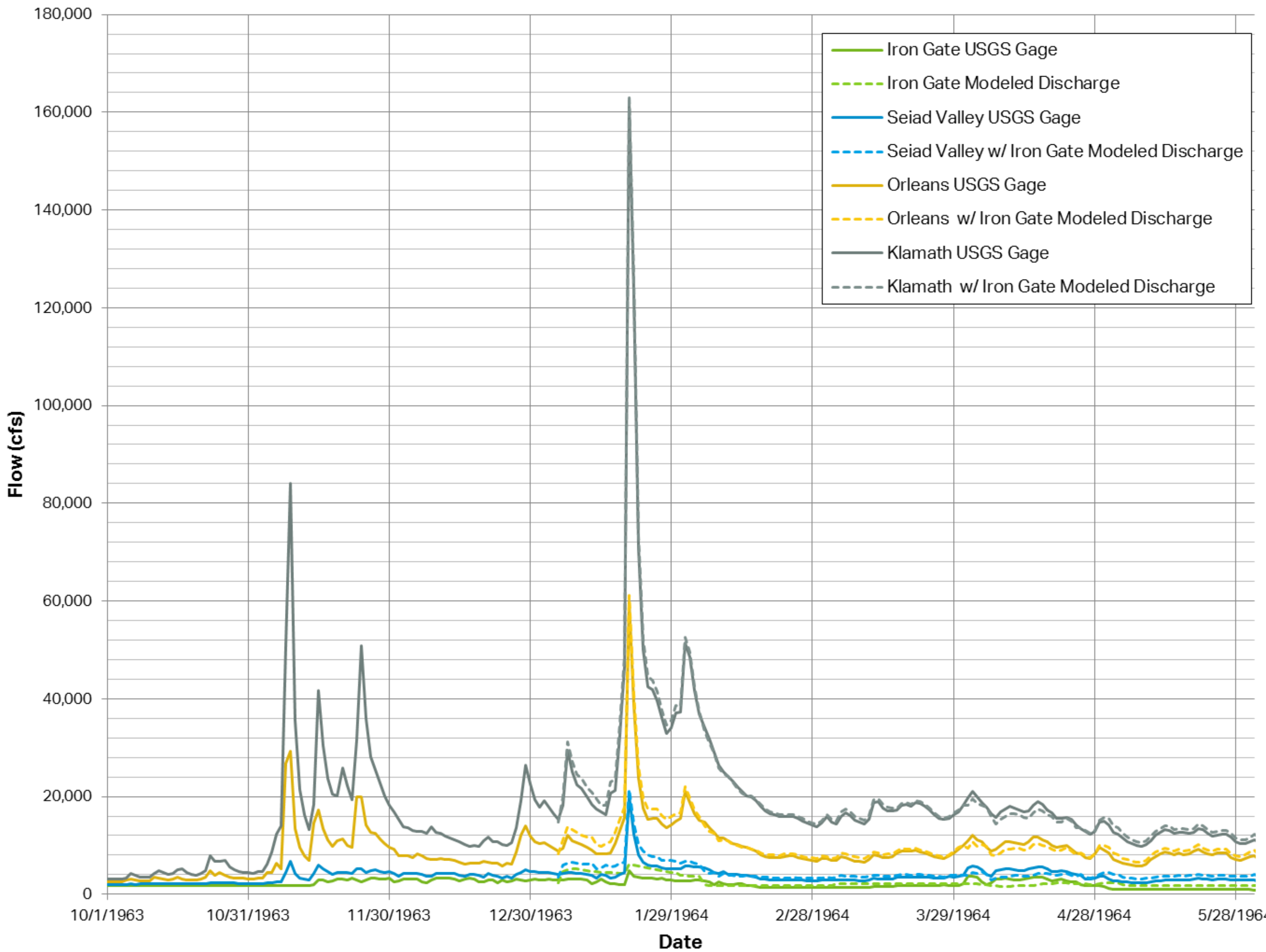


Figure 4.6-20 Comparison of Flows Downstream of Iron Gate Dam – Water Year 1964 (Model Year 1965)

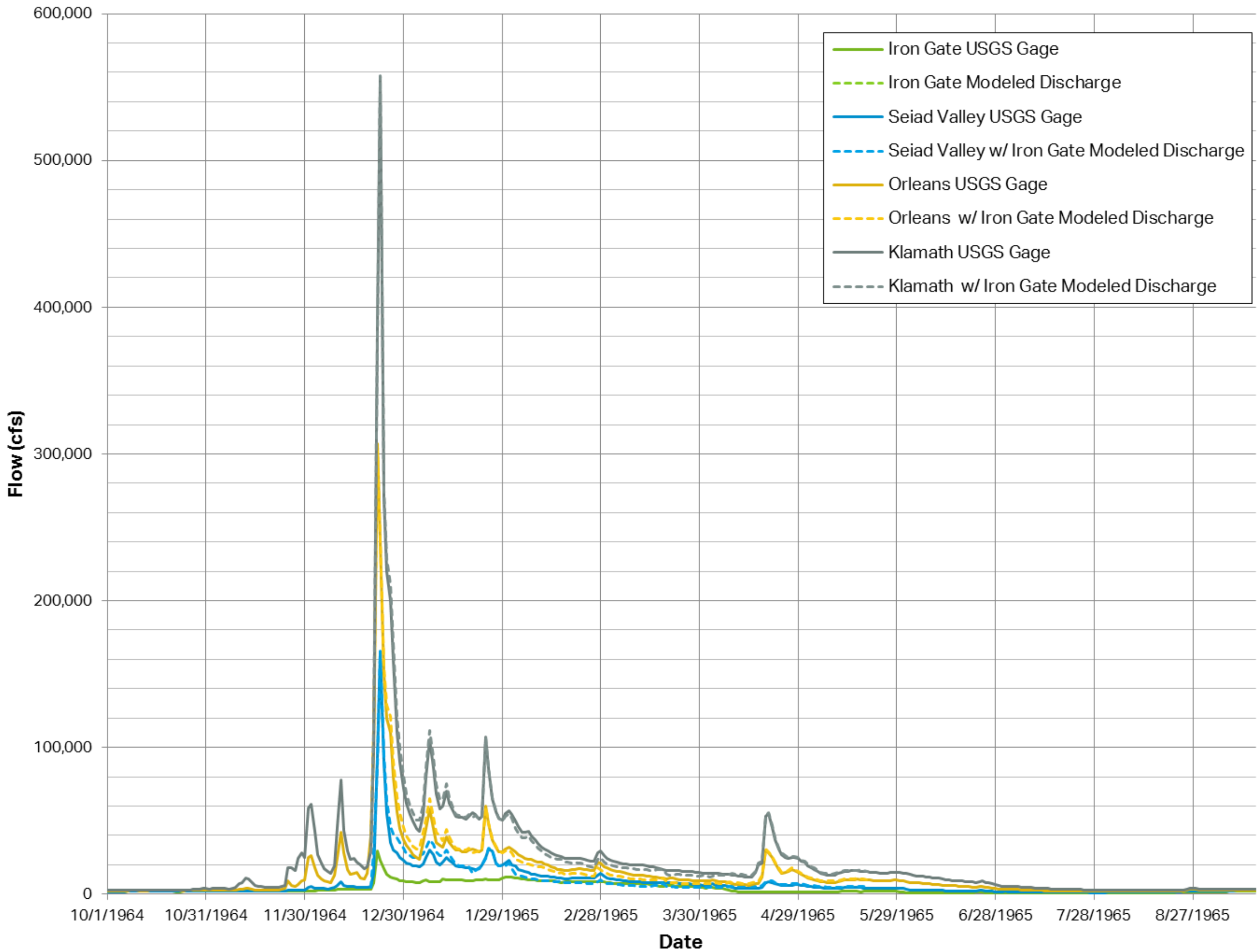


Figure 4.6-21 Comparison of Flows Downstream of Iron Gate Dam – Water Year 1965 (Model Year 1966)

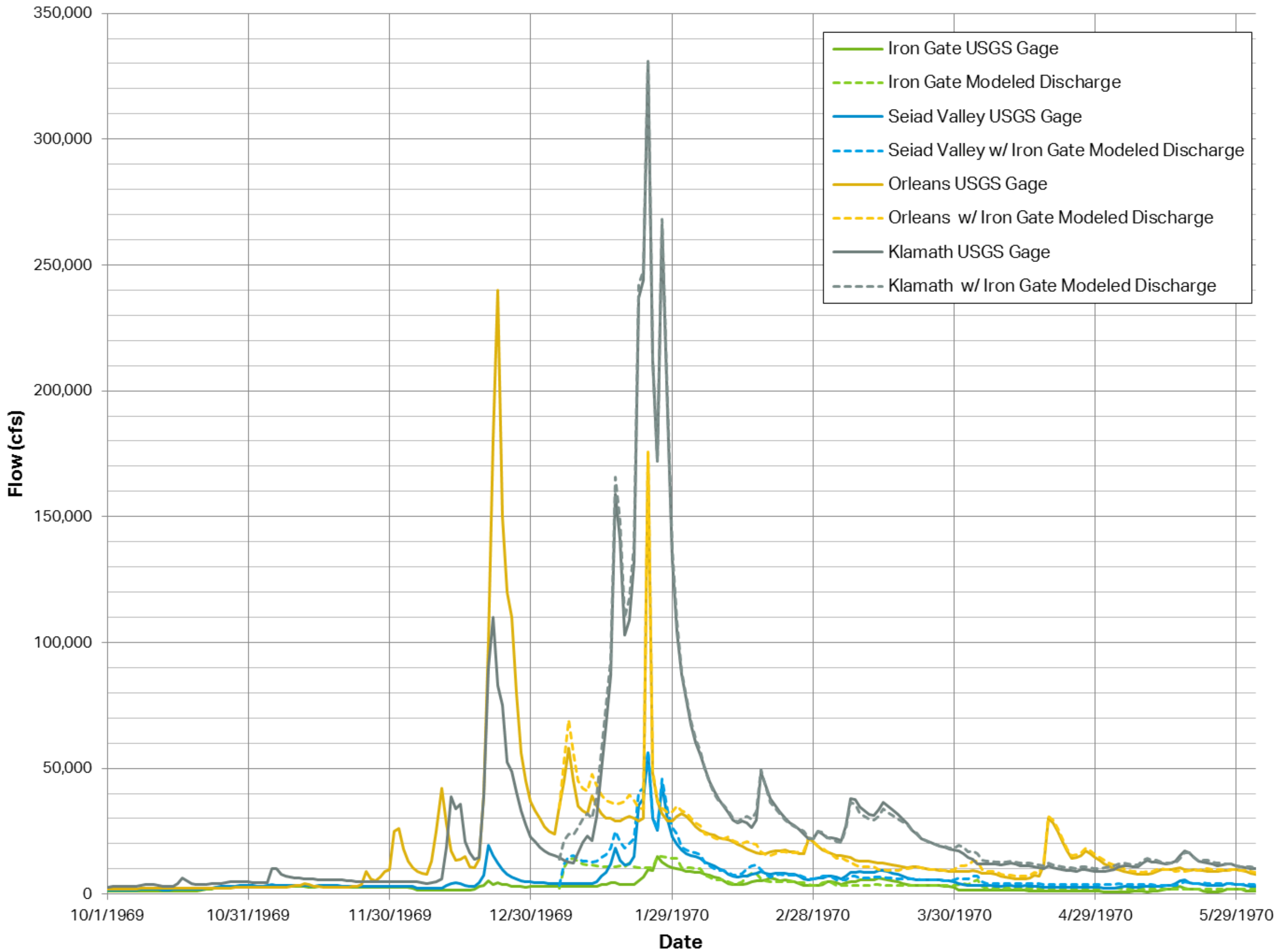


Figure 4.6-22 Comparison of Flows Downstream of Iron Gate Dam – Water Year 1970 (Model Year 1970)

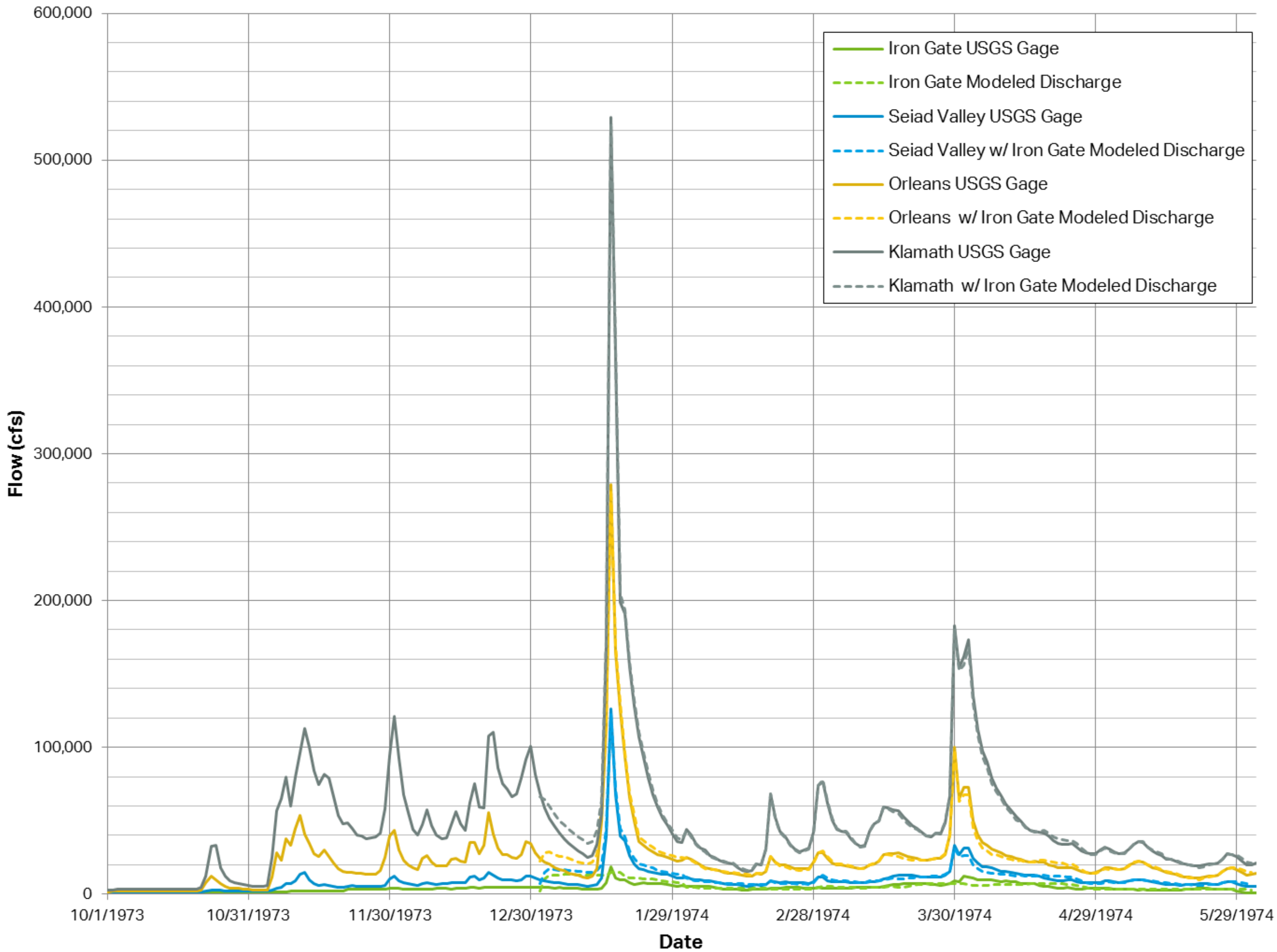


Figure 4.6-23 Comparison of Flows Downstream of Iron Gate Dam – Water Year 1974 (Model Year 1974)

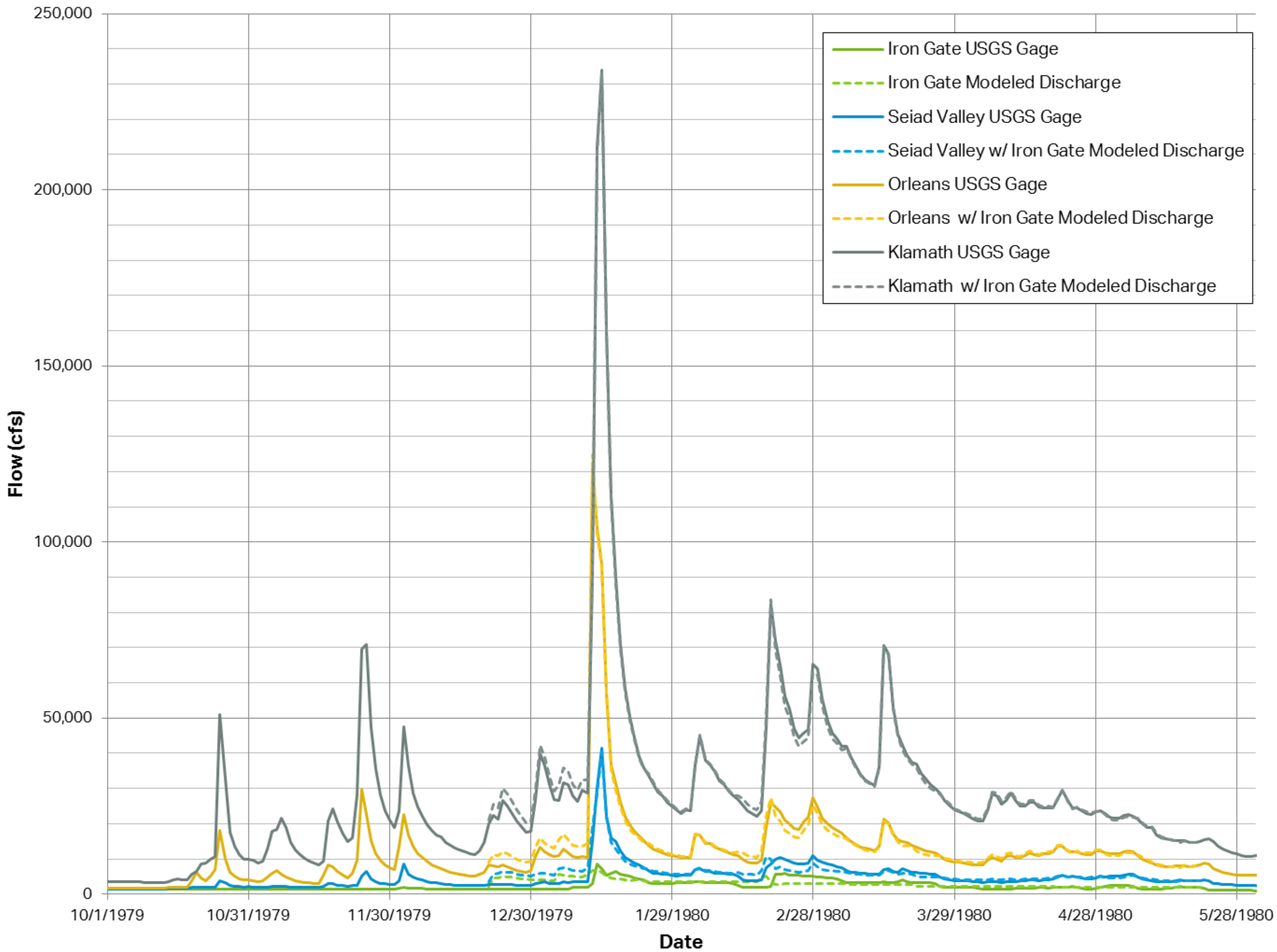


Figure 4.6-24 Comparison of Flows Downstream of Iron Gate Dam – Water Year 1980 (Model Year 1980)

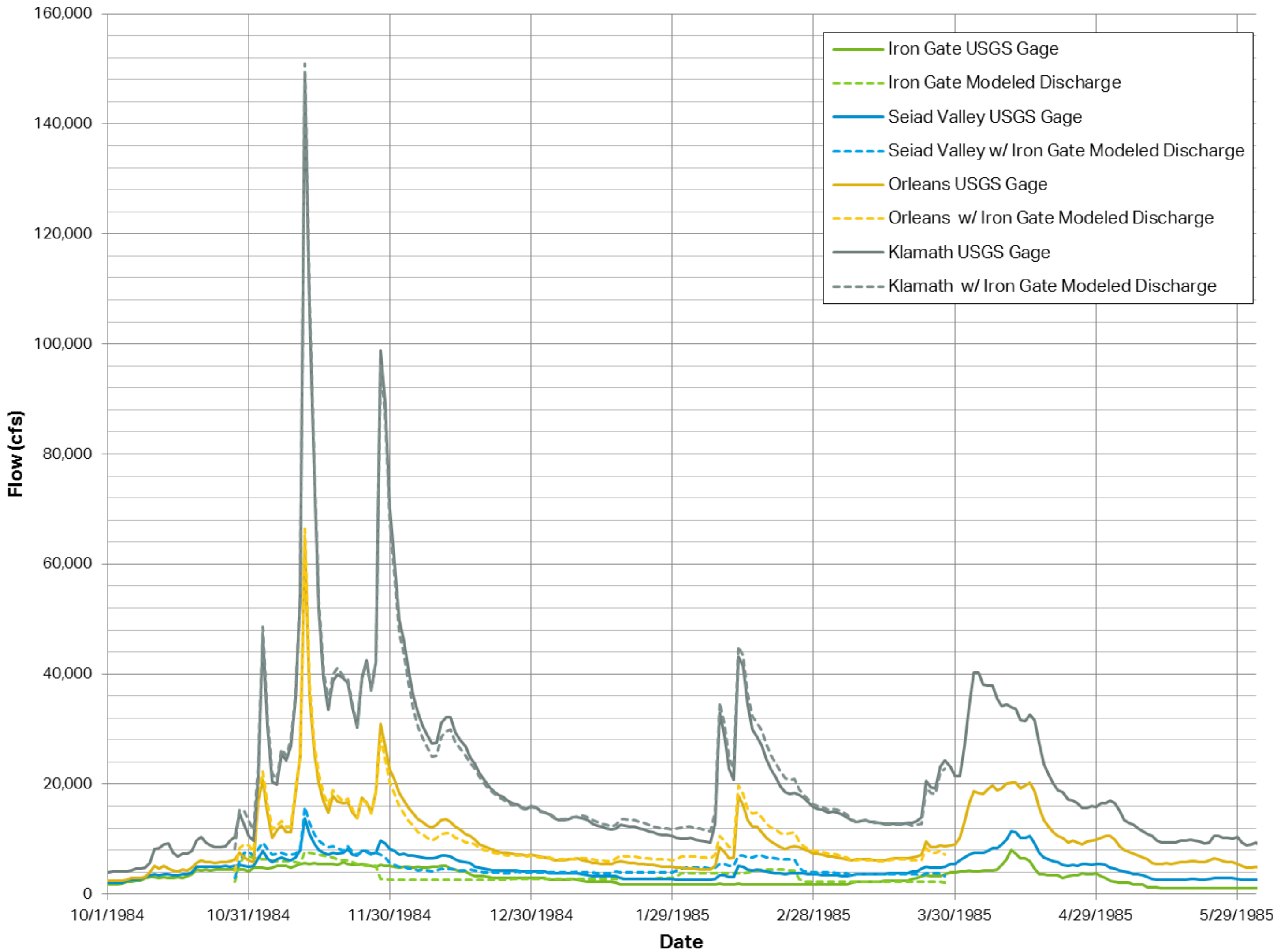


Figure 4.6-25 Comparison of Flows Downstream of Iron Gate Dam – Water Year 1985 (Model Year 1985)

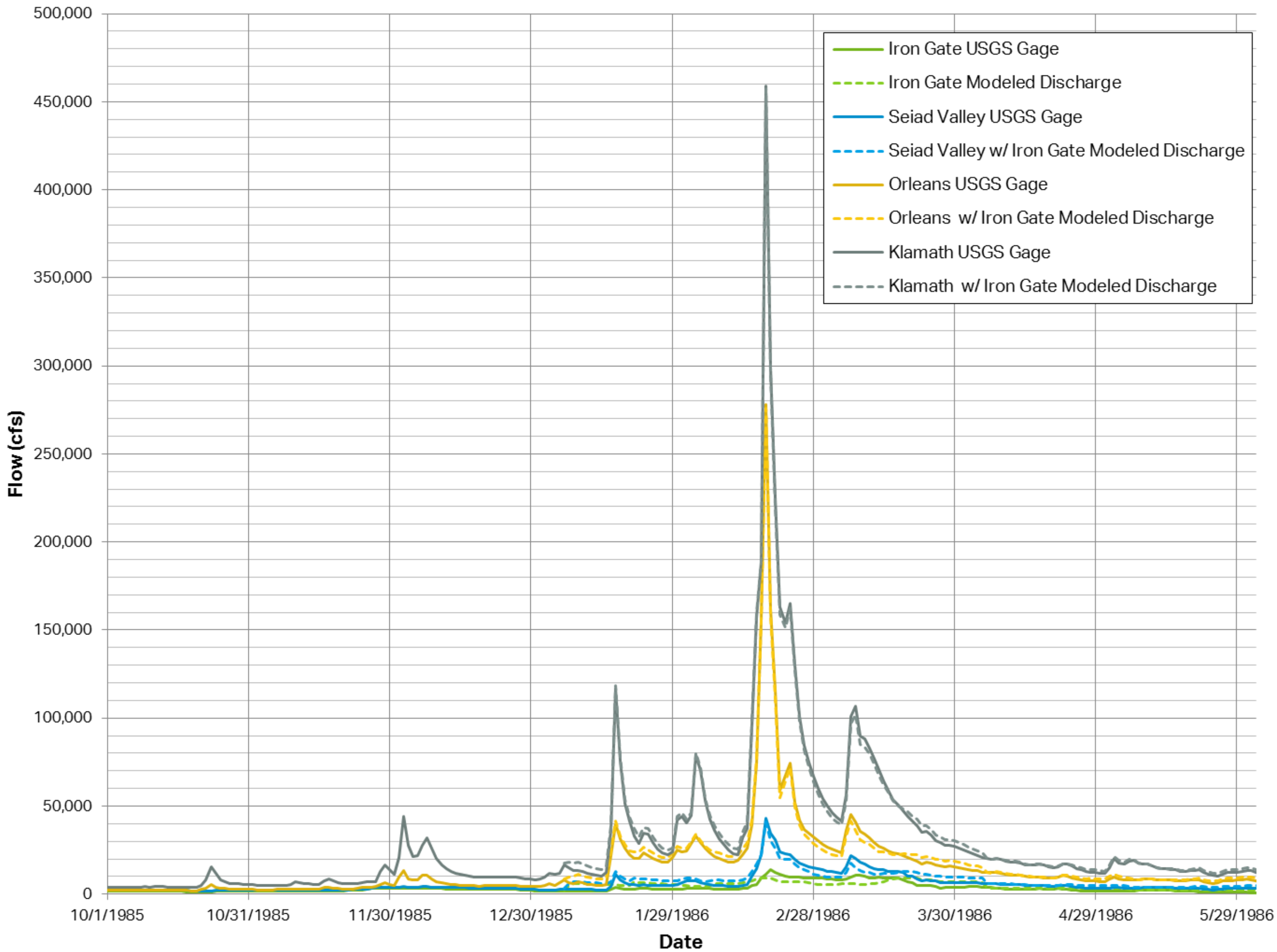


Figure 4.6-26 Comparison of Flows Downstream of Iron Gate Dam – Water Year 1986 (Model Year 1986)

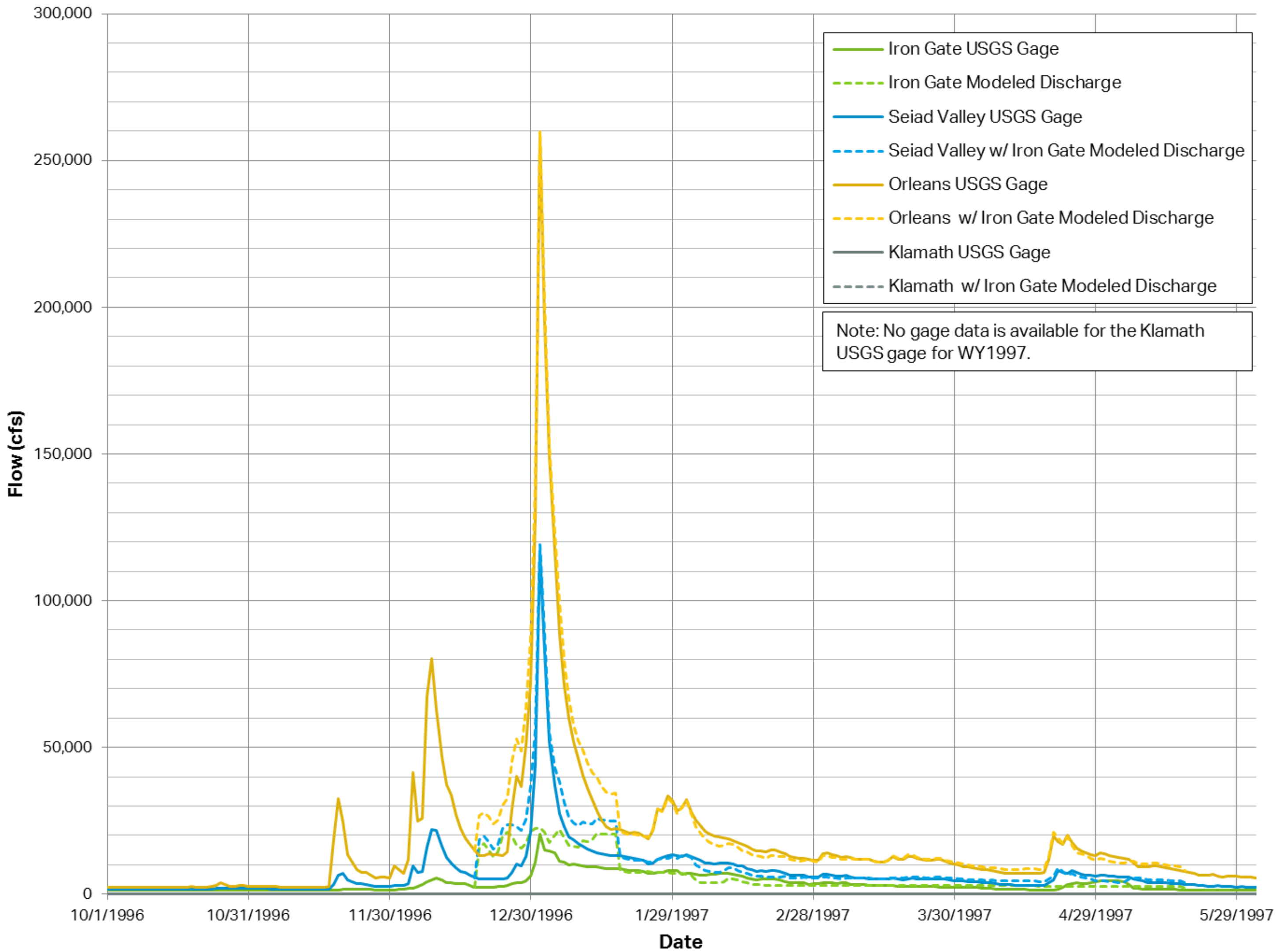


Figure 4.6-27 Comparison of Flows Downstream of Iron Gate Dam – Water Year 1997 (Model Year 1997)

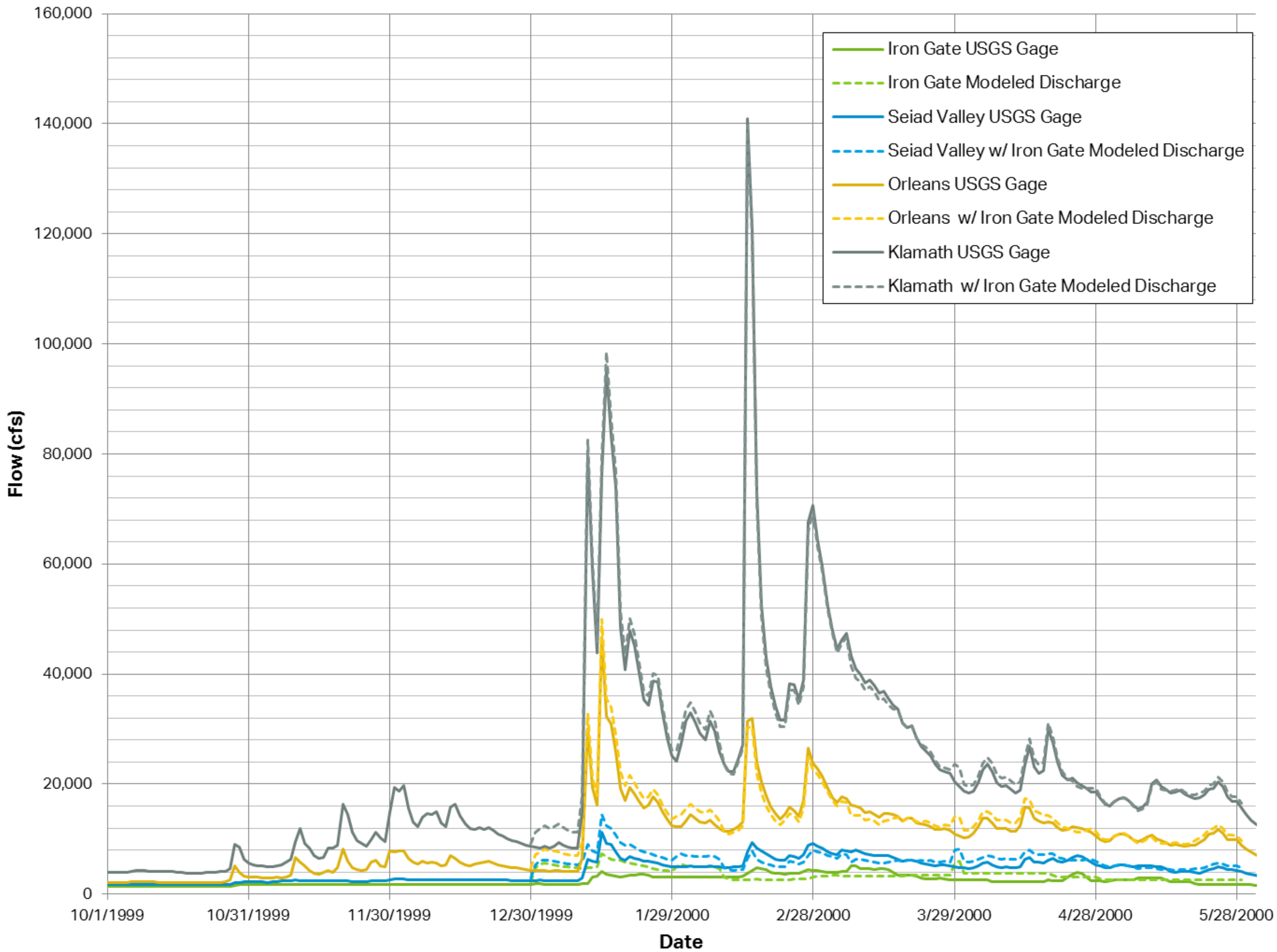


Figure 4.6-28 Comparison of Flows Downstream of Iron Gate Dam – Water Year 2000 (Model Year 2000)

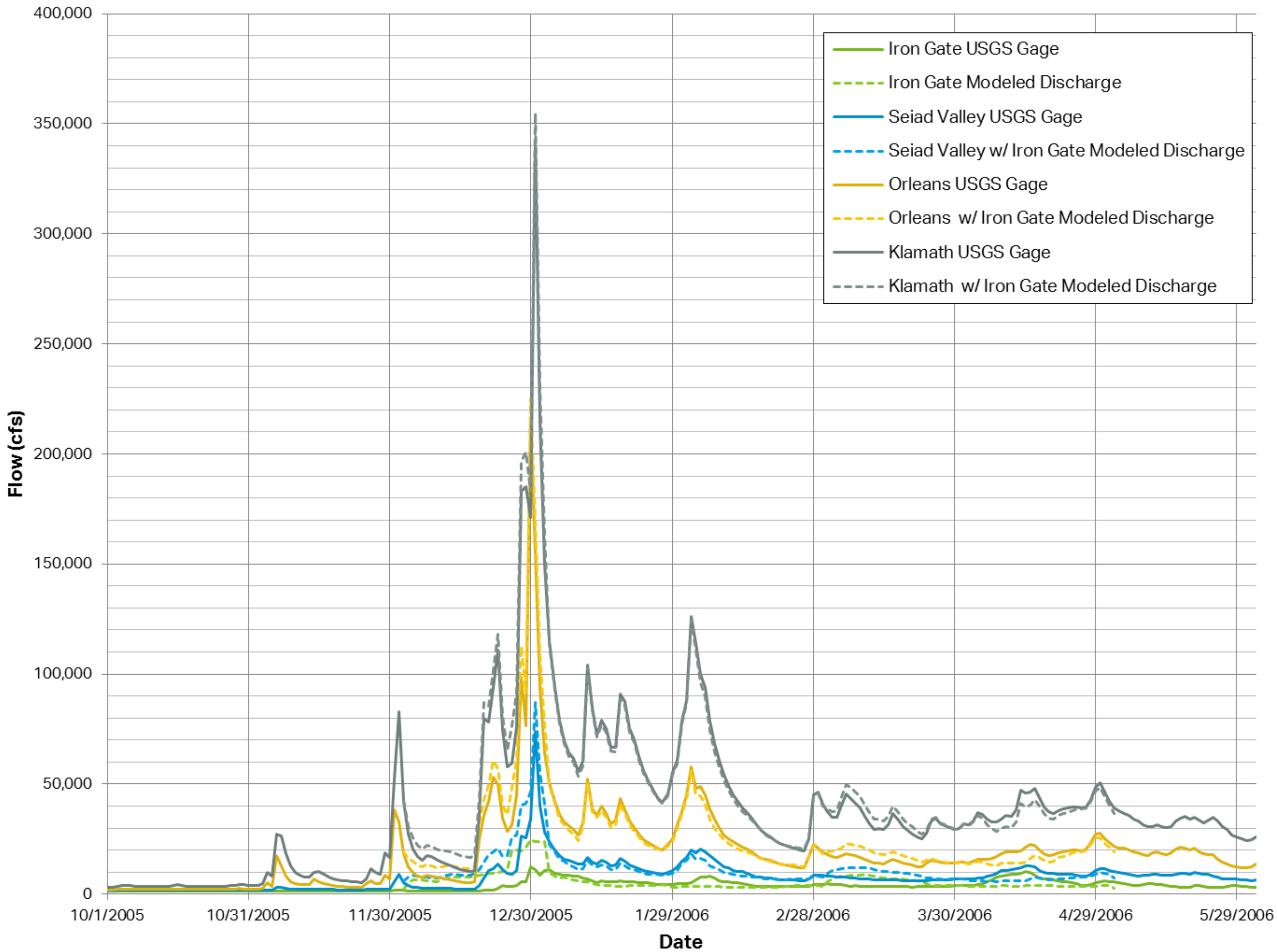


Figure 4.6-29 Comparison of Flows Downstream of Iron Gate Dam – Water Year 2006 (Model Year 2006)

4.7 Monitoring During Reservoir Drawdown

KRRC's contractor will monitor Iron Gate Dam and the embankment section of J.C. Boyle Dam during reservoir drawdown for any evidence of embankment instability. Shallow slumps may occur on the upstream slope, but such occurrences would not compromise the safety of the embankments. Monitoring will include daily visual observations of the upstream slope for signs of instability such as cracking or slumping. KRRC's contractor will install survey monuments and a minimum of two inclinometers in each embankment during the year prior to reservoir drawdown and will monitor them on a daily basis for evidence of deep failures within the upstream shell. KRRC's contractor will also install piezometers in the upstream shell (a minimum of 2) and the core (a minimum of 2) of the embankments for monitoring during reservoir drawdown to confirm that changes in pore pressure during drawdown are similar to or greater than assumed in the analyses (see Appendix D).

KRRC will monitor portions of the reservoir rim at each development, as appropriate, by daily visual observations for signs of any instability such as cracking or slumping. KRRC will install survey monuments and inclinometers in areas of particular sensitivity (e.g., near residences and cultural resources) and will monitor them on a daily basis for evidence of potential slope failure. After drawdown, KRRC will complete monthly visual observations for 12 months to monitor inclinometers and look for evidence of potential slope failure. If KRRC finds no evidence or trends showing slope instability after the monitoring discussed above, KRRC will complete no further slope stability monitoring. Should KRRC identify evidence or trends of slope movement, monthly monitoring shall continue for another 12 months, and KRRC shall complete an assessment to determine the likelihood of slope failure and possible mitigation measures.

Appendix L discusses monitoring during drawdown related to cultural resources.

4.8 Best Management Practices to Implement During Reservoir Drawdown

4.8.1 Blockage of Diversion Facilities

Diversion facility failure or blockage, particularly of the Iron Gate or Copco No. 1 diversion tunnels, during reservoir drawdown could impact the duration of drawdown. Failure modes of the diversion tunnels include: debris blocking the tunnel inlet, abutment instability and failure blocking the tunnel inlet, mechanical failure of the operating gate, and tunnel collapse. To avoid inlet blockages, Best Management Practices (BMPs) include installing large grates at the inlets and providing a mechanism to clear the grates using barge mounted equipment. Depending on the severity of the blockage or the mechanical failure, KRRC may suspend and delay reservoir drawdown to the following year after repairs are made.

Diversion facility failure or blockage of the Iron Gate diversion tunnel during dam removal could result in a condition where the dam no longer has an operable spillway. BMPs for this occurrence include conservative design criteria for the modification of the diversion tunnel to make inlet blockage, tunnel collapse, and mechanical gate failure unlikely. In addition, by the time dam removal starts on June 1, the diversion tunnel will have been in full operation for 5 months demonstrating its operability.

Diversion facility failure or blockage of the Copco No. 1 diversion tunnel during dam removal will not prevent dam removal because flows that would have been diverted through the tunnel would flow through the spillway gates or over the lowered dam crest. Flow over the lowered crest at Copco No. 1 Dam would prevent access for further concrete removal; however, KRRC expects the lowered crest to be sufficient for overtopping flows, and does not present a safety hazard.

KRRC will update the existing Emergency Action Plans (EAPs) for the dams. The EAPs describe the notification process for impending catastrophic dam failure and include flood inundation mapping. KRRC will submit the EAP to the BOC for its independent review and recommendations.

4.8.2 Stability of Embankments

Instability of the upstream slope of the J.C. Boyle or Iron Gate embankment during reservoir drawdown could result in either loss of erosion protection or loss of freeboard due to a slope failure that encompasses a portion of the dam crest. In the case of shallow slumping that disrupts erosion protection, BMPs include stockpiling riprap materials during the season prior to reservoir drawdown for repairs. Likewise, in the unlikely event that a slope failure displaces a portion of the dam crest, BMPs include stockpiling embankment materials for emergency repairs of the crest of the embankments.

4.9 Stability of Reservoir Rim

KRRC performed a reservoir rim stability evaluation that is provided in Appendix E. When discussing reservoir rim stability during drawdown at the various reservoir locations, it is important to differentiate between the potential for deep-seated large landslides along the reservoir rim that could impact roads or property, and slides of material beneath the current water surface, which would only impact resources within the local limited slide footprint.

Minor, shallow slides of existing material beneath the existing reservoir water surfaces are possible during drawdown at each reservoir location (Appendix E). These minor slides would not extend outside of the current reservoir footprint and would only potentially impact resources within the limited slide footprint (e.g. cultural resources). Within Copco No. 1 Reservoir, some larger deeper slides are also possible beneath the existing reservoir water surface, where submerged higher bluffs exist along the original Klamath River channel. These shallow slides and potential slides along the river channel in Copco No. 1 Reservoir pose no threat to roads or property, however, these areas will be monitored during and post-drawdown to assess any potential impact to existing cultural resources.

Based on the evaluation included in Appendix E, the potential for deep-seated large landslides along the reservoir rim is low at both J.C. Boyle and Iron Gate Reservoirs. At Copco No. 1 Reservoir, however, while the majority of the reservoir rim is expected to remain stable during drawdown, certain segments along the reservoir rim have a potential for slope failure that could impact existing roads and/or private property. In some areas, the impact could be relatively minor, while in other areas the impact could be greater. Based on the analysis in Appendix E, approximately 3,700 linear feet of slopes along Copco Road (approximately 10.7% of north shore length), and approximately 2,800 linear feet of slope adjacent to private property (approximately 8.7% of south shore length) require additional field investigation and analysis to gain a more refined understanding of slope stability in those areas. Up to eight parcels along the referenced-reservoir rim segments appear to have existing habitable structures that could potentially be impacted.

Additional field geologic data is required to confirm the potential for slope failure along the referenced-reservoir rim segments. KRRC expects to complete the additional field investigation in July and August of 2018, followed by completion of a series of material property laboratory tests. KRRC will use results from the field investigation and laboratory testing to update stability assessments in the rim segments of concern in fall 2018. Should additional study determine that there is a high probability of slope failure in any of these areas, KRRC will consider the following actions to offset potential impacts:

1. For segments along Copco Road:
   a) Re-align road segment away from rim slope
   b) Engineer structural slope improvements (e.g. drilled shafts or other structural elements that could be installed to resist slope movement)
2. For segments adjacent to property or structures:
   a) Move structure or purchase property
   b) Engineer structural slope improvements (e.g. drilled shafts or other structural elements that could be installed to resist slope movement)

4.10 Potential for Effects Downstream of the Project

The sections below discuss potential effects in the river channel downstream of Iron Gate Dam, including aggradation at tributaries, pool depths, lateral channel migration, water quality and slope instability. For a discussion of the effects on downstream flows, see Section 4.5.5 above.

4.10.1 Previous Modeling Results and Limitations

KRRC expects aggradation in the reach between Iron Gate Dam and Bogus Creek because this reach is immediately downstream of Iron Gate Dam and the relatively deep pools in this reach will fill with coarse sediment. This reach is artificially degraded because of the release of sediment-depleted, clear water flows from the dam.

USBR did not use the results of the two-dimensional model to quantify volumes of eroded reservoir sediment, sediment deposition in the downstream channel, or suspended sediment concentrations. USBR primarily used the two-dimensional model to help inform their revegetation plan for dam removal at Copco. USBR was interested in the general shape and location of the river channel post dam removal and the modeled shape and location corresponded well to the pre-dam maps. USBR eventually used the pre-dam maps to determine the most likely location of the post-dam removal channel.

4.10.2 Aggradation and Tributary Confluences

There are likely different responses for tributaries within the reservoir areas and for tributaries downstream of Iron Gate Dam. Within the reservoirs, previously deposited reservoir sediment may or may not be eroded during drawdown, depending upon the flows present in the tributaries and in the Klamath River. Should barriers form at these locations within the former reservoirs, KRRC will make efforts post-drawdown to remove the barrier and connect the tributary (see Section 6.1.3)

At tributaries downstream of Iron Gate Dam, there are several different possibilities for tributary response depending upon the relative balance of Klamath River flow, tributary flow, and sediment concentration. There are naturally-occurring, small depositional features at most tributary mouths along the Klamath River and having some deposition at these locations could take the form of a partial bar rather than fully blocking the tributary mouth and is not necessarily a negative impact.

4.10.3 Pool Depths

The reaches below Iron Gate Dam have all been unnaturally depleted of coarse and fine sediment due to the trapping of sediment within the reservoirs. Therefore, there has likely been some river bed degradation and river bed lowering caused by the depletion of coarse sediment. A return to pre-removal conditions in the pools downstream of the dams is not expected, nor desired. The pools are likely deeper and coarser than they would be under natural sediment supply conditions. There will be an immediate filling of pools after dam removal and an immediate fining of the river bed sediment. After one or two average floods, flows will remove most of the fine sediment from the pools and they will return to being dominated by a coarser substrate. However, the river will not recover full, pre-removal, pool depths and instead it will return to more natural pool depths. Numerical models are not able to reliably predict the pool-riffle formation and exact depths. USBR provided an estimate of the bed material response as part of the USBR (2012) report.

KRRC proposes a survey of the river bed downstream of Iron Gate Dam to Humbug Creek prior to dam removal, and every year after dam removal for the first 3 years. KRRC does not propose mechanical intervention in the main channel of the Klamath River at any substantial scale because the disturbance of the bed could cause more ecological impact than the sediment in the bed. Moreover, as mentioned above, KRRC does not believe that it is reasonable or prudent to want to recover pre-removal pool depths downstream of the dam.

4.10.4 Lateral Migration

Lateral migration is a natural part of all alluvial rivers and cannot be fully controlled throughout a large river. In fact, preventing lateral migration through bank protection can degrade the aquatic habitat of the river by causing channel bed degradation. That being said, the Klamath River is predominantly a bedrock-controlled river and naturally has very little migration and bank erosion. USBR (2012) compared mapping of terraces to one performed by Ayres (1999) and found very little difference in the plan form of the river over time. The risk of bank erosion would be higher when coarse sediment and large woody debris are introduced into the channel and deposits, which then forces the river to take a new path. An example of this process is the

Elwha River dam removals where several locations of bank erosion were observed after dam removal. The risk of bank erosion on the Klamath River is much smaller for a variety of reasons: there is much less coarse sediment in the reservoirs, the banks are mostly bedrock controlled, and there is no large source of woody debris upstream of the reservoirs because of operations at Link River and Keno Dams. For these reasons, no monitoring or adaptive management associated with downstream lateral migration is proposed.

4.10.5 Water Quality and Suspended Sediment

USBR (2012) performed simulations for a variety of water year types, some of which result in release of suspended sediment after March 15, and USBR discusses effects in that report. As discussed in Section 4.4, the updated approach to drawdown at Copco No. 1 significantly reduces the likelihood of a prolonged drawdown and high sediment concentrations. Due to the low probability of a prolonged drawdown, there is minimal risk of any associated negative effects from suspended sediment post-drawdown.

4.10.6 Water Quality and Sediment Contaminants

This summary is in reference to contaminant concentration analyses in Klamath River reservoir sediments and aquatic biota, and provides an evaluation of the results with respect to current USACE Sediment Evaluation Framework (SEF) for the Pacific Northwest (USACE, 2016) and U.S. Environmental Protection Agency (EPA) screening levels (SLs). The 2012 EIS/R summarizes sediment and aquatic biota testing completed by Camp Dresser and McKee (CDM) during or before 2011, a time period during which the Northwest Regional Sediment Evaluation Team (RSET) reviewed and finalized the freshwater contaminant screening levels. Although the 2009 SEF SLs and the EPA Regional Screening Levels (RSLs) were not the only thresholds considered in the 2011 analysis and result, an examination of previous results and conclusions with respect to the most recent SEF SLs and RSLs is necessary to ensure current science and regulatory standards are met.

The following review of the 2011 results under the 2016 SEF SLs and compliance with a Level 2B[22] evaluation confirms the conclusions presented in the 2012EIS/R that the reservoir sediments in each reservoir are suitable for unconfined, aquatic disposal and exposure and that contamination risks are unlikely and/or are either lower than with the dams still in place and/or lower than background levels. The marine SLs are relatively unmodified from the 2009 SEF, and the most recent freshwater SLs in the 2016 SEF are typically less protective than standards set forth by, e.g., EPA RSLs and ODEQ Bioaccumulation Screening Level Values (SLVs) for fish consumption. As a result, any revisions to the standards have negligible impact on previous conclusions.

Testing Summary

To assess the risk of contamination in biota and humans from the release of reservoir sediments, an evaluation of the sediments from each reservoir was completed in 2011 and generally followed the tiered

[22] A Level 2B assessment includes physical, chemical, biological, and other special evaluations completed to provide more empirical evidence regarding the potential for sediment contamination in the project area to have adverse effects on receptors (RSET 2016).

sediment evaluation framework presented in the 2009 SEF. The results and conclusions are summarized in the 2012 EIS/R and Klamath Dam Removal Overview Report for the Secretary of the Interior (SDOR). All steps required for a Level 2B evaluation were conducted, and they included a review of existing information (Level 1), screening assessment of sediment chemistry (Level 2A), bioassays and screening assessment of elutriate chemistry (Level 2B), and an additional examination of reservoir fish tissues. Additionally, concentrations were compared with the protective standards (i.e., low SLs) of the EPA RSLs and ODEQ SLVs for fish consumption. The contamination risk of concentrations in excess of the SLs was evaluated in consultation with several state and federal agencies and with respect to several contaminant exposure pathways from the sediments to biota and humans. The pathways included a “dams remain” option and four dam removal options: in the water column and in deposits in terrace and banks, the river bed, and near-shore marine environment. Additionally, values were compared with known background values for the area.

Previous Results

Based on the screening level evaluation, the previous analysis concluded that the risk of contamination to humans and freshwater, marine, and terrestrial biota along the four dam removal pathways was unlikely. In all but one case, contaminant concentrations above standards from the SLs, RSLs, or SLVs were at levels unlikely to cause adverse effects (see SDOR Figure 4.4.9-2). The one contaminant concentration determined to cause potential short-term minor to limited effect on freshwater biota was not a result of comparison with SEF SLs or EPA RSLs. With the exception of nickel in J.C. Boyle and Copco No. 1 and dieldrin in J.C. Boyle, the only contaminants reported in excess of the SEF standards were a result of the reporting limits (RLs) of the laboratory analysis in excess of the SLs, rather than detected concentrations of the contaminants in excess of the SLs. Exceedances based on reporting limits, rather than detected concentrations, included several polynuclear aromatic hydrocarbons (PAHs), phthalates, pesticides, and polychlorinated biphenyls (PCBs), but were generally not in excess of SL2 values.

The only exceedances of the EPA RSLs were the total carcinogenic RSLs for residential soils for arsenic and nickel in each reservoir. The EPA RSL threshold for lifetime exposure to humans to contaminated soils in residential settings for arsenic and nickel are 0.39 and 0.38 mg/kg, respectively, and, although exceeded, the exposure durations will be sufficiently low for exposure to be unlikely to lead to adverse effects. The results of the bioassays only indicated the potential for toxicity of reservoir sediments to benthic biota in J.C. Boyle reservoir, and CDM argued that increased toxicity in a dam removal scenario is unlikely given the dilution of the material. The lab results of contaminant testing for each reservoir are presented in EIS/R Appendix C and CDM (2011) Chapter 3 and Appendices A and B.

Current Screening Limit Standards and Reassessment of Results

KRRC reviewed previous results with respect to minor changes in SLs since 2011 and determined that the changes do not alter the previous conclusions. The updated SEF SLs in the current 2016 SEF Table 6-2 are generally similar to previous iterations of SEF SLs. The marine SLs are unchanged from the 2009 SEF with the exception of the pesticide dichlorodiphenyltrichloroethane (DDT), for which the SL was increased. The freshwater SL1 values from the 2016 SEF are generally similar to and typically higher than previous values, so the conclusions in the 2012 EIS/R regarding SEF SLs are still valid.

KRRC reassessed the concentrations of the metals arsenic, chromium, nickel, and silver, for which the 2016 SEF SLs are lower than those used by CDM. For arsenic, chromium, and nickel, the lowest freshwater screening levels used by CDM were lower than the SEF SL1 value, so there is no change in the samples designated as exceeding the SLs criteria. Silver was not previously found to exceed any SLs. The standards of the EPA RSLs for the total carcinogenic RSLs for residential soils for arsenic and nickel are more protective than the SEF values, and the RSL values have not changed in a way that alters previous evaluations.

In the 2016 SEF, PAH SLs are defined as summed quantities rather than SLs for each contaminant as with the previous SLs. The maximum PAH RL values from the 2011 analysis are sufficiently low to not exceed the total PAH SL value in the 2016 SEF when summed. For 19 analytes (e.g., some PCBs, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs)) measured during 2009-2010, RLs were greater than SLs, so it remains undetermined if concentrations exceed revised SLs. However, it was determined that these contaminants were unlikely to contribute to risk of contamination, and this argument is unaffected by any revisions to SLs. The results of the bioassays are not impacted by any new standards or SLs.

4.10.7 Flooding and Slope Instability

KRRC considers the potential for significant flooding and slope instability downstream of Iron Gate Dam due to and during reservoir drawdown activities to be low and equivalent to (or better than) the existing condition. This is primarily due to the discharge capacity of the modified Iron Gate diversion tunnel, which is equivalent to a 5-year flood event. If the reservoir refills and spills during an event much larger than the 5-year flood event, this larger event would cause increased downstream flows even without the drawdown because the reservoirs are not used for flood control. For non-flood event periods, flows in the downstream channel will not exceed a 5-year flooding event; therefore, KRRC does not expect reservoir drawdown to cause erosion or subsequent slope instability downstream of Iron Gate Dam. In fact, during reservoir drawdown, Iron Gate Reservoir will actually attenuate larger flood events resulting in lower flood discharges than would occur under existing conditions.

Since drawdown will not result in flooding or slope instability, KRRC does not propose reconnaissance of potentially inundated areas downstream of Iron Gate Dam.

Chapter 5: Dam Removal Approach

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5. DAM REMOVAL APPROACH

5.1 Introduction

The general strategy for dam removal assumes the natural release of sediment to the Klamath River from the three larger reservoirs (J.C. Boyle, Copco, and Iron Gate) will be initiated no earlier than January 1, 2021. KRRC will accomplish the reservoir drawdown and associated sediment release through regulated releases from the diversion facilities described in Section 4.2, to draw down the reservoirs in a controlled manner. Development removal, as defined by the KHSA, is to produce a free-flowing river at all four hydroelectric dam sites (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate) by the specified December 31 completion date.

The proposed Project (Full Removal alternative) achieves the project objectives of free-flowing river conditions and volitional fish passage by the complete removal of dams (except for buried features), power generation facilities, water intake structures, canals, pipelines, and ancillary buildings. The Partial Removal alternative, which KRRC presents for purposes of environmental review, also achieves the objectives of free-flowing river conditions and volitional fish passage, but portions of each dam would remain in place, along with ancillary buildings and structures such as powerhouses, foundations, tunnels, and pipes. The Partial Removal alternative is discussed in this section as the Partial Removal Options (PROs). PROs that will not be buried will be sealed or fenced to prevent unauthorized entry and for public safety, and will likely involve long-term maintenance costs. KRRC will remove hazardous materials from each dam site and from any PRO if it were to be implemented during construction.

Quantity estimates for all features removed by the Project, including earth fill volumes, concrete volumes and weights of mechanical and electrical equipment, have been carefully prepared using detailed engineering drawings provided by PacifiCorp, which are believed to represent current, as-built conditions. Members of the engineering design team have examined each dam site by to confirm the existence of project features for which quantities have been prepared for this level of design. However, KRRC has conducted no independent surveys or measurements of dam embankments, concrete structures, or equipment to confirm the PacifiCorp data. KRRC will use new topographic and bathymetric surveys to confirm earthwork quantities.

The following sections define the removal limits, PROs, access roads, staging areas, disposal sites, likely demolition methods, and waste disposal requirements for each dam and hydropower development. Drawings have been prepared for each development to define the proposed removal limits for the dam and for each appurtenant feature in plan and cross-sectional view, and are included in Appendix B (CEII) and Appendix C (non CEII). Figure 5.1-1(C) shows an overview of the work areas and major access routes.

Figure 5.1-1 Project Limits of Work and Access (Appendix C)

The bulleted list below provides a roadmap for specific waste disposal items:

- Sections 5.2.3 (J.C. Boyle), 5.3.3 (Copco No. 1), 5.4.3 (Copco No. 2) and 5.5.3 (Iron Gate) summarize location and size of disposal sites. Figures 5.2-1(C), 5.3-1(C), and 5.5-1(C) show disposal site location and approximate grading. Figures 5.2-8 (C), 5.2-9 (C), 5.3-8 (C), 5.5-4 (C), and 5.5-5(C) provide additional detail (plan and profile) for the disposal sites.
- Sections 5.2.7, 5.3.7, 5.4.7 and 5.5.7 provide description of materials (quantity and type) being buried at each disposal site.
- Sections 5.2.3, 5.3.3, 5.4.3 and 5.5.3 summarize measures and monitoring associated with disposal site erosion.
- Sections 5.2.7, 5.3.7, 5.4.7 and 5.5.7 provide description of materials (quantity and type) that will be disposed of at local landfills, including an estimate of truck trips.
- Sections 5.2.7, 5.3.7, 5.4.7 and 5.5.7 provide description of material (quantity and type) that will be recycled.
- Description of hazardous material (quantity and type) that may be encountered, and plans for safe handling and disposal is provided in Appendix O3.

5.2 J.C. Boyle Dam and Powerhouse

5.2.1 Removal Limits

J.C. Boyle Dam is located within a relatively narrow canyon on the Klamath River at RM 230.6. Minimum requirements for a free-flowing condition and volitional fish passage on the Klamath River through the J.C. Boyle dam site require the complete removal of the embankment section and concrete cutoff wall to the bedrock foundation, to ensure long-term stability of the site and to prevent the development of a potential fish barrier at the site in the future. Table 5.2-1 summarizes and Figure 5.2-1 (C) shows features the Project will remove or potentially retain as PROs.

Figure 5.2-1 J.C. Boyle Dam Removal Features and Limits (Appendix C)

Table 5.2-1 J.C. Boyle Dam and Powerhouse, Removal Requirements

Feature	Full Removal	Partial Removal Options	Comments[1]
Embankment Dam, Cutoff Wall	Remove	Remove	
Spillway Gates and Crest Structure	Remove	Remove	
Concrete Box Diversion Culverts	Remove	Remove	
Fish Ladder and Diffusion Box	Remove	Remove	
Timber Bridge	Remove	Remove	
Steel Pipeline and Supports	Remove	Retain	PRO: Retain as footbridge, supports will remain in 100-year floodplain
Canal Intake (Screen) Structure	Remove	Retain	PRO: Seal openings, install security fence

Feature	Full Removal	Partial Removal Options	Comments[1]
Left Concrete Gravity Section	Remove	Retain	
Canal Headgate Structure	Remove	Retain	PRO: Retain as observation point
Power Canal (Flume)	Remove	Retain	PRO: Retain invert slab
Shotcrete Slope Protection	Retain	Retain	Removal would destabilize excavated rock slopes and increase potential for rock falls
Forebay Spillway Control Structure and Discharge Chute	Remove	Remove	
Tunnel Inlet Portal Structure	Remove	Remove	
Surge Tank	Remove	Remove	Potential future seismic stability
Penstocks, Supports, Anchors	Remove	Remove	Avoid maintenance, facilitate wildlife migration
Tunnel Portals	Plug	Plug	Plug with reinforced concrete
Powerhouse Gantry Crane	Remove	Remove	
Powerhouse (incl. mechanical and electrical equipment)	Remove	Retain	PRO: Substructure below roadway, seal openings
Powerhouse Hazardous Materials (transformers, batteries, insulation, petroleum products)	Remove	Remove	
Tailrace Flume Walls	Remove	Remove	
Tailrace Channel Area	Backfill	Backfill	
Canal Spillway Scour Area	Backfill	Backfill	Backfill to extent possible with concrete rubble from dam, canal, and powerhouse
Three 69-kV Transmission Lines, 2.8 mi total (incl. poles and transformers)	Remove	Remove	
Switchyard (incl. fencing, poles, and transformers)	Remove	Remove	
Buildings: office building (the Red Barn), maintenance shop, fire protection building, communications building, 2 residences, storage shed, reservoir level gauges house	Remove All	Retain	PRO: Retain some structures

1. PROs would involve long-term maintenance costs, including the preservation of any exposed items with coatings containing heavy metals (such as the penstocks).

Retention of the portions of the J.C. Boyle powerhouse below the roadway as a PRO would require the structure to be sealed. KRRC assumes the paint on the downstream face of the concrete structure contains heavy metals and would be carefully removed. Mechanical and electrical equipment could be left in place with all power connections to the outside removed; however, any oil in the turbine governor and hydraulic control systems, transformers, oil storage tanks, or other equipment would be removed. KRRC's contractor will also remove other potentially hazardous materials, such as batteries. The tailrace channel between the powerhouse and the river channel could be backfilled to the pre-construction contours if necessary, which would eliminate the need to remove the concrete training walls. Retention of the lower portion of the powerhouse would not impact the 100-year floodplain.

5.2.2 Construction Access

Figures 5.1-1(C) and 5.2-1(C) show construction access roads and associated improvements that may be required for removal of J.C. Boyle Dam and Powerhouse. KRRC observed existing conditions of the highways, local roads, and structures in the field to identify deficiencies and determine if improvements are necessary for mobilization and/or hauling during construction and demolition activities. KRRC will complete access road improvements prior to associated construction and removal at the dam and powerhouse. The following sections summarize the assessment completed of each road or highway identified for use during construction, and specific improvements are identified, as appropriate.

The Dalles California Highway (US97)

The Dalles California Highway (US97) is classified as a rural principal arterial road that runs north-south in Oregon and intersects with Keno Worden Road. It is a two-lane undivided roadway with a posted speed limit of 65 mph. KRRC's contractor will use this stretch of highway for mobilization of construction equipment and as a haul route to carry demolished materials other than earth and concrete rubble from the dam and powerhouse site to approved commercial landfills. The alignment and pavement are in good condition and well maintained. KRRC does not propose improvements and upgrades to this highway for mobilization or hauling of materials for the Project. Pavement rehabilitation will likely not be needed during or post-construction. KRRC's contractor will obtain transportation permits, if required, from the Department of Transportation for mobilizing "wide-load" truck trailers with construction equipment. KRRC's contractor will obtain hauling permits if US97 is used for carrying oversize loads of materials removed from the site.

Figure 5.2-2 US97 and Keno Worden Rd

Oregon Route 66 (OR66, Green Springs Highway)

OR66 is a state highway classified as a rural minor arterial that runs east-west in Oregon and north of the Klamath River. It is a two-lane undivided roadway with posted limits of 35 to 45 mph. The highway's western terminus is at Oregon 99 near Ashland and its eastern terminus is at The Dalles California Highway (US97) and Oregon 140 near Klamath Falls. KRRC's contractor will use the segment of roadway between J.C. Boyle Dam/Powerhouse Access Road and US97 for mobilization and as a haul route for materials taken to commercial landfills. The pavement is in fair condition. KRRC does not propose improvements and upgrades to this highway for mobilization and hauling for the Project. Pavement rehabilitation will likely not be needed during or post-construction. This portion of OR66 includes Spencer Bridge (ODOT Bridge No. 19789).

Spencer Bridge

Spencer Bridge (OR66) is a 3-span continuous welded steel plate girder bridge that is approximately 558 feet long and 43 feet wide. It was built in 2005 for a HL-93 truck design load. The structure has a reinforced concrete deck with two12-foot lanes and 8-foot shoulders. The structure is supported on two column bents founded on 6–foot-diameter shafts and seat type abutments. The west abutment is founded on 2–foot-diameter shafts and the east abutment is founded on a spread footing placed on compacted stone fill.

Figure 5.2-3 Spencer Bridge (OR66)

KRRC's contractor will use this structure for mobilization and as a haul route for materials taken to commercial landfills. The alignment and deck are in excellent condition and well maintained. KRRC does not propose improvements and upgrades to this structure for mobilization for the Project. Nor does KRRC propose temporary traffic control.

Keno Worden Road

Keno Worden Road is a county road classified as a rural minor collector and connects to The Dalles California Highway to the southeast and OR66 to the northwest in Oregon. It is a two-lane undivided roadway with posted speed limits of 20 to 35 mph. KRRC's contractor will use the roadway for mobilization and as a haul route for materials taken to commercial landfills. The existing pavement of Keno Warden Road is in fair condition. KRRC does not propose improvements and upgrades to this highway for mobilization and hauling for the Project. Pavement rehabilitation will likely not be needed during or post-construction.

Topsy Grade Road

Topsy Grade Road is a county road that runs east of and parallel to the Klamath River with the northeast terminus at OR66 just east of Spencer Bridge and becomes Copco Lake Road at the California/Oregon border to the southwest. It is a two-way access road ranging in width between 14 feet and 18 feet. Most of the roadway is gravel and some short sections are asphalt, particularly near the Topsy Campground (managed by BLM) at J.C. Boyle Reservoir. KRRC's contractor will use the section of roadway between the Topsy Recreation Site and OR66 for mobilization and material hauling. KRRC does not propose improvements and upgrades to this roadway for the Project. KRRC's contractor may perform pavement rehabilitation during or post-construction. KRRC's contractor will use temporary traffic control for any pavement rehabilitation.

Figure 5.2-4 Topsy Grade Road – Causeway Road

Access Road from OR66 to J.C. Boyle Dam

The Access Road from OR66 to J.C. Boyle Dam is a private gravel road ranging in width between 16 to 18 feet and is owned and maintained by PacifiCorp. The pavement is in fair condition. KRRC's contractor will use this section of roadway for mobilization and material hauling. KRRC will improve parts of the road by regrading uneven or rutted areas. At the intersection with OR66, KRRC will perform tree removal and widening of the intersection on the access road approach, which will improve corner sight distance for mobilization and hauling activities. In addition, KRRC will install advance signage to notify vehicles using OR66 of construction trucks entering/exiting at the intersection. KRRC's contractor will use temporary traffic control during tree removal and intersection widening. This road will be left in place and will be used by both the future land owner and BLM, who uses it to access their adjacent property.

J.C. Boyle Powerhouse Road

The Powerhouse Access Road is an access road that runs between the J.C. Boyle Powerhouse and Dam sites. The majority of this road is owned by BLM, while a short length is owned by PacifiCorp. The full length, however, is maintained by PacifiCorp. It is a two-way undivided gravel road 16 to 22 feet wide. The existing gravel road condition is fair. KRRC's contractor will use this section of roadway as a primary haul route to transport material from the powerhouse to the scour hole below the forebay, and to haul some excavated material from the dam to the tailrace. The average one-way haul distance from the powerhouse to the scour hole below the forebay is approximately 1.8 miles. The average one-way haul distance from the dam to the tailrace is approximately 4.2 miles. KRRC does not propose improvements and upgrades for this roadway for the Project. KRRC anticipates road maintenance in some areas during construction to ensure adequate accessibility, where the existing surface will be damaged due to construction vehicles. Temporary traffic control will not be required. This road will be left in place and will be used by both the future land owner and the public to access adjacent BLM property.

Timber Bridge

A private, PacifiCorp-owned timber bridge spans over the Klamath River just south of J.C. Boyle Dam. The structure is a single span rolled steel beam bridge that is 100–foot-long and 18 feet wide with a 16-foot travel lane. It was built in 2003 for a HS20-44 truck design load. It is used to access the power canal and powerhouse. The bridge has a timber deck supported on 4 beams that are welded to steel floor beam at the abutments. The floor beam is founded on 4 steel piles. The alignment and deck are in good condition and well maintained.

KRRC's contractor will not use the bridge for mobilization of construction access, and improvements and upgrades to this structure are not required. Temporary traffic control will not be required. KRRC's contractor will demolish this bridge post-construction, as described in Section 7.4.

Power Canal Access Road

The power canal access road runs between the dam and forebay spillway. The majority of this road is owned by BLM, while a short length is owned by PacifiCorp. The full length, however, is maintained by PacifiCorp. It is a gravel road immediately adjacent to the power canal and has a width of approximately 14 feet. The surface is in poor condition. KRRC's contractor will use this section of roadway for construction access until the power canal has been completely removed. Minor periodic roadway maintenance such as re-grading will likely be required to address roadway deterioration during construction. KRRC does not propose temporary traffic control. This road will be left in place for continued use by BLM.

Figure 5.2-5 Timber Bridge at J.C. Boyle

Disposal Access Road

The private, PacifiCorp-owned disposal access road runs between the dam and on-site disposal area just north of the dam. KRRC's contractor will use this road will be used for material hauling. The average one-way haul distance is approximately 0.4 mile. Improvements for this roadway include regrading uneven and rutted areas and widening in some segments to facilitate two-way traffic. KRRC does not propose temporary traffic control as this is not a public road. KRRC's contractor will demolish this road and restore it to native vegetation post-construction.

Right Abutment Access Road

The private, PacifiCorp-owned right abutment access road runs between the dam and Topsy Grade Road. It is a gravel road in fair condition. KRRC's contractor will use the roadway for mobilization and material hauling. KRRC does not propose improvements to the road and does not propose temporary traffic control. KRRC's contractor will demolish this road and restore it to native vegetation post-construction.

Figure 5.2-6 Power Canal Access Road

Penstock Access Roads

Several BLM-owned dirt roads extend from the J.C. Boyle Powerhouse Road up to various elevations along the penstocks. KRRC's contractor will use that these roads to access the penstocks for demolition and related material hauling. KRRC does not propose improvements to the roads for the Project. KRRC does not propose temporary traffic control. KRRC's contractor will demolish this road and restore it to native vegetation post-construction.

Figure 5.2-7 Right Abutment Access Road

5.2.3 Staging Areas, and Disposal Sites

Figure 5.2-1(C) shows construction staging areas and disposal sites for removal of J.C. Boyle Dam and Powerhouse within the limits of work on and are discussed in the following sections. The contractor will mobilize construction equipment to the site by about October 2020 to prepare the staging areas and prepare the right abutment disposal site for dam removal post-drawdown.

Staging Areas

Equipment staging areas (Figure 5.2-1(C)) will be located at the left abutment of the dam and near the forebay and downstream powerhouse. Identified staging areas include a 4.7 acre area and a 5.6 acre area on the left abutment of the dam, a 1.0 acre area at the forebay, and a 1.7 acre area at the powerhouse. The contractor will prepare staging areas by clearing vegetation and minor grading. The staging areas will be restored post-construction by minor grading and hydroseeding. See Section 6 for additional detail associated with restoration.

Disposal Sites

The contractor will permanently bury earth materials generated from removal of the J.C. Boyle development on-site in a portion of the original borrow pit located on the right abutment of the dam (see Figure 5.2-1(C) and sections in Figures 5.2-8(C) and 5.2-9(C)) within the project area. Excavated embankment materials will be hauled along existing access roads to the northwest portion of the former borrow pit just north of the cleared transmission line corridor, covering an area of approximately 6 acres. KRRC's contractor will grade the disposed material as a hill (maximum fill height of about 35 feet) contoured to blend into the surrounding topography as shown in plan and section on Figure 5.2-1(C), Sheet 1. Preparation of the disposal site will include clearing of existing vegetation and stripping and stockpiling of what little topsoil is present. KRRC's contractor will excavate the top 12 inches of the downstream face of the dam and stockpile it near the disposal site for later use as topsoil for restoration of the disposal site. Special precautions will be required for work below the high voltage transmission lines, but adequate clearance is available. After final grading for drainage and aesthetics, KRRC's contractor will cover the disposal site with topsoil and hydroseed the area. Compaction other than by equipment travel will not be necessary. See Section 6 for additional detail associated with restoration. KRRC will complete erosion monitoring on an annual basis for 5 years following placement to assess whether significant erosion and slope deterioration has occurred. If significant erosion occurs, KRRC will repair the eroded area to the satisfaction of the appropriate regulatory agency.

Figure 5.2-8 J.C. Boyle Right Abutment Disposal Site Plan & Sections (Appendix C)

Figure 5.2-9 J.C. Boyle Forebay Spillway Scour Hole Backfill Plan & Sections (Appendix C)

Concrete rubble from the dam, flume, forebay, and powerhouse will be placed within the project property in the eroded scour hole below the forebay spillway structure (Figure 5.2-1(C), Sheet 8), and covered with 3 to 5 feet of rock and soil debris that has eroded and been moved downslope of the scour hole. KRRC's contractor will use the previously eroded rock and soil, which they will obtain from the slope below the scour hole, as top cover so that the restored scour hole will blend more naturally into the adjacent slopes. The scour hole, which is approximately 100 feet deep with near vertical side slopes, was eroded into a steep slope (1.3H:1V to as steep as 1H:1V) of talus and colluvium. Filling of the scour hole to match the original slope and maintain an adequate factor of safety for slope stability will not be feasible. The concrete rubble, which has a high shear strength, will be spread in lifts and track walked with a small bulldozer to a finished slope of 1.5H:1V. The finished slope will have a factor of safety of more than 1.3. The volume of available concrete rubble will fill the hole to within about 66 feet of the top of the hole (Figure 5.2-1(C), Sheet 8). The vertical slopes extending above the finished fill grade will be flattened to 1H:1V. The fill will be shaped to drain toward the center of the fill, which will be rock lined to provide for erosion protection. Use of the previously eroded rock and soil debris will allow similar vegetative cover to be used for restoration as is currently present on the slopes upstream and downstream of the scour hole.

Rebar, mechanical and electrical equipment from the dam, power canal and powerhouse, in addition to building material and demolished powerline material will be disposed of at an approved landfill near Klamath Falls. Table 5.2-3 lists tonnage and volume of these materials.

5.2.4 J.C. Boyle Dam and Powerhouse Removal

Dam Removal

Immediately following reservoir drawdown with the reservoir level below the spillway crest (see Section 4.2.1), KRRC's contractor will remove all three spillway gates and operators, the spillway bridge deck, the spillway piers, and the log boom in the dry. KRRC's contractor will retain the left abutment wall with fish ladder that supports the left side of the embankment for flood protection until after spring runoff when embankment removal could begin.

KRRC's contractor will maintain sufficient embankment freeboard at all times between the elevation of the excavated embankment surface and the reservoir to reduce the potential for flood overtopping and potential embankment failure. The freeboard requirement will be to provide 100-year flood protection for the time of year that embankment dam removal is occurring (see Section 4.4). KRRC will not start excavation of the J.C. Boyle embankment section until July 1, 2021, and will complete excavation by September 30, 2021 to minimize hydrologic risk.

Removal of the remaining features at the dam will be as follows:

1. At the beginning of embankment excavation, reservoir inflows will have reduced to a level that is below the crown of the diversion culverts (elevation 3765.2).
2. Remove dam embankment in July and August to no lower than elevation 3770.7 (about 30 feet above bedrock at upstream toe) to provide an upstream cofferdam (Figure 5.2-10 (B)) sufficient to ensure minimum 100-year flood protection (with freeboard) in September for flows up to about 3,500 cfs through left abutment. Remove riprap from upstream and downstream slopes as embankment is removed and temporarily stockpile for later use on downstream slope of upstream cofferdam. Remove embankment materials downstream of upstream cofferdam limits to final channel grade, including concrete cutoff wall. Remove the left abutment wall with fish ladder concurrent with dam removal.
3. Place excavated rockfill (from stockpile) on downstream face of upstream cofferdam as required for controlled breach of cofferdam embankment to bedrock elevation 3740.7 at upstream toe.
4. Remove the concrete spillway crest structure down to the top of the diversion culvert, and remove the canal intake structure and the left gravity wall in July, concurrently with the beginning of embankment removal (Figure 5.2-10 (B)).
5. Prior to September 30, 2021, but following breaching of the upstream cofferdam at Iron Gate Dam (to minimize downstream impacts), breach the J.C. Boyle upstream cofferdam by notching below reservoir level (expected to be below RWS elevation 3763.7). Breaching will occur with a reservoir head behind the cofferdam of about 20 feet. Achieve final reservoir drawdown by natural erosion of the armored cofferdam to the original streambed level. The cofferdam breach at J.C. Boyle could release up to 5,000 cfs.
6. Following the cofferdam breach, remove any remaining embankment materials from river channel in the wet (during low flow period) as required, and remove remaining diversion culvert concrete in the dry.

7. Remove all other features (buildings, paving on access roads, etc.) as required. Restore dam site and right abutment disposal site as required, including the placement of topsoil and seeding.

Portions of the dam and hydropower demolition must be performed within the in-stream construction window negotiated with the regulatory agencies. See Section 8.6 of this Definite Plan for information pertaining to the construction schedule and timing of the various activities.

Figure 5.2-10 J.C. Boyle Dam Removal (Appendix B)

Canal Removal

Removal of the power canal will likely be from the downstream end to the upstream end but the contractor could alter the approach. In portions of the canal that are two-walled, both walls and the invert slab will be demolished using mechanical methods (e.g. hydraulic shears or hoe-ramming). In portions of the canal that are single-walled, KRRC's contractor will demolish the wall and the invert slab, but shotcrete that may have been used to stabilize portions of the inside wall formed by exposed rock will be left in place. Removal of the shotcrete could destabilize the rock slope increasing the potential for rock falls during and after construction. KRRC's contractor will remove reinforcement from the concrete as the demolition proceeds upstream. KRRC's contractor will haul the concrete rubble and gravel underlying the invert slab downstream and place it in the forebay structure spillway scour hole (see Section 5.2.3.2). Following removal of the canal structure, KRRC's contractor will restore the excavated bench the canal was built on by grading the bench to drain, armoring portions of the bench where drainage from uphill areas will cross the bench, and removing vehicular access to the bench. The outer portion of the bench (current location of the access road), will be decompacted using tines on the back of a motor grader and hydroseeded. As an alternative, KRRC may maintain the current access road for fishing access, if requested by BLM and subject to arrangements that are satisfactory to BLM and KRRC. KRRC's contractor will regrade the forebay area to drain and to blend in with surrounding topography (see Figure 5.2-11). See Section 6 for additional detail associated with restoration.

Figure 5.2-11 J.C. Boyle Forebay Backfill Plan and Sections (Appendix C)

Powerhouse Removal

KRRC's contractor will remove the downstream powerhouse, as required, any time after decommissioning by constructing a cofferdam in the tailrace channel for removal operations in the dry. Removal of the remaining features at the powerhouse will be as follows:

1. Use sump pumps to dewater area, as required. Retain the cofferdam as partial backfill for tailrace channel.
2. Remove penstocks and plug tunnel openings.
3. Remove switchyard and warehouse building.
4. Backfill the tailrace channel by removing up to 5 feet of alluvial material from upstream and downstream of the tailrace channel (Figure 5.2-1(C), Sheet 9) that originally came from excavation of

the powerhouse and tailrace and placing the material in the channel by pushing using a bulldozer or placement using a large excavator.

5. Place a turbidity curtain along the downstream edge of the channel to minimize water quality impacts to the river during placement of the backfill.

Transmission Line and Switchyard Removal

Transmission line removal at J.C. Boyle includes demolishing the J.C. Boyle switchyard, demolishing overhead distribution lines and associated poles or towers, as applicable, and installation of new connections to maintain the power grid (see Figure 5.2-12).

KRRC's contractor will demolish approximately 2.8 miles of overhead transmission/distribution line and approximately 42 poles. Lines to be demolished include:

- 230 kV distribution lines between J.C. Boyle switchyard and J.C. Boyle Dam, including to the village houses near the dam
- 230 kV connections in the J. C. Boyle powerhouse area

Major switchyard demolition components include:

- Two (2) A-Frame Dead End Structures (typically ~60-80ft high)
- Two (2) large 230 kV Transformers
- Two (2) 230 kV Power Circuit Breakers
- One (1) 230 kV switchyard tie structure
- Approximately 600-ft of perimeter chain-link fence

PacifiCorp may salvage the transformers and other equipment for reuse at other facilities.

New connections include installation of two (2) new 230 kV strain transmission structures outside J.C. Boyle switchyard to tie the existing 230 kV transmission line north and south of J.C. Boyle switchyard together. Currently these lines loop in/out of J.C. Boyle, but continuity will be broken when the contractor removes the powerhouse and switchyard.

Figure 5.2-12 Project Transmission Line Removal (Appendix B)

5.2.5 Demolition Methods, Estimated Equipment and Workforce

KRRC proposes the following demolition methods, estimated equipment requirements, and estimated workforce requirements for planning purposes based on similar projects and engineering judgment. Alternative methods, equipment, and workforce that would also meet project requirements are possible and could be refined by KRRC's contractor.

Demolition Methods

KRRC's contractor will remove the spillway gates and traveling hoists by a large crane for loading onto highway trucks and heavy-haul trailers, with the reservoir drawn down below the spillway crest. The reinforced concrete spillway bridge deck and piers could be removed in pieces by hydraulic excavators, or in sections by conventional or diamond-wire sawcutting. KRRC's contractor will remove the upstream concrete stoplogs for the diversion by blasting if they cannot be pulled out of their slots by a crane under reservoir head.

KRRC's contractor will remove the lower portion of the concrete spillway section by hoe-ramming or by drilling and blasting in the dry. Drilling for blasting will include small- to mid-sized hydraulic track drills and perhaps air-track drills supported by 850 to 1,200 cubic feet per minute (CFM) air compressors. Considerable jack-leg and similar hand drilling will supplement the machine drilling for special shots. Reinforced concrete in deck, wall, and floor slabs for remaining features to be removed (including fish ladder, canal intake structure, power canal, forebay structures, and powerhouse) will be excavated by mechanical methods (e.g. hydraulic shears or hoe-ramming), or possibly in sections by conventional or diamond-wire sawcutting. KRRC's contractor will haul concrete rubble in 25 to 30 ton articulated off-road trucks or 12 to 15 ton tandem-axle highway trucks to the scour hole below the forebay. KRRC's contractor will haul mechanical and electrical equipment and miscellaneous items in a mixture of 12 to 15 ton tandem-axle highway trucks, 25-ton rock trailers, and conventional heavy-haul trailers to an approved off-site disposal area.

Conventional earthmoving equipment required to remove the embankment will consist of up to eight 25 to 30 ton articulated off-road trucks with two 4 CY excavators to reach the required average production rate of 400 CY per hour, or 16,000 CY per week (5 days per week, single shift) for removal of the dam embankment within 8 to 9 weeks. KRRC expects the contractor to use dozers for knockdown and grading at the disposal sites as well as to support higher production, mass excavation operations.

Estimated Equipment and Workforce Requirements

The estimated equipment that will be used for the removal of J.C. Boyle Dam and Powerhouse and for restoration of the reservoir area pre- and post- drawdown are shown in Table 5.2-2.

Table 5.2-2 J.C. Boyle Dam and Powerhouse, Estimated Equipment List

Name of Equipment	Pre-Drawdown	Post Drawdown
Crawler-mounted lattice boom crane, 150 to 200 ton, 160- to 200-foot boom		X
Rough terrain hydraulic crane, 35 to 75 ton		X
Hydraulic track excavators, 65,000 to 120,000 lb, with Cat H120 hoe-ram, thumb and shear attachments		X
Cat 966 or Cat 988 wheel-loaders, 4 CY bucket		X
Cat 740 articulated rear dump trucks, 30 ton (22 CY)	X	X
D-6 or D-8 standard crawler dozers	X	X

Name of Equipment	Pre-Drawdown	Post Drawdown
Front-end wheel loader, integrated tool carrier, 25,000 lb		X
Cat TL943 rough terrain telescoping forklift		X
Rough terrain telescoping manlift		X
Truck-mounted seed sprayer, 2500 gallon		X
On-highway, light duty diesel pickup trucks, ½ ton and 1 ton crew	X	X
On-highway flatbed truck with boom crane, 16,000 lb		X
On-highway truck tractors, 45,000 lb		X
Off-highway water tanker, 5,000 gallon		X
Engine generators, 6.5 KW to 40 KW, diesel or gasoline		X
Air compressors, 100 psi, 185 to 600 cfm, diesel		X
Hand-held drilling, cutting, and demolition equipment		X
Portable welders and acetylene torches		X
4-inch submersible trash pumps, electric		X

An estimated average workforce of 25 to 30 people will be required for the construction activities, for an estimated duration of 12 months from site mobilization to construction completion for either dam removal alternative. The peak workforce required during excavation of the dam embankment could reach 40 to 45 people.

5.2.6 Imported Materials

KRRC's contractor will import some materials to the site to support dam removal. The most likely materials to be imported include gravel surfacing from a commercial quarry for temporary haul roads (approximately 2,800 tons, 100 truck trips), seed and mulch materials, and minor quantities of ready-mix concrete and reinforcing steel from local commercial sources for tunnel plugs.

5.2.7 Waste Disposal

Table 5.2-3 shows estimated quantities of materials generated during removal of J.C. Boyle Dam and Powerhouse, numbers of truck trips, and approximate haul distances for waste disposal. KRRC's contractor will place excavated concrete in the scour hole below the emergency spillway. KRRC's contractor will primarily place excavated embankment materials in the right abutment disposal area. KRRC's contractor will separate reinforcing steel from the concrete prior to placement in the scour hole and haul it to a local recycling facility. KRRC's contractor will haul all mechanical and electrical equipment to a suitable commercial landfill or salvage collection point.

Table 5.2-3 Waste Disposal for Full Removal of J.C. Boyle Dam

Waste Material	In-Situ Quantity	Bulk Quantity [1]	Disposal Site	Peak Daily Trips [2]	Total Trips [3]
Earth	102,000 CY 7,100 CY	123,000 CY 7,800 CY	Onsite right abutment disposal area Onsite powerhouse tailrace	5 units/160 trips (unpaved road) 5 units/160 trips (unpaved road)	5,600 trips (1 mile RT) 360 trip (8 miles RT)[5]
Concrete at: Dam Power canal Powerhouse	 4,700 CY 33,300 CY 1,900 CY	 6,100 CY 43,200 CY 2,600 CY	Onsite forebay spillway scour hole	2 units/50 trips (unpaved road)	 120 trips (4 miles RT) 1,810 trips (2 miles RT) 270 trips (4 miles RT)
Rebar at: Dam Power canal Powerhouse	 200 tons 3,800 tons 100 tons	—	Landfill near Klamath Falls	2 units/10 trips (OR66)	 20 trips (44 miles RT) 380 trips (48 miles RT) 10 trips (52 miles RT)
Mech. and Elec at: Dam Power canal Powerhouse	 700 tons 300 tons 1,500 tons	—	Landfill near Klamath Falls	2 units/10 trips (OR66)	 90 trips (44 miles RT) 40 trips (48 miles RT) 200 trips (52 miles RT)
Building Waste	10 buildings 12,000 ft^2	2,700 CY	Landfill near Klamath Falls	2 units/10 trips (OR66)	270 trips (44 miles RT)
Power lines	2.8 miles of 69-kV	—	Landfill near Klamath Falls		

Notes:

1. Volumes increased 30 percent for concrete rubble, 20 percent for loose earth materials.
2. Peak daily trips for each site are based on the number of vehicles (units) shown, operating within one 8-hour shift.
3. Total trips of earthfill and concrete assume off-highway articulated trucks with a nominal load capacity of 22 CY. Total trips for hauling rebar using truck tractor-trailers is based on 10 tons per trip. Total trips for hauling mechanical and electrical items using truck tractor-trailers is based on 8 tons per trip. Total trips for building waste using truck tractor-trailers is based on 10 CY per trip.

Table 5.2-4 shows potential commercial landfills or salvage collection points and capacities. Appendix O3 discusses potential hazardous materials at J.C. Boyle Dam and Powerhouse and their disposal.

Table 5.2-4 Waste Disposal Facilities near J.C. Boyle Dam

Name of Facility	Location	Distance from Site	Remaining Capacity	Materials Accepted
Klamath County landfill	Klamath Falls, OR	20 miles	435,000 CY (2010)	construction and demolition waste, asbestos, contaminated soils, and recyclables

5.3 Copco No. 1 Dam and Powerhouse

5.3.1 Removal Limits

Copco No. 1 Dam is located within a narrow canyon on the Klamath River at RM 202.2. Minimum requirements for a free-flowing condition and volitional fish passage on the Klamath River through the Copco No. 1 Dam site requires the complete removal of the concrete gravity arch dam between the left abutment rock contact and the concrete intake structure on the right abutment, to approximate elevation 2463.5, or 20 feet below the existing streambed level at the dam (see Appendix G), to prevent the development of a potential fish barrier at the site in the future. Table 5.3-1 summarizes and Figure 5.3-1 (C) shows features the Project will remove or potentially retain as PROs.

Table 5.3-1 Copco No. 1 Dam and Powerhouse, Removal Requirements

Feature	Full Removal	Partial Removal Options	Comments [2]
Concrete Dam	Remove [1]	Remove [1]	
Spillway Gates, Deck, Piers	Remove	Remove	
Penstocks	Remove	Retain	PRO: Seal openings, install security fence
Powerhouse Intake Structure	Remove	Retain	PRO: Seal openings, install security fence
Gate Houses on Right Abutment	Remove	Possible	PRO: Likely to be removed for access and for large crane for dam removal.
Diversion Control Structure	Retain	Retain	PRO: Remove gate hoists, stems, and wire ropes, demolish unstable concrete
Tunnel Portals	Plug	Plug	Plug with reinforced concrete
Powerhouse (incl. mechanical and electrical equipment)	Remove	Retain	PRO: If retained will remain in 100 year floodplain
Powerhouse Hazardous Materials (transformers, batteries, insulation)	Remove	Remove	
Four 69-kV Transmission Lines (3.0 mi total) (incl. poles and transformers)	Remove	Remove	
Switchyard	Remove	Remove	
Warehouse and Residence	Remove	Remove	

Notes:

1. Remove to El. 2463.5 which is 20 feet below original channel bottom (see Appendix G).
2. PROs would involve long-term maintenance costs, including the preservation of any exposed items with coatings containing heavy metals (such as the penstocks).

Figure 5.3-1 Copco No. 1 and Copco No. 2 Dams Removal Features and Limits (Appendix C)

Retention of the Copco No. 1 Powerhouse as a PRO will require the structure to be sealed and fenced. KRRC assumes the paint on the east (upstream) face of the concrete structure contains heavy metals and would be carefully removed. Mechanical and electrical equipment could be left in place with all power connections to the outside removed; however, any oil in the turbine governor and hydraulic control systems, transformers, oil storage tanks, or other equipment would be removed. KRRC's contractor will also remove other potentially hazardous materials, such as batteries and treated wood. KRRC's contractor could place rockfill or concrete rubble along the right river bank just upstream of the powerhouse to improve the flow conditions past the structure.

5.3.2 Construction Access

Figures 5.1-1(C) and 5.3-1(C) show construction access roads and associated improvements that may be required for removal of Copco No. 1 Dam and Powerhouse, and associated work. KRRC observed existing conditions of the highways, local roads, and structures in the field to identify deficiencies, and determine if improvements are necessary for mobilization and/or hauling during construction and demolition activities. KRRC will complete access road improvements prior to associated construction and removal at the dam and powerhouse.

The delivery of off-road construction equipment, including cranes, large excavators, loaders, and large capacity dump trucks will be by special tractor-trailer vehicles operating under "wide load" restrictions and at appropriate speeds.

Interstate 5 (I-5)

The Cascade Wonderland Highway (I-5) is classified as an interstate freeway that runs north-south through California and Oregon. The existing Henley Hornbrook interchange (Exit 789) provides access from the freeway to Copco Road. I-5 is a divided roadway with two-lanes on each direction with paved shoulders with a posted speed limit of 70 mph. KRRC's contractor will use I-5 for mobilization of construction equipment and as a haul route to carry demolished materials other than earth and concrete rubble from the dam and powerhouse site to approved commercial landfills. The alignment and pavement are in very good condition and well maintained. KRRC does not propose improvements and upgrades to this highway for mobilization or hauling of materials for the Project. Nor does KRRC propose temporary traffic control. KRRC's contractor will obtain transportation permits, if needed, from the Department of Transportation for mobilizing "wide-load" truck trailers with construction equipment or for hauling oversize materials removed from the site.

Copco Road

Copco Road is a county road that runs east-west along the Klamath River. Copco Road provides access to various local access roads that lead to Iron Gate Dam and Powerhouse, Copco No. 1 Dam and Powerhouse, and Copco No. 2 Dam and Powerhouse. Copco Road will be a primary hauling and access road for all three California dam sites for transporting materials and equipment. Construction area signs will be required to provide advance warnings to trucks and other road users to improve safety. In addition, KRRC proposes road maintenance in some areas during construction, where existing pavement is damaged due to construction trucks.

This report divides Copco Road into five sections for discussion of the existing conditions and proposed improvements needed for the Project.

Copco Road from I-5 to Ager Road (3.1 miles)

Copco Road from Interstate 5 to Ager Road is a County road and classified as a major collector. It is a two-way undivided road with pavement in good condition. KRRC does not propose improvements and upgrades to this highway for mobilization and hauling for the Project. KRRC's contractor may perform pavement rehabilitation during or post-construction. KRRC's contactor will use temporary traffic control for any pavement rehabilitation. This portion of Copco Road includes Cottonwood Creek Bridge.

Cottonwood Creek Bridge

Cottonwood Creek Bridge is a single span reinforced concrete slab bridge that is approximately 89 feet long and 32 feet wide. The structure has two 12-foot lanes and 4-foot shoulders. It was built in 1980 with an HS20-44 design loading. The structure is supported on pinned diaphragm abutments founded on spread footings. The alignment and deck are in good condition and well maintained. KRRC does not propose improvements and upgrades to this structure for mobilization for the Project. Temporary traffic control will not be required.

Copco Road from Ager Road to Lakeview Road (5 miles)

Copco Road from Ager Road to Lakeview Road is a County road and classified as a minor collector. It is a two-way undivided road with pavement in poor condition and a posted speed limit of 35 mph. KRRC does not propose improvements and upgrades to this highway for mobilization and hauling for the Project. KRRC's contractor may perform pavement rehabilitation during or post-construction. KRRC's contactor will use temporary traffic control for any pavement rehabilitation. This portion of Copco Road includes Dry Creek Bridge (Caltrans Bridge No. 2C0144).

Dry Creek Bridge

Dry Creek Bridge is a single span bridge that is approximately 24 feet long and 31 feet wide, and was built in 1960. It has timber beams and a timber deck with an asphalt overlay. The structure has two 14-foot lanes and no shoulders. The structure is supported by seat type abutments. No information is available regarding the foundation type.

The structural members of Dry Creek Bridge, which are over 55 years old, are inadequate to carry the current legal/permit loads as well as project mobilization and hauling trucks. KRRC's contactor will construct a temporary structure and detour over Dry Creek, north of the existing bridge, to allow for mobilization and hauling truck access. The type of temporary structure over the Dry Creek will be determined during the design phase. Temporary structure options include temporary railcar bridge, box culvert or pipe culvert. Alternatively, KRRC's contractor may implement bridge strengthening or bridge replacement. In the case of replacement, KRRC's contactor would still construct a temporary bridge as described above during the construction of the replacement bridge at the current location. See Figure 5.3-2 for the existing bridge location and proposed detour. KRRC anticipates minimal impact to the existing traffic for the planned improvements. Impact to traffic will be limited to the traffic switch from the existing road alignment to the detour and temporary structure.

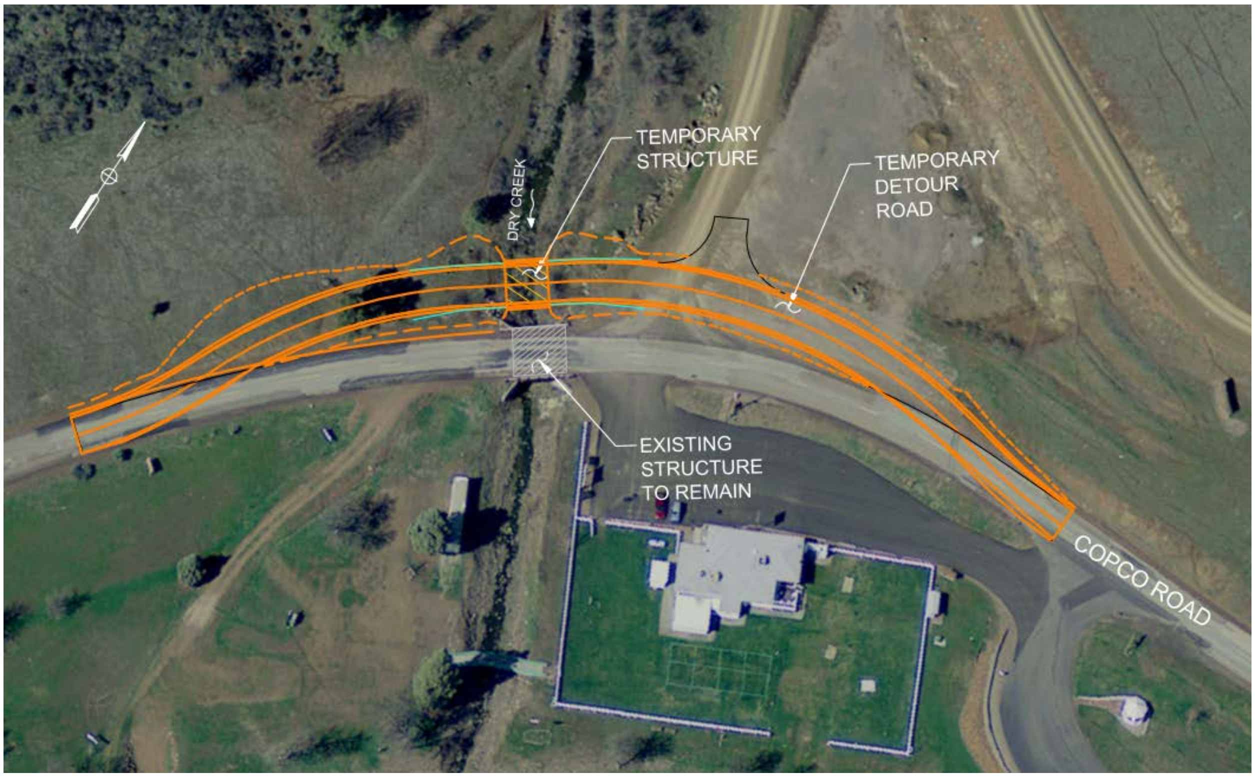

Figure 5.3-2 Copco Road Temporary Structure at Dry Creek

Copco Road from Lakeview Road to Daggett Road (9.6 miles)

Copco Road from Lakeview Road to Daggett Road is a County road classified as a minor collector and runs along the norths side of the Klamath River. It is a two-way undivided county road about 24 feet wide with posted speed limit of 35 mph. Pavement condition along this stretch is poor and will require pavement maintenance during construction. KRRC does not propose improvements and upgrades for this road prior to dam removal. KRRC's contractor may perform pavement rehabilitation during or post-construction. KRRC's contactor will use temporary traffic control for any pavement rehabilitation. This portion of Copco Road includes Brush Creek Bridge (Caltrans No. 2C0280) and Jenny Creek Bridge (Caltrans No. 2C0280).

Brush Creek Bridge

Brush Creek Bridge is a single span 18–inch-deep reinforced concrete slab bridge that is approximately 25 feet long and 24 feet wide. It was built in 1976 with an HS20-44 design loading. The structure has two12-foot lanes and no shoulders. The structure is supported on strutted abutments founded on spread footings. The alignment and deck are in fair condition and well maintained. KRRC does not propose improvements and upgrades to this structure for mobilization for the Project. KRRC does not propose temporary traffic control. KRRC does not propose post-project erosion protection.

Jenny Creek Bridge

Jenny Creek Bridge is a single span precast pre-stressed deck bulb tee girder bridge that is approximately 114 feet long and 27 feet wide (Figure 5.3-3). It was built in 2008 with an HL-93 design loading. The deck has an asphalt overlay with two12-foot lanes with no shoulders. The structure is supported on seat type abutments founded on pile caps with steel H-piles. Abutment 2 has a portion of the previous abutment left in place in front of the new abutment.

Figure 5.3-3 Jenny Creek Bridge

The alignment and deck are in very good condition and well maintained. The bridge is suitable for the access and hauling requirements of the Project, but KRRC proposes replacing this bridge as a necessary long-term improvement to offset the effects of reservoir drawdown. Refer to Section 7.4.3.9 for more details.

Copco Road from Daggett Road to Copco Access Road (2.6 miles)

Copco Road from Daggett Road to Copco Access Road is classified as a minor collector with a roadway width of 14 to 22 feet. The surface starts out as asphalt and transitions to aggregate base 1.2 miles east of the Daggett Road intersection, and has very low traffic volume. KRRC does not propose improvements and upgrades prior to dam removal. KRRC's contractor may perform road surface maintenance during or post-construction. KRRC's contactor will use temporary traffic control for any road surface maintenance. This portion of Copco Road includes Fall Creek Bridge (Caltrans Bridge No. 2C0198).

Fall Creek Bridge

Fall Creek Bridge is a single span bridge with timber beams of unknown age and a concrete deck (Figure 5.3-4). The structure is supported on seat type abutments. No information is available regarding foundation type. Since the superstructure is timber beams of unknown age and the beams appear inadequate to carry the legal/permit loads as well as project mobilization and hauling trucks. KRRC proposes replacing this structure by a single span bridge of similar length and width as the existing structure. Alternatively, the contractor may implement other methods such as a temporary bridge over the existing bridge or structural strengthening of the existing bridge.

If KRRC opts for a new bridge, KRRC's contactor will construct it at the existing bridge alignment in two phases to maintain traffic during construction of the replacement bridge. Given the topographic constraints at the site, constructing the bridge in two phases will result in less hillside excavation and impacts than providing a parallel temporary bridge and detour during construction. In the first phase, KRRC's contactor will provide one-way traffic in the southern lane using flaggers, and KRRC's contactor will construct the new northern lane. In the second phase, KRRC's contactor will reverse the operation with one-way traffic in the northern lane and construction occurring on the new southern lane of the bridge. KRRC's contactor will separate traffic from work with K-rails. See Figure 5.3-5 for the existing bridge location. Impact to traffic will involve one-way controlled traffic during the bridge replacement.

If KRRC opts for a temporary bridge, KRRC's contractor will construct it over the existing bridge with placement of a longer temporary bridge supported landward of the existing bridge supports. Some graded fill placed on the roadway approaches may be necessary to transition from the existing bridge elevation to the slightly higher temporary bridge elevation. A temporary bridge will remain in place for the duration of construction, and KRRC's contractor will remove it along with any fill on the approach roadways, leaving the existing bridge in place, at the end of construction.

Figure 5.3-4 Fall Creek Bridge on Copco Road

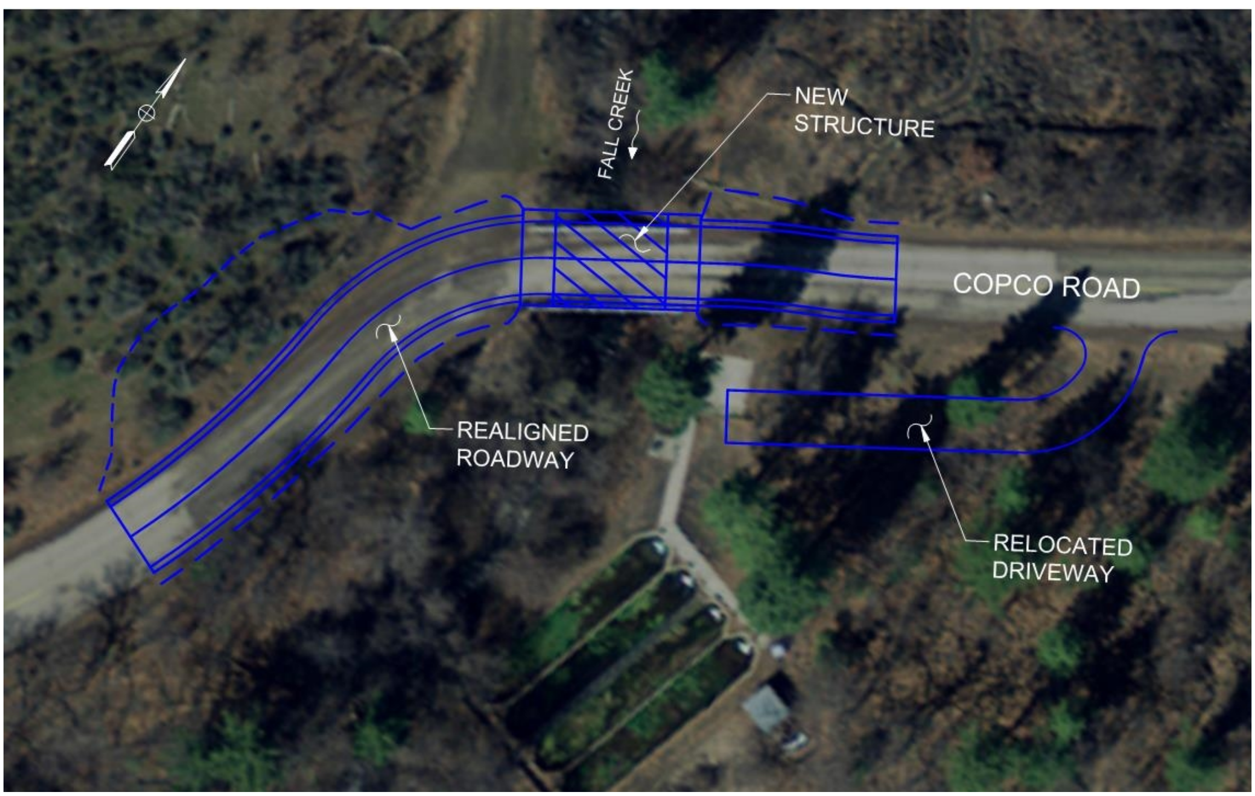

Figure 5.3-5 Fall Creek Bridge Replacement

Copco Road from Copco Access Road to Copco Road Bridge (5.9 miles)

Copco Road from Copco Access Road to Copco Road Bridge is classified as a minor collector with a roadway width of 12 feet. The road surface is primarily dirt and has very low traffic volume. KRRC's contractor will not use this portion of Copco Road for dam or powerhouse removal but will use it for construction access to various post construction improvements, such as culvert replacements and installing rock slope protection. See Section 7.4 for details. KRRC does not propose improvements and upgrades prior to dam removal. Nor does KRRC propose temporary traffic control. The east end of this segment of Copco Road crosses Copco Lake at Copco Road Bridge (Caltrans No. 2C0039).

Copco Road Bridge

Copco Road Bridge is a two-span cast-in-place post-tensioned concrete box girder bridge that is approximately 203 feet long and 25 feet wide (Figure 5.3-6). It was built in 1988 for a HS 20-44 truck design load. The structure has two 12-foot lanes and no shoulders. The structure is supported by a pier wall founded on a pile cap with steel H-piles that are grouted into rock. The abutments are diaphragm type founded on a pile cap with steel H-piles. KRRC's contractor will not use this structure for mobilization of construction equipment. The alignment and pavement are in very good condition and well maintained. KRRC does not propose improvements and upgrades to this structure for mobilization. Nor does KRRC propose temporary traffic control.

Figure 5.3-6 Copco Road Bridge

Copco Access Road

Copco Access Road is a private road between Copco Road and the dam that provides access to Copco No. 1 Dam and powerhouse sites and Copco No. 2 Dam site (Figure 5.3-7). The first approximate 0.1 mile of the road nearest Copco Road is on non-PacifiCorp private land, and the remaining approximate 0.9 miles is on PacifiCorp land. The road surface is primarily dirt with a roadway width of 14 feet up to the chain link gate, then past the gate the pavement type changes to asphalt concrete in good condition traversing through Copco No. 1 residential area. Past the residential area, the road surface changes to a dirt road with steep descending hilly terrain towards Copco No. 1 and Copco No. 2 dam sites. The Copco No. 1 Dam access portion is a dirt road with a hairpin bend. It appears landslides have occurred on the hillside above this hairpin bend. A second hairpin bend occurs on the segment down to Copco No. 2 Dam, and a third hairpin bend occurs if travelling between the top of Copco No. 1 Dam and the powerhouse.

The lower side of this access road is very steep with no barrier protection. KRRC proposes that this segment of the dirt/gravel road be regraded for construction access by clearing and grubbing the available space between the toe of the higher hillside and the existing edge of the dirt/gravel road to provide a wider road section for construction and hauling trucks. KRRC assumes one-way traffic with turnouts for the access road. Turnarounds for haul trucks will be at the powerhouse and at the disposal site or the staging area. The average one-way haul distance from the base of the dam to the disposal site is 0.5 mile.

KRRC proposes construction area signage and some temporary traffic control devices to improve safety during construction. During mobilization, the contractor will off-load equipment in the staging area and the equipment will track down to the dam and powerhouse area. KRRC's contractor will demolish the portions of the road on PacifiCorp property and restore the area with native vegetation post-construction.

Barge access to the outlet of the diversion tunnel for construction of a new gate structure will occur from the right bank just upstream of the Copco No. 2 Dam.

Barge access to Copco Lake will occur at an existing boat ramp located at Copco Cove on the western shore (Figure 5.1-1(C)). Access to the boat ramp will require minor improvement of the Copco Cove access road for placing the barge-mounted crane on the reservoir. The boat ramp will also require extension into the reservoir to be able to remove the barge following removal of the spillway structure.

Ager Beswick Road

Ager Beswick Road between Copco Road to the east and Ager Road to the west is classified as a minor collector road with a posted speed limit of 25mph. It is a two-way undivided County road with pavement condition ranging from fair to good. KRRC's contractor will not use the road for hauling, but the contractor may use it for mobilization of a barge-mounted crane from the existing boat ramp at Mallard Cove on the southern shore. KRRC does not propose upgrades and improvements to this road prior to dam removal. Access to the boat ramp will require minor improvements to the access road off of Ager Beswick Road to enable placing a barge-mounted crane in the reservoir. The boat ramp will also require extension into the reservoir to be able to remove the barge following removal of the spillway structure. KRRC does not propose temporary traffic control.

Figure 5.3-7 Copco Access Road

5.3.3 Staging Areas and Disposal Sites

Figure 5.3-1(C) shows construction staging areas and a disposal site for removal of Copco No. 1 Dam and Powerhouse within the limits of work, and these are discussed in the following sections. KRRC's contractor will mobilize construction equipment to the site by about June 2020 to prepare the staging areas and disposal site, and construct the diversion tunnel improvements described in Section 4.2.

Staging Areas

The primary 2.3 acre staging area will be located on the right abutment near the existing switchyard as shown on Figure 5.3-1(C), Sheet 1. Two smaller staging areas are located in the same vicinity (0.6 acre across the road and 0.5 acre by the penstocks).

Disposal Sites

A single disposal site, located on the right abutment at the current location of a maintenance building and a vacant residence (Figure 5.3-1(C) and Figure 5.3-8(C)), will be used for concrete debris generated from the removal of the dam and powerhouse. The disposal area covers an area of approximately 3.5 acres. KRRC's contractor will grade the disposal site as a hill (maximum fill height of about 55 feet) contoured to blend into the surrounding topography as shown in plan and section on Figure 5.3-1(C), Sheet 1. Preparation of the disposal area will include clearing of vegetation, demolition of the two structures, removal of transmission lines, and stripping and stockpiling of excavated topsoil for later use. After placement of the concrete debris (without rail and rebar), the on-site disposal area will be covered with topsoil and the excavated embankment material from Copco No. 2 Dam (see Section 5.4), graded, sloped for drainage, and hydroseeded. Compaction of materials placed in the disposal area other than by bulldozers spreading the materials and equipment travel will not be required. See Section 6 for additional detail associated with restoration. KRRC will complete erosion monitoring on an annual basis for 5 years following placement to assess whether significant erosion and slope deterioration has occurred. If significant erosion occurs, KRRC will repair the eroded area to the satisfaction of the appropriate regulatory agency.

Rebar, mechanical and electrical equipment, building materials and demolished powerline material will be disposed of at an approved landfill near Yreka, CA. Tonnage and volume of these materials are listed in Table 5.3-3.

Figure 5.3-8 Copco No. 1 & Copco No. 2 Disposal Site Plan & Sections (Appendix C)

5.3.4 Copco No. 1 Dam and Powerhouse Removal

Dam and Powerhouse Removal

KRRC's contractor will remove the spillway gates and operators, the spillway bridge deck, and the spillway piers in December 2020 as the reservoir is drawn down to below the spillway crest (completed January 1, 2021). With the reservoir drawn down to approximate elevation 2590, KRRC's contractor will use a barge-mounted crane to remove all 13 spillway gates and operators, spillway bridge deck, and spillway gate piers in the dry. The contractor will then remove the barge-mounted crane from the site.

As the reservoir is drawn down through the new large gate structure at the downstream end of the diversion tunnel, the following work will be performed:

1. Close the penstock gates and demolish the right abutment gate houses and mobilize large crane to the right abutment above the dam to provide construction access and support for dam removal.
2. Demolish the penstocks, remove the mechanical and electrical equipment from the powerhouse, and demolish the above grade portion of the powerhouse and prepare it for use as a part of construction access to the downstream side of the dam.
3. Excavate the dam in lifts (assumed to be 12-foot high) between abutments in the dry (Figure 5.3-9(B)). Drop concrete rubble to the base of the dam to form a temporary access between the dam base and the powerhouse. Haul concrete rubble by truck from the base of the dam to the disposal site on right abutment (Figure 5.3-1(C), Sheet 1).

4. Remove concrete powerhouse intake structure on the right abutment in the dry concurrent with dam demolition. Extend temporary access road to the dam toe upstream for removal of the concrete rubble from the intake structure.
5. Construct and maintain temporary cofferdams in the river channel as required for removal of the powerhouse and of the diversion control structure in the dry, during low flow period.
6. Demolish remaining portion of powerhouse and remove all rubble using trucks along access road. Use sump pumps to unwater low areas as required.
7. Remove cofferdams from river channel when no longer needed.
8. Plug upstream diversion tunnel intake.
9. Demolish new diversion gate structure and plug downstream portal of the diversion tunnel with concrete.
10. Restore dam site, staging area, and concrete disposal site. Place topsoil and seed where required.
11. Demobilize from site.

Portions of the dam and hydropower demolition must be performed within the in-stream construction window negotiated with the regulatory agencies. See Section 8.6 of this Definite Plan for information pertaining to the construction schedule and timing of the various activities.

Figure 5.3-9 Copco No. 1 Dam Removal (Appendix B)

Transmission Line and Switchyard Removal

Transmission line removal at Copco No. 1 includes demolishing the Copco No. 1 switchyard, demolishing overhead distribution and transmission lines and associated poles or towers, as applicable, and installation of new connections to maintain the power grid (see Figure 5.2-12).

KRRC's contractor will demolish approximately 3.7 miles of overhead transmission/distribution line and approximately 39 poles. Lines to be demolished include:

- 69 kV transmission lines between Copco No. 1 switchyard and Copco No. 1 powerhouse
- 69 kV transmission lines between Copco No. 1 switchyard and Copco No. 2 powerhouse, while maintaining poles with distribution underbuild
- Production lines in the general area of Copco No. 1 powerhouse
- Distribution lines supplying the two village houses near the dam
- 69 kV transmission lines between Copco No. 1 switchyard and Fall Creek hydro-electric plant; including removing transmission conductors (69 kV) on Poles "1X/001" and "2X/001" but keeping the distribution conductors intact
- Distribution lines between Copco No. 1 switchyard and Copco No. 2. Dam

Major switchyard demolition components include:

- Four (4) 69 kV Dead End Structures
- Two (2) 69 kV Circuit Breakers
- Four (4) 69 kV Disconnect Switches (on same structure as Circuit Breakers)
- All associated auxiliary equipment

New connections include relocation of existing poles in the proposed Copco disposal site to locations nearer the access road and reconnection of that distribution line.

5.3.5 Demolition Methods, Estimated Equipment and Workforce

KRRC proposes the following demolition methods, estimated equipment requirements, and estimated workforce requirements for planning purposes based on engineering judgment. Alternative methods, equipment, and workforce that will also meet project requirements are possible and could be refined by the selected contractor.

Demolition Methods

The concrete gravity arch dam was constructed with large (cyclopean) boulders placed in the concrete matrix, and reinforced throughout with an estimated 455 tons of 30-pound steel rails placed in horizontal mats and in vertical rows across construction joints (for an average weight of about 25 lb per CY of concrete). Dam demolition will likely be performed in horizontal lifts using conventional drilling and blasting methods. Drilling, using small air track or hydraulic track drills that could safely operate on the dam crest, will likely control overall production. Up to five drill crews will be required working two 8-hour shifts 5-days per week. KRRC assumes the need for redrilling where rail steel is encountered will impact production. KRRC estimates blasting an average of between three and six shots per day for up to 16 weeks.

KRRC assumes acetylene torches to cut rail steel in the dam. A large crawler-mounted crane will likely be used on the right abutment to help remove the rail steel from the dam. A sheet-pile or H-pile cofferdam will be constructed along the right bank of the river to isolate a portion of the dam toe and the powerhouse, providing an access road and a work pad to stage concrete rubble collection, loading, and hauling. Concrete rubble will likely be loaded into articulated off-road rock trucks having a haul capacity of 30 tons, using either a hydraulic track excavator or a front-end loader. Over 700 tons of concrete rubble could be removed per day using two trucks making 12 rounds each during one 8-hour shift, with nearly 70,000 tons (or 36,000 CY in-place volume) to be removed from the dam within approximately 16 weeks.

KRRC assumes removal of mass concrete in the right abutment intake structure in lifts, similar to the concrete in the dam, but at a slower rate due to the embedded penstock pipes and mechanical equipment. The contractor could remove the concrete rubble from the lift surface using a large crane, or from the bottom of the canyon using an extension of the lower haul road constructed for demolition of the dam, during the low flow period. KRRC's contractor will excavate reinforced concrete in the powerhouse deck, wall, and floor slabs by mechanical methods (e.g. hydraulic shears and hoe-ramming).

Estimated Equipment and Workforce Requirements

The estimated equipment that will be used for the removal of Copco No. 1 Dam and Powerhouse and for restoration of the reservoir area is shown in Table 5.3-2.

Table 5.3-2 Copco No. 1 Dam and Powerhouse, Estimated Equipment List

Name of Equipment	Pre-Drawdown	Post-Drawdown
Crawler-mounted lattice boom crane, 100 to 120 ton, 160- to 200-foot boom	X	X
Rough terrain hydraulic crane, 35 to 75 ton	X	X
Mid-size hydraulic excavator, 28,000 to 60,000 lb, 1 to 2 CY bucket	X	X
Cat 336 hydraulic track excavator, 80,000 lb, 3.5 CY bucket		X
Hydraulic track excavators, 65,000 to 120,000 lb, with Cat H120 hoe-ram, thumb and shear attachments		X
Cat 966 (52,000 lb, 5 CY bucket) or Cat 988 (65,000 lb, 6 CY bucket) articulated wheel-loaders		X
Cat 725 or Cat 730 articulated rear dump trucks, 30 ton (22 CY)	X	X
D-6 or D-7 standard crawler dozers	X	X
Front-end wheel loader, integrated tool carrier, 25,000 lb		X
Cat TL943 rough terrain telescoping forklift	X	X
Rough terrain telescoping manlift		X
Cat 140 motorgrader		X
Flexifloat sectional barges	X	X
Truck-mounted seed sprayer, 2500 gallon		X
On-highway, light duty diesel pickup trucks, ½ ton and 1 ton crew	X	X
On-highway flatbed truck with boom crane, 16,000 lb	X	X
On-highway truck tractors, 45,000 lb	X	X
Off-highway water tanker, 5,000 gallon		X
On-highway water truck, 4,000 gallon		X
Engine generators, 6.5 KW to 40 KW, diesel or gasoline	X	X
Air compressors, 100 psi, 185 to 600 cfm, diesel	X	X
Airtrack drill or hydraulic track drill		X
Hand-held drilling, cutting, and demolition equipment	X	X
Portable welders and acetylene torches	X	X
4-inch submersible trash pumps, electric	X	X
Light plants, 2,000 to 6,000 watt, 10 to 25 hp, diesel		X

An estimated average workforce of 30 to 35 people will be required for the construction activities, for an estimated duration of 19 months from site mobilization to construction completion. The peak workforce required during demolition of the concrete dam could reach 50 to 55 people.

5.3.6 Imported Materials

KRRC's contractor will need to import some materials to the site to support dam removal. The most likely materials to be imported include gravel surfacing from a commercial quarry for temporary haul roads (approximately 320 tons, 10 truck trips), sheetpile or H-piles for construction of cofferdams, topsoil (approximately 10,200 CY and 850 truck trips assuming 12 CY per truck or tractor trailer), seed and mulch materials, and minor quantities of ready-mix concrete and reinforcing steel from local commercial sources for tunnel plugs. Construction of the new gate structure in the year prior to dam removal will require importing mechanical equipment, and additional reinforcing steel and ready-mix concrete for lining the diversion tunnel and constructing the new gate structure.

5.3.7 Waste Disposal

Table 5.3-3 shows estimated quantities of materials generated during removal of Copco No. 1 Dam and Powerhouse, numbers of truck trips, and approximate haul distances for waste disposal. KRRC's contractor will place excavated concrete in the on-site disposal site. KRRC's contractor will separate rail and reinforcing steel from the concrete prior to placement in the disposal area and haul it to a local recycling facility. KRRC's contractor will haul all mechanical and electrical equipment to a suitable commercial landfill or salvage collection point.

Table 5.3-4 shows potential commercial landfills or salvage collection points and capacities. Appendix O3 discusses potential hazardous materials at Copco No. 1 Dam and Powerhouse and their disposal.

Table 5.3-3 Waste Disposal for Full Removal of Copco No. 1 Dam

Waste Material	In-Situ Quantity	Bulk Quantity [1]	Disposal Site	Peak Daily Trips [2]	Total Trips [3]
Concrete	75,900 CY	104,000 CY	On-site	2 units/50 trips (unpaved road)	4,430 trips (2 miles RT)[4]
Rebar	1,000 tons	—	Transfer station near Yreka	1 unit/5 trips (Copco Road)	100 trips (62 miles RT)
Mech. and Elec	1,100 tons	—	Transfer station near Yreka	1 unit/5 trips (Copco Road)	140 trips (62 miles RT)
Building Waste	2 buildings 1,300 ft^2	300 CY	Transfer station near Yreka	1 unit/5 trips (Copco Road)	30 trips (62 miles RT)
Power lines	3.0 miles of 69-kV	—	Transfer station near Yreka		

1. Volumes increased 30 percent for concrete rubble from reinforced concrete and 40 percent from mass concrete.
2. Peak daily trips for each site are based on the number of vehicles (units) shown, operating within one 8-hour shift.
3. Total trips of concrete assume off-highway articulated trucks with a nominal load capacity of 22 cubic yards. Total trips for hauling rebar using truck tractor-trailers is based on 10 tons per trip. Total trips for hauling mechanical and electrical items using truck tractor-trailers is based on 8 tons per trip. Total trips for building waste using truck tractor-trailers is based on 10 CY per trip.
4. Truck trips for concrete disposal will only travel on project lands and private roads. These trips will not occur on public roads.

Table 5.3-4 Waste Disposal Facilities near Copco No. 1 Dam

Name of Facility	Location	Distance from Site	Remaining Capacity	Materials Accepted
Yreka Transfer Station	Yreka, CA	30 miles	3,924,000 CY (2010)	Class III sanitary landfill accepting construction and demolition waste and mixed municipal waste, and Medium volume transfer station accepting metals and mixed municipal recyclable materials

5.4 Copco No. 2 Dam and Powerhouse

5.4.1 Removal Limits

Copco No. 2 Dam is located within a narrow canyon on the Klamath River at RM 201.8. Minimum requirements for a free-flowing condition and volitional fish passage on the Klamath River through the Copco No. 2 Dam site will require the removal of the concrete gated spillway structure and concrete end sill between the existing sidewalls. Table 5.4-1 summarizes and Figure 5.3-1 (C) shows features the Project will remove or potentially retain as PROs.

Table 5.4-1 Copco No. 2 Dam and Powerhouse, Removal Requirements

Feature	Full Removal	Partial Removal Options	Comments[1]
Concrete Dam	Remove	Remove	
Spillway Gates, Structure	Remove	Remove	
Power Penstock Intake Structure and Gate	Remove	Retain	PRO: Seal openings, install security fence
Tunnel Portals	Concrete Plug	Retain	PRO: Intake structure gate could be closed
Embankment Section and right sidewall	Remove	Remove	
Basin Apron and End Sill	Remove	Remove	
Remnant Cofferdam Upstream of Dam	Remove	Remove	
Wood-stave Penstock	Remove	Remove	
Concrete Pipe Cradles	Remove	Retain	
Steel Penstock, Supports, Anchors	Remove	Retain	PRO: Could be retained for historic purposes Seal openings, install security fence

Feature	Full Removal	Partial Removal Options	Comments[1]
Powerhouse (incl. mechanical and electrical equipment)	Remove	Retain	PRO: Could be retained for historic purposes Seal openings, install security fence
Powerhouse Hazardous Materials (transformers, batteries, insulation)	Remove	Remove	
Powerhouse Control Center Building, Maintenance Building, Oil and Gas Storage Building	Remove	Remove	
69-kV Transmission Line, 6.5 mi	Remove	Remove	
Switchyard	Retain Portions	Retain Portions	Portions must remain in service with 230-kV switchyard on north side of river
Tailrace Channel	Backfill	Backfill	
Copco Village (incl. Former Cookhouse/Bunkhouse, Modern Bunkhouse, Garage/Storage Building, Bungalow with Garage, 3 Modular Houses, 4 Ranch-Style Houses, and School house/Community Center)	Remove	Remove	

Note:

1. Partial removal options would involve long-term maintenance costs, including the preservation of any exposed items with coatings containing heavy metals (such as the penstocks).

Retention of the Copco No. 2 Powerhouse as a PRO would require the structure to be sealed and fenced. Mechanical and electrical equipment could be left in place with all power connections to the outside removed; however, any oil in the turbine governor and hydraulic control systems, transformers, oil storage tanks, or other equipment would need to be removed. KRRC's contractor will also remove other potentially hazardous materials, such as batteries and treated wood.

5.4.2 Construction Access

Figures 5.1-1(C) and 5.3-1(C) show construction access roads and associated improvements that may be required for removal of Copco No. 2 Dam, which will be the same as for Copco No. 1 Dam and Powerhouse, and are discussed in Section 5.3.2. Figure 5.3-1(C) shows the construction access roads for removal of Copco No. 2 Powerhouse and the wood-stave penstock within the limits of work, and these are discussed in the following sections. KRRC will complete access road improvements prior to associated construction and removal at the dam and powerhouse.

Copco Road

Copco Road from I-5 provides the primary access to Copco No. 2 Dam and Powerhouse. Refer to Section 5.3.2 for more details. The main haul and access road included in that section is applicable to

Copco No. 2 Dam. The average one-way haul distance from Copco No. 2 dam to the disposal site is approximately 0.3 mile.

The delivery of off-road construction equipment, including cranes, large excavators, and loaders will be by special tractor-trailer vehicles operating under “wide load” restrictions and at appropriate speeds. KRRC’s contractor will off-load equipment used for dam removal in the staging area and the equipment will track down to the dam under their own power.

Daggett Road

Copco No. 2 Powerhouse and the wood-stave penstock are accessed from Copco Road via Daggett Road. Daggett Road is a PacifiCorp-owned private gravel access road with a roadway width of 12 to 14 feet. Approximately 0.25 miles from Daggett Road Bridge, the surface becomes primarily dirt at 10 to 12 feet wide, and has very low traffic volume. KRRC assumes one-way traffic with turnouts for the access roads, for an average haul distance of 0.5 mile from the powerhouse to the bridge. KRRC does not propose improvements and upgrades prior to dam removal. KRRC’s contractor may perform road surface maintenance during or post-construction. Temporary traffic control will not be required because this is not a public road. This portion of Daggett Road includes Daggett Road Bridge.

The delivery of off-road construction equipment, including cranes, large excavators, and loaders will be by special tractor-trailer vehicles operating under “wide load” restrictions and at appropriate speeds. KRRC’s contractor will off-load equipment used for removal of the powerhouse and wood-stave penstock in Copco Village and the equipment will track down to the powerhouse area and wood-stave penstock under their own power.

Daggett Road Bridge

Daggett Road Bridge is PacifiCorp-owned, private four span continuous steel bridge that utilizes rolled beams in the approach spans and a riveted steel plate girder for the main span. The structure has a timber deck and railings and is approximately 233 feet long and 14 feet wide. It has one 12-foot lane and no shoulders. The structure is supported on concrete pier walls at Bents 3 and 4 that are founded on what appears to be rock masonry footings. Bent 1 is composed of steel H-pile extensions with a steel cap. The abutments are seat type. The main span girder and Bents 3 and 4 were constructed in, approximately, 1924 and incorporated into the reconstructed structure in 1983. The reconstructed structure was built for a HS20 truck design load. The structure has been posted with load limits based upon an unknown analysis. No information is available regarding the foundations.

KRRC’s contractor will use this structure for mobilization of construction equipment and for hauling of demolished materials to commercial landfills. Because the bridge has been posted with a reduced load limit that is less than the current legal/permit loads on bridges and the loads of vehicles that will use it for the Project, KRRC proposes replacing this structure with a bridge of similar length and width as the existing structure. Alternatively, the contractor may implement other methods such as a temporary bridge adjacent to the existing bridge or structural strengthening of the existing bridge.

KRRC's contactor will construct either a new bridge structure or a temporary bridge adjacent to the existing bridge on a revised alignment. KRRC's contactor will remove the old bridge only after completion of the new bridge structure. KRRC's contactor will realign the approach roadway slightly for the new bridge or temporary bridge location (Figure 5.4-1). Impacts to traffic will be limited to the traffic switch from the existing road alignment to the new one. A new bridge will be left in place post-construction for future property owner access. A temporary bridge will remain in place for the duration of construction and will be removed, leaving the existing bridge in place, at the end of construction, and the approach roadways will be restored to the existing alignments,

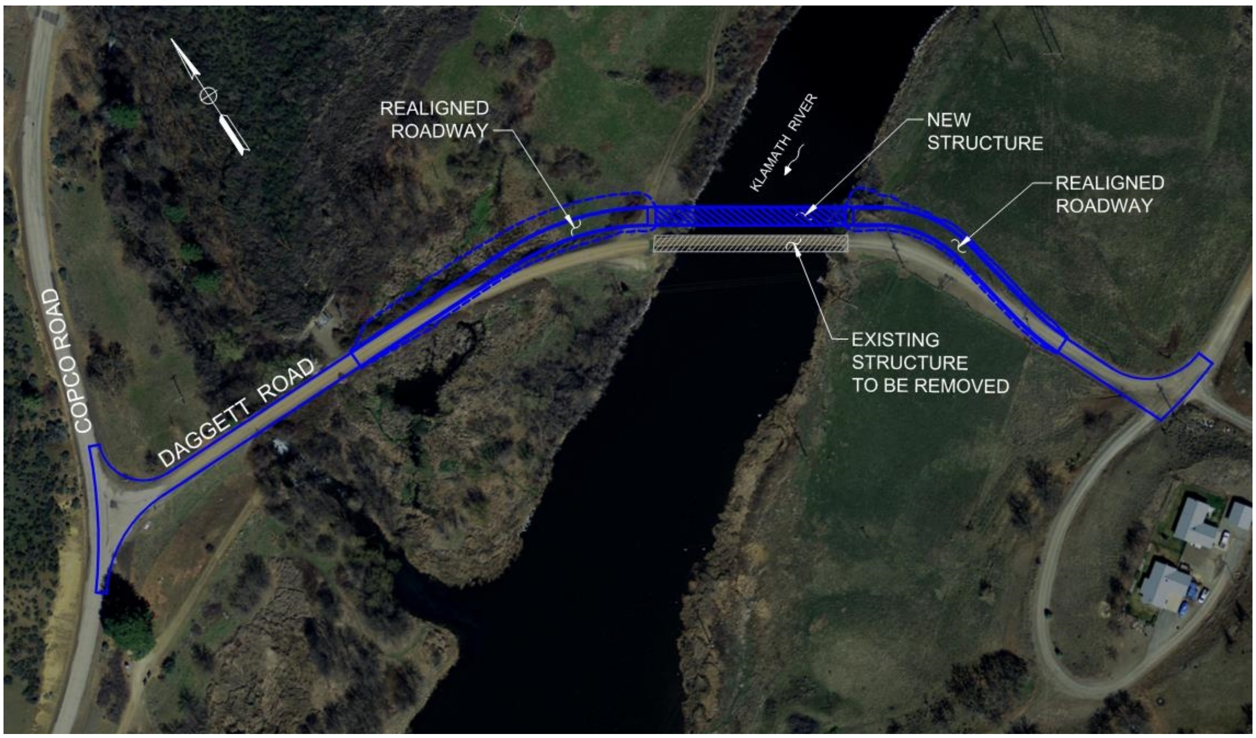

Figure 5.4-1 Daggett Road Bridge Replacement

5.4.3 Staging Areas and Disposal Sites

Staging areas and disposal sites for removal of Copco No. 2 Dam will be the same as for Copco No. 1 Dam and Powerhouse as shown on Figure 5.3-1 (C) and as discussed in Section 5.3.3. Figure 5.3-1(C), Sheet 2 shows the staging areas and disposal sites for removal of Copco No. 2 Powerhouse and the wood-stave penstock within the limits of work on, and these are discussed in the following sections.

Staging Areas

Equipment staging areas for dam removal will be the same as described for Copco No. 1 (see Section 5.3.3). Work areas for removal of the wooden lathe penstock and the powerhouse will be as shown on Figure 5.3-1(C), Sheets 2 and 3. An additional 0.9-acre staging area is located at the powerhouse.

Disposal Sites

KRRC's contractor will permanently bury concrete rubble generated from removal of Copco No. 2 Dam in the disposal site described in Section 5.3.3.2 for Copco No. 1. KRRC's contractor will use earth materials generated from removal of Copco No. 2 Dam as cover over the concrete rubble in the disposal site.

KRRC's contractor will permanently bury concrete rubble generated from removal of the Copco No. 2 Powerhouse in the powerhouse tailrace covering an area of about 1 acre. After placement of the concrete rubble (sans rail and rebar), the on-site disposal area will be covered with materials excavated from nearby areas that were graded around the powerhouse facilities during original construction, graded, sloped for drainage, and hydroseeded. Compaction of materials placed in the tailrace channel other than by bulldozers spreading the materials and equipment travel will not be required. KRRC will complete erosion monitoring on an annual basis for 5 years following placement to assess whether significant erosion and slope deterioration has occurred. If significant erosion occurs, KRRC will repair the eroded area to the satisfaction of the appropriate regulatory agency.

Rebar, mechanical and electrical equipment, building materials, demolished powerline material and woodstave material will be disposed of at an approved landfill near Yreka, CA. Tonnage and volume of these materials are listed in Table 5.4-3.

5.4.4 Copco No. 2 Dam and Powerhouse Removal

Dam Removal

Dam removal will begin on about May 1, 2021 by closing the caterpillar gate at the power penstock intake structure to stop releases to Copco No. 2 Powerhouse and cease power generation. KRRC's contractor will make controlled releases through the gated spillway (crest elevation 2476.5) during the low flow period to draw the reservoir down from RWS elevation 2486.5 to RWS elevation 2481.5 in one day using the two right-hand side spillway gates. Remove of the dam will include the following steps.

1. Remove equipment and concrete pad from dike crest to provide room for demolition equipment and for construction access.
2. Construct a temporary cofferdam within the river channel to isolate the two left-hand spillway bays and the power penstock intake structure (see Figure 5.4-2(B)). Remove the spillway gates, hoists, bridge deck, and concrete crest structure to elevation 2457.5 in the dry. Remove trash racks, caterpillar gate, and concrete structure, and construct tunnel plug in the dry. Restore left river bank. Remove temporary cofferdam and allow reservoir to stabilize at approximately RWS elevation 2463.5 through left-hand dam breach.

3. Construct a second temporary cofferdam within the river channel to isolate the three remaining spillway bays on the right-hand side (Figure 5.4-2 (B)). Remove the spillway gates, hoists, bridge deck, and concrete crest structure to elevation 2457.5 in the dry. Remove earth embankment. Remove temporary cofferdam.
4. Complete any remaining demolition work as required. Restore Dam site and on-site disposal area (shared with Copco No. 1 demolition) as required by October post-drawdown, including the placement of topsoil and seeding. Demobilize from site.

Portions of the dam and hydropower demolition must be performed within the in-stream construction window negotiated with the regulatory agencies. See Section 8.6 of this Definite Plan for information pertaining to the construction schedule and timing of the various activities.

Figure 5.4-2 Copco No. 2 Dam Removal (Appendix B)

Powerhouse and Wood-Stave Penstock

Removal of the wooden stave penstock and powerhouse will occur following closure of the caterpillar gate and shutdown of the powerhouse on about May 1, 2021, as follows:

1. Remove wood-stave penstock and concrete features and construct reinforced concrete tunnel plugs at the tunnel portal at each end of the wood-stave penstock.
2. Construct cofferdam in tailrace channel for removal of powerhouse in the dry during low flow period. Use sump pumps to unwater area. Leave cofferdam in place within tailrace channel and backfill to restore left river bank.

Transmission Line and Switchyard Removal

Transmission line removal at Copco No. 2 includes demolishing portions of the Copco No. 2 switchyard south of the river and demolishing overhead distribution and transmission lines and associated poles or towers, as applicable (see Figure 5.2-12). The Copco No. 2 switchyard north of the river will remain.

KRRC's contactor will demolish approximately 6.7 miles of overhead transmission/distribution line and approximately 40 poles. Lines to be demolished include:

- Distribution lines between Copco No.2 powerhouse line and Copco No. 2 Dam
- 69 kV transmission lines between Copco No. 1 switchyard and Copco No.2 powerhouse branch line
- 69 kV transmission lines between Copco No. 2 powerhouse and Iron Gate switchyard
- Production lines in the general area of Copco No. 2 powerhouse

Major switchyard demolition components include:

- Two (2) 115 kV / MV transformers. (secondary voltage not known)
- Five (5) medium voltage circuit breakers
- One (1) MV / 12 kV transformer (primary voltage not known)

- All associated auxiliary equipment

5.4.5 Demolition Methods, Estimated Equipment and Workforce

KRRC proposes the following demolition methods, estimated equipment requirements, and estimated workforce requirements for planning purposes based on engineering judgment. Alternative methods, equipment, and workforce that will also meet project requirements are possible and could be refined by the selected contractor.

Demolition Methods

KRRC's contactor will remove the spillway gates and traveling hoists by a large crane for loading onto highway trucks and heavy-haul trailers. KRRC's contactor could remove the reinforced concrete spillway bridge deck and piers in pieces by hydraulic excavators or in sections by conventional or diamond-wire sawcutting. Removal of the remainder of the spillway concrete structure will likely be performed using conventional drilling and blasting methods as each portion is dewatered. Drilling for blasting will include small- to mid-sized hydraulic track drills and perhaps air-track drills supported by 850 to 1,200 CFM air compressors. KRRC's contactor could use considerable jack-leg and hand drilling to supplement the machine drilling for special shots. The loading and hauling equipment will be similar to that employed at Copco No. 1, but with fewer active crews. KRRC's contactor will excavate reinforced concrete in deck, wall, and floor slabs for remaining features to be removed (including intake structure, gravity structure, sidewalls, apron, and powerhouse) by mechanical methods (e. g. hydraulic shears or hoe-ramming).

Estimated Equipment and Workforce

The estimated equipment that will be used for the removal of Copco No. 2 Dam and Powerhouse and for restoration of the reservoir area is shown in Table 5.4-2.

Table 5.4-2 Copco No. 2 Dam and Powerhouse, Estimated Equipment List

Name of Equipment	Pre-Drawdown	Post-Drawdown
Crawler-mounted lattice boom crane, 100 to 120 ton, 160- to 200-foot boom		X
Rough terrain hydraulic crane, 35 to 75 ton	X	X
Mid-size hydraulic excavator, 28,000 to 60,000 lb, 1 to 2 CY bucket	X	X
Cat 336 hydraulic track excavator, 80,000 lb, 3.5 CY bucket		X
Hydraulic track excavators, 65,000 to 120,000 lb, with Cat H120 hoe-ram, thumb and shear attachments		X
Cat 966 (52,000 lb, 5 CY bucket) or Cat 988 (65,000 lb, 6 CY bucket) articulated wheel-loaders		X
Cat 725 or Cat 730 articulated rear dump trucks, 30 ton (22 CY)		X
D-6 or D-7 standard crawler dozers		X
Front-end wheel loader, integrated tool carrier, 25,000 lb	X	X

Name of Equipment	Pre-Drawdown	Post-Drawdown
Cat TL943 rough terrain telescoping forklift	X	X
Rough terrain telescoping manlift	X	X
On-highway, light duty diesel pickup trucks, ½ ton and 1 ton crew	X	X
On-highway flatbed truck with boom crane, 16,000 lb	X	X
On-highway truck tractors, 45,000 lb	X	X
Off-highway water tanker, 5,000 gallon		X
On-highway water truck, 4,000 gallon	X	X
Engine generators, 6.5 KW to 40 KW, diesel or gasoline	X	X
Air compressors, 100 psi, 185 to 600 cfm, diesel	X	X
Airtrack drill or hydraulic track drill		X
Hand-held drilling, cutting, and demolition equipment	X	X
Portable welders and acetylene torches	X	X
4-inch submersible trash pumps, electric	X	X

An estimated average workforce of 25 to 30 people will be required for the construction activities, for an estimated duration of about 6 months from site mobilization to construction completion for either dam removal alternative. The peak workforce required during excavation of the dam and powerhouse could reach 35 to 40 people.

5.4.6 Imported Materials

KRRC assumes import of some materials to the site to support dam removal. The most likely material that may be required for construction will include gravel surfacing for temporary haul roads, soil cover for concrete waste disposal, seed and mulch materials, and minor quantities of ready-mix concrete and reinforcing steel from local commercial sources for tunnel plugs.

5.4.7 Waste Disposal

Table 5.4-3 shows estimated quantities of materials generated during removal of Copco No. 2 Dam and Powerhouse, numbers of truck trips, and approximate haul distances for waste disposal. Concrete rubble generated during dam removal will be placed within the same on-site disposal area on the right abutment (Figure 5.3-1(C), Sheet 1) used for Copco No. 1 Dam. KRRC's contactor will use excavated embankment material as topsoil to cover the on-site disposal area after grading and being sloped for drainage. KRRC's contactor will bury concrete rubble resulting from demolition of the powerhouse within the existing tailrace channel. KRRC's contactor will separate reinforcing steel from the concrete prior to placement in the disposal area or tailrace channel and haul it to a local recycling facility. KRRC's contactor will haul all mechanical and electrical equipment to a suitable commercial landfill or salvage collection point.

Table 5.4-4 shows potential commercial landfills or salvage collection points and capacities. Appendix O3 discusses potential hazardous materials at Copco No. 2 Dam and Powerhouse and their disposal.

Table 5.4-3 Waste Disposal for Full Removal of Copco No. 2 Dam

Waste Material	In-Situ Quantity	Bulk Quantity [1]	Disposal Site	Peak Daily Trips [2]	Total Trips [3]
Earth	1,800 CY	2,100 CY	On-site	2 units/50 trips (unpaved road)	100 trips (2 miles RT)[4]
Concrete at dam	6,600 CY	8,500 CY	On-site	2 units/50 trips (unpaved road)	390 trips (2 miles RT)[4]
Concrete at powerhouse	6,300 CY	8,100 CY	Onsite tailrace area	Dispose at site (no hauling)	0
Rebar at: Dam Powerhouse	 300 tons 100 tons	—	Transfer station near Yreka, CA	1 unit/5 trips (Copco Road)	30 trips (62 miles RT) 10 trips (56 miles RT)
Mech. And Elec at: Dam Powerhouse	 300 tons 1,900 tons	—	Transfer station near Yreka, CA	1 unit/5 trips (Copco Road)	40 trips (62 miles RT) 240 trips (56 miles RT)
Building Waste	XX buildings 10,6000 ft²	2300 CY	Transfer station near Yreka, CA	1 unit/5 trips (Copco Road)	230 trips (56 miles RT)
Treated wood (wood-stave penstock)	700 tons		Landfill near Anderson, CA	1 unit/2 trips (Interstate 5)	70 trips(140 miles RT)
Power lines	6.5 miles of 69-kV	—	Transfer station near Yreka, CA		

Notes:

1. Volumes increased 30 percent for concrete rubble, 20 percent for loose earth materials.
2. Peak daily trips for each site are based on the number of vehicles (units) shown, operating within one 8 hour shift.
3. Total trips of earthfill or concrete assume off-highway articulated trucks with a nominal load capacity of 22 CY. Total trips for hauling rebar using truck tractor-trailers is based on 10 tons per trip. Total trips for hauling mechanical and electrical items using truck tractor-trailers is based on 8 tons per trip. Total trips for building waste using truck tractor-trailers is based on 10 CY per trip.
4. Truck trips for earth and concrete disposal will only travel on project lands and private roads. These trips will not occur on public roads.

Table 5.4-4 Waste Disposal Facilities near Copco No. 2 Dam

Name of Facility	Location	Distance from Site	Remaining Capacity	Materials Accepted
Yreka Transfer Station	Yreka, CA	30 miles	3,924,000 CY (2010)	Class III sanitary landfill accepting construction and demolition waste and mixed municipal waste, and Medium volume transfer station accepting metals and mixed municipal recyclable materials

5.5 Iron Gate Dam and Powerhouse

5.5.1 Removal Limits

Iron Gate Dam is located in a relatively narrow canyon on the Klamath River at RM 193.1. Minimum requirements for a free-flowing condition and volitional fish passage on the Klamath River through the Iron Gate Dam site require the complete removal of the zoned earthfill embankment, concrete cutoff walls, and fish trapping and holding facilities located on random fill downstream of the dam between the rock abutments to the bedrock foundation, to ensure long-term stability of the site and to prevent the development of a potential fish barrier in the future Table 5.5-1 summarizes and Figure 5.5-1 (C) shows features the Project will remove or potentially retain as PROs.

The lower portion of the outdoor-type powerhouse, if retained as a PRO will be within the 100-year floodplain. Retention of the Iron Gate Powerhouse as a PRO would require the structure to be sealed. Mechanical and electrical equipment could be left in place with all power connections to the outside removed; however, KRRC's contractor would remove any oil in the turbine governor and hydraulic control systems, transformers, oil storage tanks, or other equipment. KRRC's contractor would also remove other potentially hazardous materials, such as batteries and treated wood. The short tailrace channel between the powerhouse and the river channel could be backfilled to the pre-construction contours if necessary, effectively burying the remaining structure.

Table 5.5-1 Iron Gate Dam and Powerhouse, Removal Requirements

Feature	Full Removal	Partial Removal Options	Comments [1]
Embankment Dam, Cutoff Walls	Remove	Remove	
Penstock Intake Structure and Footbridge	Remove	Remove	
Penstock	Remove	Remove	
Water Supply Pipes and Aerator	Remove	Remove	
Spillway Structure	Retain	Retain	Bury to extent practicable
Powerhouse (incl. mechanical and electrical equipment)	Remove	Retain	PRO: Lower portion with openings sealed
Powerhouse Hazardous Materials (transformers, batteries, insulation)	Remove	Remove	
Powerhouse Tailrace Area	Backfill	Backfill	
Fish Facilities on Dam (fish ladder and trapping and holding facilities)	Remove	Remove	
Fish Hatchery	Retain	Retain	See Section 8.10
Switchyard	Remove	Remove	
69-kV Transmission Line, 0.5 mi	Remove	Remove	

Feature	Full Removal	Partial Removal Options	Comments [1]
Diversion Tunnel Intake Structure and Footbridge	Remove	Remove	
Diversion Tunnel Portals	Concrete Plug	Concrete Plug	
Diversion Tunnel Control Tower, Hoist, and Gate	Remove	Remove	

1. Partial removal options would involve long-term maintenance costs, including the preservation of any exposed items with coatings containing heavy metals (such as the penstocks).

Figure 5.5-1 Iron Gate Dam Removal Features and Limits (Appendix C)

5.5.2 Construction Access

Figure 5.5-1(C) shows construction access roads and associated improvements required for removal of Iron Gate Dam and Powerhouse within the limits of work, and these are discussed in the following sections. Section 5.3.2 discusses the conditions and improvements needed for Copco Road. KRRC observed existing conditions of the local roads and structures in the field to identify deficiencies and determine if improvements are necessary for mobilization and/or hauling during construction and demolition activities of the Iron Gate Dam and Powerhouse. The assessments are discussed in the following sections. KRRC will complete access road improvements prior to associated construction and removal at the dam and powerhouse.

The delivery of off-road construction equipment, including cranes, large excavators, loaders, and large capacity dump trucks will be by special tractor-trailer vehicles operating under “wide load” restrictions and at appropriate speeds.

Lakeview Road between Copco Road and the Disposal Site

Lakeview Road is a county gravel road approximately 24 feet wide, running between Copco Road and the disposal site just east of Iron Gate Reservoir (Figure 5.5-2). The road continues beyond the disposal site into the Iron Gate Estates subdivision. The posted speed limit is 20 mph. The gravel road surface is in stable condition and suitable for construction use. The road (with the powerhouse access road) could be used for one-way hauling traffic with turnouts and will have an average one-way haul distance of 1.4 miles from the dam to the center of the disposal site. KRRC does not propose improvements and upgrades for mobilization and hauling for the Project. KRRC’s contractor may perform road surface maintenance during or post-construction. Temporary traffic controls will be required during roadway maintenance activities. This portion of Lakeview Road includes Lakeview Road Bridge (Caltrans Bridge No. 2C0255).

Lakeview Road Bridge

Lakeview Road Bridge is county-owned nine span simply supported rolled steel beam bridge constructed in 1960, and is approximately 272 feet long and 14.5 feet wide. It has a reinforced concrete deck with one 12-foot lane and no shoulders. The structure is posted with load limits following an investigation by the California Department of Transportation (Caltrans), Structure Maintenance and Investigation that was requested by the Siskiyou County Department of Public Works. The structure is supported on bents composed of timber pile extensions with timber or steel caps and timber abutments. No information is available regarding the foundations.

Because the bridge has been posted with a reduced load limit that is less than the current legal/permit loads on bridges and loads of vehicles that will use it for the Project, KRRC proposes replacing this structure for construction access. Alternatively, KRRC's contractor may implement other methods such as a temporary bridge adjacent to the existing bridge or structural strengthening of the existing bridge.

KRRC's contractor will construct either a new bridge or a temporary bridge of similar length and width on a revised alignment adjacent to the existing bridge (Figure 5.5-3). KRRC's contractor will remove the old bridge after completion of the new bridge only. KRRC's contractor will realign the approach roadway slightly for the new bridge or temporary bridge location. The impact to traffic will be limited to the switch from the existing road alignment to the new one. A temporary bridge will remain in place for the duration of construction, and KRRC's contractor will remove it, leaving the existing bridge in place, at the end of construction, and KRRC's contractor will restore the approach roadways to the existing alignments.

Figure 5.5-2 Lakeview Road

Powerhouse Access Road

The private PacifiCorp-owned powerhouse access road is located immediately to the east of the Lakeview Road bridge south abutment, and it runs east-west between Lakeview Road and the Iron Gate powerhouse. The road has a gravel surface between Lakeview Road intersection and the security swing gate. East of the security gate, the road is asphalt concrete about 14 feet wide and in good condition. KRRC's contractor will use this road as a haul route. KRRC does not propose improvements and upgrades for mobilization and hauling. KRRC's contractor may perform road surface maintenance during construction. Temporary traffic controls will be required during roadway maintenance activities. KRRC's contractor will provide additional signage and stop control along the access road approach to the Lakeview Road intersection during construction. KRRC's contractor will demolish this road and restore it to native habitat post-construction.

Left Abutment Access Road

This private PacifiCorp-owned access road runs between Lakeview Road and the left abutment of the dam. It is a gravel road about 24 feet wide. The road surface is in fair condition. KRRC's contractor will use this road as a haul route to the proposed disposal site. KRRC's contractor may perform periodic roadway maintenance during construction to ensure adequate access. Temporary traffic control will not be required as this is not a public road. KRRC's contractor will demolish this access road and ramps and restore the area to native habitat at the completion of dam removal.

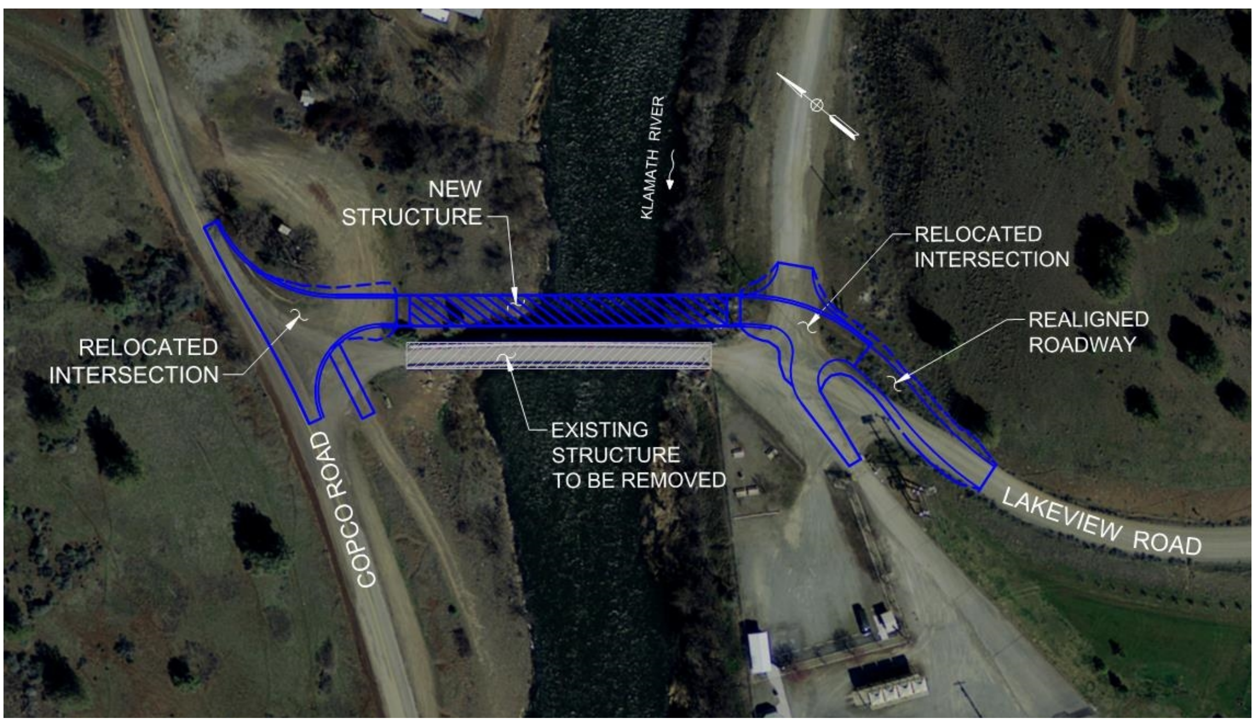

Figure 5.5-3 Lakeview Road Bridge Replacement

Upstream Left Abutment Access Road

The private PacifiCorp-owned original haul route from an upstream borrow area to the dam will be reopened once the reservoir has been drawn down. This will allow two-way traffic to the north side of the disposal site with an average haul distance of 0.9 mile from the dam to the disposal site. As the dam embankment excavation descends, the original ramps out of the canyon that were used during original construction may be able to be reused. KRRC's contractor will demolish this access road and ramps and restore the area to native habitat at the completion of dam removal.

Access Road from Long Gulch Recreation Facility to Lakeview Road

This private PacifiCorp-owned road is a gravel access road approximately 12 feet wide, running between Long Gulch Recreational Facility and Lakeview Road. The gravel road surface is in fair condition. KRRC's contractor will use the road for one-way hauling traffic during removal of the Long Gulch Recreation Facility. KRRC does not propose improvements and upgrades for mobilization and hauling. KRRC's contractor may perform road surface maintenance during construction. Temporary traffic controls will be required during roadway maintenance activities. KRRC's contractor will demolish this access road and restore the area to native habitat at the completion of dam removal.

Access Road from Overlook Point Recreation Facility to Copco Road

This private PacifiCorp-owned road is a gravel access road approximately 12 feet wide, running between Overlook Point Recreation Facility and Copco Road. The gravel road surface is in fair condition. KRRC's contractor will use the road for one-way hauling traffic during removal of the Overlook Point Recreation Facility. KRRC does not propose improvements and upgrades for mobilization and hauling. KRRC's contractor may perform road surface maintenance during construction. KRRC's contractor will provide temporary traffic controls during roadway maintenance activities. KRRC's contractor will demolish this access road and restore the area to native habitat at the completion of dam removal.

5.5.3 Staging Areas and Disposal Sites

Figure 5.5-1(C), Sheets 1 and 2 show construction staging areas and disposal sites for removal of Iron Gate Dam and Powerhouse within the limits of work, and these are discussed in the following sections. The contractor will mobilize construction equipment to the site by June 2020 to prepare the staging and disposal areas, and to construct the diversion tunnel improvements described in Section 4.2 for subsequent dam removal after drawdown.

Staging Areas

Figure 5.5-1(C), Sheet 2 shows staging areas for equipment or material staging, including 7.7 acres above the left abutment of the dam, 1.4 acres southwest of the disposal site, and 1.4 acres northeast of the disposal site. Also shown on Figure 5.5-1(C), Sheet 1 is 1.9 acres near the right abutment downstream of the dam (currently occupied by two PacifiCorp residences and some outbuildings) that could be used for construction offices. KRRC's contractor will prepare the staging areas by clearing vegetation and minor grading and will restore them by minor grading and hydroseeding. See Section 6 for additional detail concerning restoration. Staging of mechanical and electrical debris will likely occur at the downstream toe of the dam in the parking area and the area of the fish collection facilities.

Disposal Sites

KRRC's contractor will permanently bury most of the earth materials and all of the concrete rubble generated from removal of the Iron Gate development on-site in a disposal site covering about 36 acres located on project property about 1 mile south of the dam. KRRC's contractor will grade the disposed material to conform to the existing topography as shown in Figure 5.5-1(C), Sheet 2 and Figure 5.5-4 (C). KRRC's contractor will place the disposed material to a maximum fill height of about 50 feet. KRRC's contractor will cover concrete rubble by a minimum of 3 feet of earth materials. Final grading of the disposal site will include relatively flat slopes (8H:1V to 5H:1V) to reduce the potential for erosion. Preparation of the disposal site requires clearing of vegetation and stripping and stockpiling of topsoil for later use for restoration of the disposal site. After final grading for drainage and aesthetics, KRRC's contractor will cover the disposal site with topsoil and hydroseeded. Compaction other than by equipment travel will not be necessary. See Section 6 for additional detail associated with restoration. KRRC will monitor erosion on an annual basis for 5 years following placement to assess whether significant erosion and slope deterioration has occurred. If significant erosion occurs, KRRC will repair the eroded area to the satisfaction of the appropriate regulatory agency.

Figure 5.5-4 Iron Gate Disposal Site Plan & Sections (Appendix C)

KRRC's contractor will place up to 200,000 CY of earth materials excavated from the dam in the existing concrete-lined side-channel spillway, chute, and flip-bucket terminal structure (located on the right abutment of the dam) to the extent practicable for restoration. Figure 5.5-1(C), Sheet 1 and Figure 5.5-5(C) show plan and section of the backfilled spillway. Finished grades of the backfill will be no steeper than about 4H:1V. Following backfilling, the uphill portion of the spillway excavation will still be visible. After final grading for drainage and aesthetics, KRRC's contractor will cover the disposal site with topsoil and hydroseeded. Compaction other than by equipment travel will not be necessary. See Section 6 for additional detail associated with restoration.

KRRC's contractor will dispose of rebar, mechanical and electrical equipment, building materials and demolished powerline material of at an approved landfill near Yreka, CA. Table 5.5-3 lists tonnage and volume of these materials.

Figure 5.5-5 Iron Gate Spillway Backfill Plan & Sections (Appendix C)

5.5.4 Iron Gate Dam and Powerhouse Removal

Dam and Powerhouse Removal

Dam removal will begin following spring runoff on June 1, 2021. KRRC's contractor will maintain sufficient freeboard to pass a 1% probable flood for that time of year (see Section 4.4) at all times between the elevation of the excavated embankment surface and any remaining reservoir to reduce the potential for flood overtopping embankment. KRRC will not start excavation of the embankment section at Iron Gate Dam before June 1 (in-stream to begin on June 15), 2021, and will complete excavation by October 15, 2021 to minimize the risk of flood overtopping.

Dam removal will be as follows:

1. Drawdown reservoir, but maintain a minimum flood release capacity of approximately 7,700 cfs in June (RWS elevation 2254.3), to accommodate the passage of at least a 1% probable flood for that time of year.
2. Remove fish facilities near downstream toe of embankment (including fish ladder and holding tanks) and dam crest sheet piles in the dry.
3. Retain embankment dam crest at level needed for flood protection, and the existing access bridge to the gate control house for regulating tunnel releases.
4. Begin embankment excavation for dam removal (see Figure 5.5-6(B)), but maintain a minimum flood release capacity of approximately 7,000 cfs in July (RWS elevation 2242.3) and 3,000 cfs in August and September (RWS elevation 2194.3), to accommodate the passage of at least a 1% probable flood for that time of year.
5. Remove an estimated 150,000 CY (7,500 CY per day) in June, 285,000 CY (14,250 CY per day) in July, and 635,000 CY (16,000 CY per day) in August and early September leaving upstream cofferdam (Figure 5.5-6 (B)). Excavation assumes 2 shifts working 6 days per week. Temporarily stockpile rockfill during excavation for placement on downstream slope of cofferdam.
6. Provide access to gate control house between base of tower at elevation 2257.3 and deck at elevation 2341.3 (84 feet high — assume vertical stairway structure, or longer footbridge from spillway crest) throughout excavation for flow control.
7. Draw down reservoir to maximum extent (during minimum streamflow and with no upstream drawdown releases) by September 1, 2021. Place rockfill on downstream face of cofferdam (having a crest no lower than elevation 2194.3) for controlled breach of armored cofferdam embankment above the existing bedrock surface at elevation 2157.3.
8. Breach cofferdam at Iron Gate Dam prior to breach of cofferdam at J.C. Boyle Dam to minimize potential downstream impacts. Breach by notching below the reservoir level (expected to be below RWS elevation 2186.3. Maximum breach outflow from cofferdam at Iron Gate Dam is estimated to be approximately 5,000 cfs.
9. Following the cofferdam breach, remove any remaining embankment materials from river channel in the wet, during low flow period, as required.
10. Remove diversion tunnel intake structure (invert elevation 2175.3), topple gate control tower for removal (base elevation 2254.3), and plug tunnel and shaft portals with reinforced concrete. Topple and remove penstock intake structure, and plug openings. Remove water supply features for fish facilities.
11. Construct cofferdam in tailrace channel for removal of powerhouse. Use sump pumps to dewater area. Remove cofferdam when no longer needed.

12. Remove all other features (buildings, switchyard, etc.) as required. Restore dam site and right abutment disposal site as required, including the placement of topsoil and seeding. See Section 6 for additional detail associated with restoration.
13. Demobilize from site when construction activities are complete.

Portions of the dam and hydropower demolition must be performed within the in-stream construction window negotiated with the regulatory agencies. See Section 8.6 of this Definite Plan for information pertaining to the construction schedule and timing of the various activities.

Figure 5.5-6 Iron Gate Dam Removal (Appendix B)

Transmission Line and Switchyard Removal

Transmission line removal at Iron Gate includes demolishing portions of the Iron Gate switchyard and demolishing overhead distribution and transmission lines and associated poles or towers, as applicable (see Figure 5.2-12).

KRRC's contractor will demolish approximately 0.8 miles of overhead transmission/distribution line and approximately 10 poles. Lines to be demolished include:

- 69 kV transmission line between Iron Gate switchyard and distribution lines to remain in service
- 69 kV transmission lines between Iron Gate switchyard and Iron Gate hatchery tie-in
- Production lines in the general area of Iron Gate powerhouse
- Distribution lines supplying the two village houses near the dam

Major switchyard demolition components include:

- 69 kV/6.6 kV transformer
- 6.6 kV power circuit breaker
- Generator
- All associated auxiliary equipment

Iron Gate Hatchery located near the Klamath River downstream of Iron Gate Dam will require a new connection from PacifiCorp's Hornbrook Substation (5G19). Details for connection requirements are unknown at this stage.

5.5.5 Demolition Methods, Estimated Equipment and Workforce

KRRC assumes the following demolition methods, estimated equipment requirements, and estimated workforce requirements for planning purposes based on engineering judgment. Alternative methods, equipment, and workforce that will also meet project requirements are possible and could be refined by the selected contractor.

Demolition Methods

Dam removal requires the modification and operation of the diversion tunnel for low-level releases to allow controlled reservoir drawdown, and a high excavation production rate for removal of the embankment during the summer, low-flow months (June through September). The Iron Gate production assessment takes into consideration the approximate lift area by elevation and how many concurrent excavation operations could be occurring at that elevation. At the top, the lift surface is narrow and long and this work will progress at the low end of the overall average production rate. As the excavation descends, the footprint will become wider and KRRC's contractor will add additional equipment to the equipment spread. The short and wide bottom lifts will also limit production, similar to the top. Consequently, KRRC's contractor will implement high (above average) production rates for the larger middle lifts. KRRC's contractor will likely complete the removal of the riprap as the embankment is excavated down. KRRC's contractor will stockpile some rockfill for later use as slope protection for the upstream cofferdam.

KRRC's contractor will likely use conventional earthmoving equipment consisting of excavators and off-road articulated or fixed-wheel haul units to reach the required average production rate of 16,000 CY per hour in August and September (Figure 5.5-6(B)). Key factors will be sizing the excavators to minimize the loading passes per haul unit, and selecting the maximum size haul units that can effectively negotiate the dam surface and haul route. KRRC's contractor will utilize shift work to achieve the desired daily production rates. The potential for acceleration of the construction schedule is limited, if required, and may only be obtained by adding additional excavation time (increasing to 6 or 7 days per week, and/or longer shifts). The Definite Plan assumes 6 days per week and 2 shifts per day for 12 shifts per week, and assumes an average of 10,000 CY per 10-hour shift, to remove the dam embankment within about 16 weeks. It is interesting to note that the original placement of 1,100,000 CY of embankment material was completed within only 18 weeks in 1961.

KRRC's contractor will likely excavate reinforced concrete in deck, wall, and floor slabs for any structures to be removed (including intake structures, control structures, fish handling facilities, and powerhouse) by mechanical methods (e.g. hydraulic shears or hoe-ramming). KRRC's contractor may remove any mass concrete using conventional drilling and blasting methods.

Estimated Equipment and Workforce Requirements

Table 5.5-2 summarizes the estimated equipment for the removal of Iron Gate Dam and Powerhouse and for restoration of the reservoir area.

Table 5.5-2 Iron Gate Dam and Powerhouse, Estimated Equipment List

Name of Equipment	Pre-Drawdown	Post-Drawdown
Crawler-mounted lattice boom crane, 150 to 200 ton, 160- to 200-foot boom		X
Rough terrain hydraulic crane, 35 to 75 ton	X	X
Hitachi hydraulic excavator, 180,000 to 240,000 lb, 6 to 8 CY bucket		X
Cat 336 hydraulic track excavator, 80,000 lb, 3.5 CY bucket		
Hydraulic track excavators, 65,000 to 100,000 lb, with Cat H120 hoe-ram, thumb and shear attachments		X
Cat 966 (52,000 lb, 5 CY bucket) or Cat 980 or Cat 988 (65,000 lb, 6 or 10 CY bucket) articulated wheel-loader	X	X
Cat 740 articulated rear dump trucks, 30 ton (22 CY) or Cat 770 fixed haul unit, 40 ton (30 CY)	X	X
D-7 or D-9 standard crawler dozers	X	X
Front-end wheel loader, integrated tool carrier, 25,000 lb		X
D-8 support and knockdown dozer		X
Front-end wheel loader, integrated tool carrier, 25,000 lb		X
Cat TL943 rough terrain telescoping forklift		X
Rough terrain telescoping manlift		X
Cat 14 or Cat 16 motorgrader	X	X
Flexifloat sectional barges	X	
Truck-mounted seed sprayer, 2500 gallon		X
On-highway, light duty diesel pickup trucks, ½ ton and 1 ton crew	X	X
On-highway flatbed truck with boom crane, 16,000 lb		X
On-highway truck tractors, 45,000 lb		X
Off-highway water tanker, 5,000 to 9,000 gallon		X
Wheel-mounted asphalt paver		X
Self-propelled rubber tire and drum vibratory compactor, 5 to 15 ton		X
Engine generators, 6.5 KW to 40 KW, diesel or gasoline		X
Air compressors, 100 psi, 185 to 600 cfm, diesel		X
Hand-held drilling, cutting, and demolition equipment		X
Portable welders and acetylene torches		X
4-inch submersible trash pumps, electric		X
Light plants, 2,000 to 6,000 watt, 10 to 25 hp, diesel		X

An estimated average workforce of 35 to 40 people will be required for the construction activities, for an estimated duration of 19 months from site mobilization to construction completion for either dam removal alternative. The peak workforce required during excavation of the dam embankment could reach 75 to 80 people.

5.5.6 Imported Materials

KRRC's contractor will import some materials to the site to support dam removal. The most likely materials to be imported include gravel surfacing from a commercial quarry for temporary haul roads (approximately 5,300 tons, 190 truck trips), seed and mulch materials, and minor quantities of ready-mix concrete and reinforcing steel from local commercial sources for tunnel plugs. Modification of the diversion tunnel will require importing mechanical equipment, and additional reinforcing steel and ready-mix concrete for lining the diversion tunnel and installing a new gate in the existing gate structure.

5.5.7 Waste Disposal

Table 5.5-3 shows estimated quantities of materials generated during removal of Iron Gate Dam and Powerhouse, numbers of truck trips, and approximate haul distances for waste disposal. KRRC's contractor will place excavated concrete in the on-site disposal area. KRRC's contractor will separate reinforcing steel from the concrete prior to placement in the disposal area and haul it to a local recycling facility. KRRC's contractor will haul all mechanical and electrical equipment to a suitable commercial landfill or salvage collection point.

Table 5.5-3 Waste Disposal for Full Removal of Iron Gate Dam

Waste Material	In-Situ Quantity	Bulk Quantity [1]	Disposal Site	Peak Daily Trips [2]	Total Trips [3]
Earth	155,00 CY 912,000 CY	170,000 CY 1,087,00 CY	Onsite spillway Onsite disposal area	12 units/800 trips (unpaved road)	8,640 trips (.5 mile RT) 48,640 trips (2 mile RT)
Concrete	15,800 CY	20,700 CY	Onsite disposal area	2 units/50 trips (unpaved road)	950 trips (2 miles RT)
Rebar	700 tons	—	Transfer station near Yreka, CA	1 unit/5 trips (Copco Road)	70 trips (54 miles RT)
Mech. And Elec	1,200 tons	—	Transfer station near Yreka, CA	1 unit/5 trips (Copco Road)	150 trips (54 miles RT)
Building Waste	4 buildings 2,700 ft^2	600 CY	Transfer station near Yreka, CA	1 unit/5 trips (Copco Road)	60 trips (54 miles RT)
Power lines	0.5 miles of 69-kV	—	Transfer station near Yreka, CA		

1. Volumes increased 30 percent for concrete rubble, 20 percent for loose earth materials.
2. Peak daily trips for each site are based on the number of vehicles (units) shown, operating within one 8-hour shift.
3. Total trips of earthfill assume off-highway articulated trucks with a nominal load capacity of 22 CY. Total trips of concrete assume off-highway articulated trucks with a nominal load capacity of 20 CY. Total trips for hauling rebar using truck tractor-trailers is based on 10 tons per trip. Total trips for hauling mechanical and electrical items using truck tractor-trailers is based on 8 tons per trip. Total trips for building waste using truck tractor-trailers is based on 10 CY per trip.

Table 5.5-4 shows potential landfills or salvage collection points and capacities. Appendix O3 discusses potential hazardous materials at Iron Gate Dam and Powerhouse and their disposal.

Table 5.5-4 Waste Disposal Facilities near Iron Gate Dam

Name of Facility	Location	Distance from Site	Remaining Capacity	Materials Accepted
Yreka Transfer Station	Yreka, CA	25 miles	3,924,000 CY (2010)	Class III sanitary landfill accepting construction and demolition waste and mixed municipal waste, and Medium volume transfer station accepting metals and mixed municipal recyclable materials

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Chapter 6: Reservoir and Other Restoration

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6. RESERVOIR AND OTHER RESTORATION

The purpose of this section is to summarize the proposed plan to stabilize remaining reservoir sediment post-drawdown and to restore the former reservoir areas at each development to native habitat. The full Reservoir Area Management Plan is provided in Appendix H.

6.1 Reservoir Restoration

As part of the 2012 EIS/R and 2013 Secretarial Determination of Record (SDOR, DOI and NMFS 2013), a Reservoir Area Management Plan (USBR 2011c) was developed by the USBR with assistance from the NMFS and agencies from the Department of the Interior. The document describes anticipated conditions in the reservoir areas after removal of the four dams based on extensive hydraulic modeling, sediment characteristics, and several reservoir drawdown scenarios. The 2011 Plan provides goals and objectives developed with a multi-disciplinary team of professionals for restoration of the former reservoir areas. The 2011 Plan was developed primarily with the intent to minimize invasive vegetation and stabilize the remaining accumulated sediments not eroded during drawdown to reduce the likelihood of future undesirable sediment releases.

As part of the ongoing design and compliance processes, the KRRC assembled a working group of regulatory, tribal, and consulting professionals representing expert knowledge from recent dam removal restoration plans to provide recommendations for updating the 2011 Plan. The group held workshops in August and October 2017, and recommended updating the goals and objectives of the 2011 Plan based on current knowledge of reservoir restoration and experience gained from recent dam removal and restoration plans. Table 6.1-1 provides preliminary updates to the goals and objectives that are incorporated into the current Reservoir Area Management Plan in Appendix H.

6.1.1 Measures to Manage Remaining Sediment

J.C. Boyle Reservoir, Copco Lake, and Iron Gate Reservoir were well documented prior to construction of the dams. Each reservoir had a topographic survey and numerous pictures of conditions prior to construction of each dam as well as construction photos for each dam. As a result, ideal vegetation communities and site potential are easily discernable and techniques for stabilizing remaining sediments are readily apparent.

The 2011 Plan focused on control of invasive exotic vegetation (IEV) species and revegetation of the reservoir areas with native grasses, shrubs and trees as the primary method for restoration. This approach is consistent with nearly all dam removal and reservoir restoration plans in the past 10 years where restoration efforts have emphasized revegetation of newly exposed floodplain areas with native plants while actively controlling IEV. To implement this plan and manage the remaining reservoir area sediments, KRRC proposes a two-pronged approach that consists of revegetation and active habitat restoration with monitoring and adaptive management. The following sequence describes the activities and restoration features that will be implemented in the reservoir areas to manage remaining sediments not eroded during drawdown:

1. Pre-dam removal (1 to 2 years pre-drawdown): conduct pre-treatment of IEV species, collect seeds and grow-out of trees and shrubs by local nurseries.
2. Reservoir drawdown (January to March, year of drawdown): perform reservoir drawdown with natural erosion and evacuation of accumulated reservoir sediment deposits, stabilize sediments and exposed areas with hydroseeding.
3. Post-drawdown first summer/fall (dry season immediately after drawdown): conduct additional seeding application where needed for exposed areas and remaining reservoir deposits with grasses and ground cover, manual removal/treatment of IEV, and installation of riparian trees and shrubs.
4. Post-removal (year after dam removal is complete): maintain vegetation, continue to remove and treat IEV, install habitat features such as willow or log structures, as needed.
5. Establishment period (years 2 through 5 post-dam removal): continue monitoring and maintenance of vegetation, removal of IEV, fish passage monitoring, and enhancement of habitat features such as willow or log structures, as needed.
6. Long term (years 5 through 10 post-dam removal): continue monitoring and adaptive management, removal of IEV, and fish passage monitoring.

Table 6.1-1 Preliminary Goals, Objectives, and Restoration Activities for Reservoir Area Restoration

Period	Goal	Objective	Restoration Activity
Pre-construction Period	Prepare native plant materials for revegetation	Collect and propagate native plant seed and grow container plants	Identify potential seed collection, seed propagation, pole harvest cutting areas, and container plant grow contractors
			Perform surveys to identify and map seed collection and pole harvest areas
			Prepare seed collection, seed propagation, container plant growing, and pole harvest contract documents
			Award and monitor native plant and seed contracts
			Develop revegetation contract documents
	Reduce invasive exotic vegetation (IEV)	Reduce and minimize the local sources of IEV	Gather existing IEV data and perform EIV surveys
			Review potential herbicides and potential impact on fish and water quality
		Implement an IEV management program	Create management plan and review with stakeholders
			Procure local contractor to perform IEV removal
			Inspect and monitor IEV removal execution

Period	Goal	Objective	Restoration Activity
	Understand evolution of reservoir post-removal and response to restoration and reservoir management	Conduct studies to fill in data gaps from 2011 Plan	Sample sediment and perform tests to investigate wetting and drying characteristics, plant nutrient availability, and natural revegetation
			Perform revegetation pilot tests for native seed mixes
			Identify reference physical and ecological conditions in tributaries
Dam removal period (0 to 1 year)	Allow natural erosion and transport of reservoir deposits and dispersal in the ocean	Maximize erosion of reservoir deposits during drawdown	Allow erosion of reservoir deposits during drawdown
	Stabilize remaining reservoir sediments	Initiate native plant revegetation	Prepare and amend sediment based on pilot test plot results
			Install irrigation system
			Hydroseed sediment by planting zones
			Install pole cuttings, acorns, and container plants
	Restore volitional fish passage in mainstem and tributaries.	Monitor and rectify any non-natural fish passage barriers	Conduct field monitoring of mainstem/tributaries, fix non-natural barriers
	Minimize IEVs	Implement and monitor IEV removal during revegetation	Include criteria for IEV removal during revegetation implementation
			Bi-weekly inspections of revegetation areas to verify IEV compliance
Short-term (1 to 5 years after removal)	Restore natural ecosystem processes	Continue native plant revegetation, maintenance and monitoring	Monitor establishment and adaptively replace failed pole cuttings, acorns, and container plants
			Maintain irrigation system
			Re-seed poorly established areas
	Minimize IEV	Continue IEV monitoring and removal	Include criteria for IEV removal during establishment
			Perform monthly inspections to verify IEV removal compliance
	Restore volitional fish passage in mainstem and tributaries	Monitor and rectify any non-natural fish passage barriers	Conduct field monitoring of mainstem/tributaries, fix non-natural barriers
Long-term (5 to 10 years)	Restore natural ecosystem processes	Continue revegetation monitoring and adaptive management	Monitor establishment and adaptively replace failed pole cuttings, acorns, and container plants
	Minimize IEV	Continue IEV monitoring and removal	Perform quarterly site inspections and verify compliance

Period	Goal	Objective	Restoration Activity
	Restore volitional fish passage in mainstem and tributaries	Continue monitoring for non-natural fish passage barriers	Remove all non-natural fish passage barriers

The use of vegetation to stabilize reservoir sediments is a common practice and well documented approach to improve ecosystem processes. For instance, all of the dam removal and reservoir restoration plans that were reviewed as part of this work (Appendix H) had native vegetation establishment in reservoir areas as the primary component to provide long-term stabilization of exposed soils. Likewise, revegetation experiments, performed in 2008 by Ellen Mussman for the Elwha River dams, showed that vegetation reduced erosion of reservoir sediments by 33% and mulch could reduce erosion by as much as 99% (Mussman 2008).

KRRC also drew upon similar wildland restoration efforts found in wildfire area restoration, natural disaster areas (i.e. Mount St. Helens), and human-induced impacted areas since these altered and often barren landscapes are very similar to the remaining reservoir sediments. Establishment of native vegetation provides many important benefits for the stability of the remaining sediments in these disturbed areas. For instance, as described in *Repairing Damaged Wildlands: A Process-Oriented, Landscape-Scale Approach*, plants can reduce flow velocities, protect the soil surface from raindrop impact, increase soil stability, and increase the amount of water infiltrating into the soil (Whisenant 1999). A comprehensive update to the 2011 Plan is provided in Appendix H and outlines in detail the proposed revegetation for the reservoir areas. In addition, the updated plan outlines active restoration treatments that can be used to further improve sediment stability and long-term success for restoration.

To protect revegetation efforts and to replace the function of the reservoirs as natural barriers, cattle exclusion fencing is also included in the Reservoir Area Management Plan. It would prevent cattle access but would allow wildlife to pass. Based on the perimeters of the reservoirs, an approximate length of 34.5 miles may be required. Exclusion fencing will be placed, in accordance with applicable Federal, State, and county regulations and guidance, around the reservoir restoration areas where they abut grazing land. The portions of the reservoir perimeters that provide topographic (e.g., steep rocky terrain) or land use (e.g., residential areas, managed forests) barriers will not be fenced.

6.1.2 Measures to Monitor Remaining Sediment

Monitoring associated with the restoration aspects of the Project is designed to measure progress toward achieving the project goals, inform potential adaptive management and maintenance needs, and provide feedback into river and reservoir area conditions to determine if the sites are trending towards or away from achieving project goals. Based on the project goals and compliance with stated objectives, KRRC will use physical site characteristics as appropriate monitoring parameters to produce data to monitor and adaptively manage reservoir area restoration efforts.

After drawdown of the reservoirs and removal of the dams, the following actions are proposed to establish “baseline” or “initial conditions”. The initial conditions reference data will be used for monitoring and adaptive management related to reservoir restoration:

1. Permanent ground photo points will be established throughout the reservoir areas that enable sufficient vantage points of critical areas within the reservoirs. Photos will be taken to provide initial conditions for monitoring data to develop informed maintenance and corrective actions. Each photo ground point will be monumented with 5/8-inch rebar and aluminum cap for long-term stability and documented with a northing, easting, and elevation using a survey-grade GPS.
2. High resolution vertical aerial photos, sub-meter accuracy, will be completed for the reservoir areas.
3. KRRC will collect Light Detection and Ranging (LiDAR) data for the reservoir areas after sediment evacuation and initial ground cover stabilization and use it to create initial conditions surface models.

Baseline data will provide a clear starting point for initial conditions in the project area to help evaluate reservoir restoration trends and trajectories. Appendix H contains the updated Reservoir Area Management Plan that has a comprehensive outline of parameters that will be monitored, which include: stability of remaining reservoir sediments, fish passage, invasive exotic vegetation, native plant revegetation, and restoration of natural ecosystem processes.

6.1.3 Measures to Restore the Klamath River within Reservoirs

Review of historical photos of the reservoir areas prior to dam construction and inundation show river processes and conditions of the Klamath River pre-dams. The Klamath River was predominantly a narrow, volcanic bedrock dominated canyon with a single-thread river. Isolated areas within the canyon are wider such as in Copco Lake and the upper portion of the J.C. Boyle Reservoir. In these wider valley sections, the gravel-bed river planform is controlled by the locally resistant topography constraints and contains floodplains and off-channel features such as remnant channels and wetlands. Furthermore, there is little evidence of large wood playing a significant role in channel planform and characteristics throughout the river.

The Klamath River in the reservoir areas is expected to re-occupy the historical channel alignment due to geological constraints and the erosion of fine sediments accumulated in the reservoir bottoms. This conclusion was reached from both a geomorphic evaluation and two-dimensional hydraulic modeling analysis by USBR 2012c. Since the Klamath River channel was not altered since construction of the dams, it is anticipated that the river will return to a natural gravel-bed river and behave similar to pre-dam conditions. One exception is that riparian vegetation, primarily willows, will not be established on the banks but will be planted with the revegetation efforts. Appendix H provides a detailed riparian revegetation plan that will be implemented to restore the Klamath River in the reservoir areas and restart natural river processes.

Critical to restoring natural ecosystem processes and restoring the Klamath River is habitat restoration on the floodplains and tributaries that flow into the Klamath River in the reservoir areas. The following restoration techniques will be implemented in the reservoir areas as appropriate (see additional detail in Appendix H):

1. **Tributary Connectivity:** Light equipment and manual labor will be used to move materials and enhance access and longitudinal connectivity of the tributaries with the mainstem Klamath River. In addition, large wood may be added to tributaries to promote habitat complexity.
2. **Wetlands, Floodplain and Off-Channel Habitat Features**: Incorporating floodplain features into exposed floodplains such as wetlands, floodplain swales, and side channels.
   a) Wetland restoration strategies for the reservoir areas include preservation of existing wetlands, hydrologic connection of off-channel wetlands with the river, or creation of new wetlands at lower elevations corresponding to the post-dam removal surfaces and hydrologic regime.
   b) Floodplain swales that vary in size and depth, but will not extend below the anticipated baseflow elevation.
   c) Side channel restoration strategies include modifying inlet and outlet hydraulics, improving hydraulic complexity with structures or realignment, and delivery of water to higher floodplain surfaces.
3. **Floodplain Roughness**: KRRC will apply floodplain roughness as a strategy to exposed areas where frequent interaction with the river channel is anticipated. KRRC will create floodplain roughness using equipment to roughen the floodplain surface with microtopography and partially bury brush and woody debris in the soil.
4. **Bank Stability and Channel Fringe Complexity**: Introduce channel fringe complexity through the riparian revegetation and strategic addition of large wood.
5. **Large Wood Habitat Features**: Although historical photos do not show large wood as a predominant geomorphic feature, KRRC will use it to improve habitat and promote reservoir area conditions that restore natural ecosystem processes and protect vegetation during the initial years of establishment.

Appendix H contains maps and additional information on reservoir area restoration with these techniques and applicable locations for implementation.

6.2 Restoration Activities Outside of Reservoir

Areas disturbed by construction activities, but outside of the former reservoir areas (e.g. staging areas, spoil disposal areas, temporary access roads, etc.) will be revegetated similarly to revegetation described in Appendix H for upland planting zone areas.

Disturbed areas outside of the former reservoir areas include the following:

1. Disposal sites for placement of embankment or concrete material: These areas typically include between 10 to 50 feet of fill, and KRRC will grade the disposal sites to match existing topographic features in the vicinity and will include a cover depth of topsoil material suitable for revegetation. KRRC will preserve and protect existing native vegetation where feasible. KRRC will not perform

ripping within twice the canopy diameter distance from protected tree trunks to protect existing roots.

2. Staging areas and temporary access road areas adjacent to demolition of other work areas: The majority of these areas are at elevations appropriate for upland planting, although in some cases they include a variety of planting zones. Many of these areas are already compacted to a high degree due to their current use, but regardless, KRRC will decompact all staging and temporary access road areas adjacent to demolition of other work areas by deep ripping and disking to facilitate seed germination and plant establishment. KRRC will preserve and protect existing native vegetation , where feasible, both during their active use and during revegetation. KRRC will not allow ripping, equipment and vehicle parking, or material storage within twice the canopy diameter distance from protected tree trunks to protect their existing roots from crushing.
3. Hydropower infrastructure demolition areas: KRRC will demolish the majority of PacifiCorp buildings and other hydropower infrastructure as part of the Project. In each former development location, after removal of all demolition debris and man-made materials, KRRC will decompact the remaining disturbed areas by deep ripping and disking, and restore them to native habitat. These areas occur in a variety of planting zones and will be restored accordingly as described in Appendix H. KRRC will preserve and protect existing native vegetation , as feasible. KRRC will not perform ripping within twice the canopy diameter distance from protected tree trunks to protect existing roots.
4. Former recreation areas: KRRC will remove some of the existing recreation areas around the reservoir rims completely, or in part. KRRC will restore all disturbed former recreation areas to native habitats. Many of these areas are heavily compacted because of their current use, but regardless of the degree of compaction, KRRC will decompact all recreation areas by deep ripping and disking to facilitate seed germination and plant establishment. KRRC will preserve and protect existing native vegetation, as feasible, and will not perform ripping within twice the canopy diameter distance from tree trunks to protect existing roots.
5. J.C. Boyle canal demolition area: KRRC will demolish the J.C. Boyle canal along its entire length. The former canal area will likely be heavily compacted from previous canal construction activities, but regardless of the degree of compaction, KRRC will decompact the canal demolition area by deep ripping and disking to facilitate seed germination and plant establishment. In addition, as part of the demolition activity, KRRC will excavate earthen materials from the river-side of the former canal width up to 3 feet and place the materials throughout the former canal width to support vegetation growth.
6. J.C. Boyle spillway scour hole: KRRC will fill the J.C. Boyle scour hole using onsite material as described in detail in Section 5.2.3. Final grading will be sloped to drain and the top 5 feet of fill will include local native material appropriate for vegetation establishment. The majority of the final graded slope is located at elevations suitable for upland seeding and planting (summarized in Appendix H). In general, KRRC will match restoration objectives, species lists and monitoring requirements with those identified for upland planting zone in Appendix H. Adjacent slopes will be utilized as a reference site for refining species lists and coverage objectives in this location.

KRRC will implement short-term revegetation of these areas in compliance with the approved SWPPP/Erosion Control Plan. KRRC will perform long-term revegetation similarly as described for upland areas, however, KRRC will also decompact these areas by deep ripping and disking.

Chapter 7: Other Project Components

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7. OTHER PROJECT COMPONENTS

7.1 Overview

There are numerous project components that fall outside of the reservoir drawdown, dam removal, and reservoir restoration activities discussed in Sections, 4, 5 and 6. KRRC partially derived these additional project components from the previous list of mitigation measures found in the Detailed Plan (USBR 2012b) and the 2012 EIS/R. These components are incorporated into the Project as the most effective way to avoid or minimize impacts of the Project. KRRC will implement these components as part of the Project.

The numbered list below provides the work component categories and Table 7.1-1 provides an overview of each project component, with references to the 2012 EIS/R mitigation measure, where appropriate:

1. **Aquatic Resource Measures**: Surveys and other measures proposed to reduce project effects on aquatic resources
2. **Terrestrial Resource Measures**: Surveys and avoidance and minimization measures proposed to reduce project effects on terrestrial resources
3. **Road Improvements**: Road and bridge improvements to maintain a level of service comparable to existing conditions
4. **Yreka Water Supply Improvements**: Pipeline and diversion facility improvements to maintain a level of service comparable to existing conditions
5. **Recreation Facilities Removal and Development Plan**: Details on recreation facility removal and associated habitat restoration, as well as proposed recreation development
6. **Downstream Flood Control Improvements**: Flood control improvements will be constructed to maintain the current level of flood control
7. **Cultural Resources Plan**: details the plan for compliance with local, state, and federal laws for cultural and tribal resources
8. **Other Plans**: Management plans to provide a framework and initial requirements for traffic, water quality, groundwater, fire management, hazardous material management, emergency response, and noise and vibration

Table 7.1-1 Summary of Other Project Components[1]

Report Section	Project Component	Description	2012 EIS/R Mitigation Measure Reference
Aquatic Resources			
7.2	Mainstem spawning	Surveys and associated protection measures	AR-1

Report Section	Project Component	Description	2012 EIS/R Mitigation Measure Reference
7.2	Outmigrating juveniles	Sampling and associated protection measures	AR-2
7.2	Iron Gate Fish Hatchery	Delayed fish release to avoid poor water quality	AR-4
7.2	Suckers	Surveys and relocation	AR-6
7.2	Freshwater mussels	Surveys and relocation	AR-7
Terrestrial Resources			
7.3, 6	Habitat restoration plan	Plan to stabilize remaining sediments and restore reservoir and other disturbed areas	TER-1
7.3	Nesting bird surveys	Surveys and avoidance and minimization measures	TER-2
7.3	Bald and Golden Eagles	Surveys and avoidance and minimization measures	TER-3
7.3	Special-status plants	Surveys and avoidance and minimization measures	TER-4
7.3	Wetlands	Delineation and incorporation of wetland features into restoration plan, to the extent feasible	TER-5
7.3	Special status bats	Surveys and avoidance and minimization measures	TER-6
7.3	Northern Spotted Owl	Surveys and avoidance and minimization measures	-
Transportation			
7.4	Bridge and culvert relocations	Improve roads, bridges and culverts affected by the Project	TR-1
Water Supply			
7.5	Yreka water supply improvements	Relocate Yreka waterline and improve fish screens at diversion facility	-
Recreation			
7.6	Recreation facility removal and development plan	Removal of numerous existing recreation facilities, and restoration with native vegetation	REC-1
Downstream Flood Improvement			
7.7	Downstream Flood Control	Maintain existing flood protection	H-2
Fish Hatchery			
7.8	Fish Hatchery	Implement agency develop hatchery plan to meet fish production expectations	-
Cultural Resources			
7.9	Cultural Resources Plan	Framework for compliance with local, state, and federal cultural resources laws	CHR-1 to CHR-4
Management Plans			
App O	Traffic Management	Framework and initial requirements for traffic management. Final plan to be developed by contractor	-
App M	Water Quality	Water quality monitoring and analysis	-

Report Section	Project Component	Description	2012 EIS/R Mitigation Measure Reference
App N	Groundwater Well Management Plan	Well monitoring	GW-1
App O	Fire Management Plan	Framework and initial requirements for fire management. Final plan to be developed by contractor	PHS-2
App O	Hazardous Material Management	Framework and initial requirements for hazardous materials management. Phase 1 assessment to be completed in 2017	-
App O	Emergency response plan	Framework and initial requirements for emergency response. Final plan to be developed by contractor	H-1
App O	Noise and Vibration Control Plan	Framework and initial requirements for noise and vibration. Final plan to be developed by contractor	NV-1

1. 2012 EIS/R Mitigation Measures AR-3 and AR-5 were not incorporated in the Project because they were determined either to be unnecessary (AR-5) or infeasible (AR-3).

7.2 Aquatic Resources

Section 7.2 includes background information pertaining to basin-specific fish populations, disease, passage and related water quality data and information. In addition, Section 7.2.5 summarizes the proposed aquatic resource measures to protect and benefit relevant species that the KRRC will implement as part of the Project. A full discussion of the aquatic resource measures is included in Appendix I.

7.2.1 Klamath Population Status Updates

The following section is intended to provide recent context on trends and estimated abundances of anadromous fish populations inhabiting the Klamath Basin downstream of Iron Gate Dam. This information provides an update on population data presented in the 2012 EIS/R. The population review includes spring and fall run Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), and steelhead (*O. mykiss*). The discussion below contains the most recent 10 years of available population abundance metrics to provide additional context to the short-term trends.

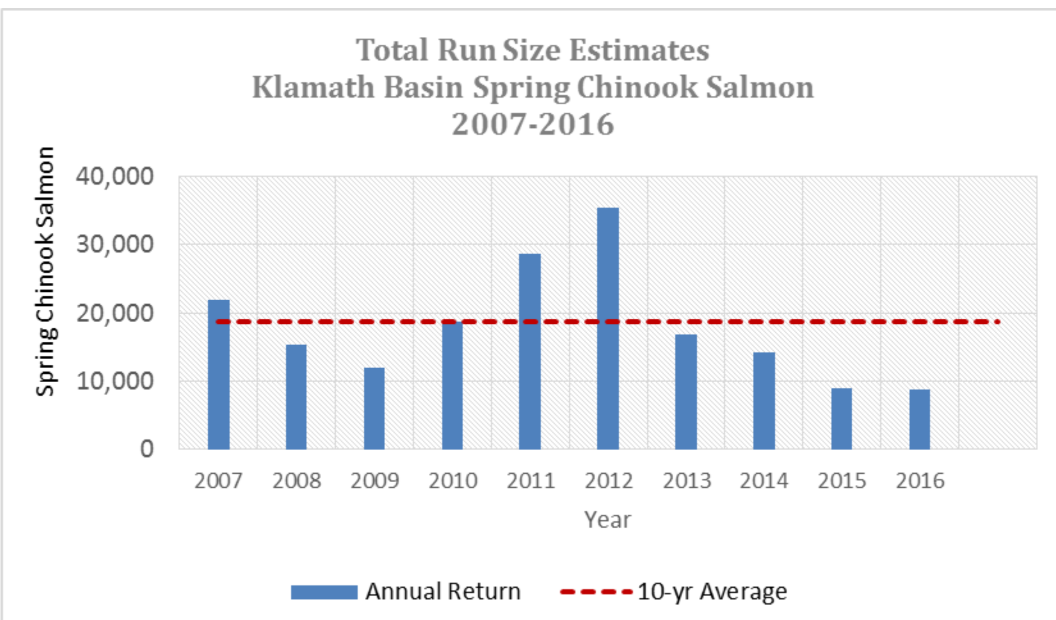
Chinook Salmon

Chinook salmon that spawn upstream of the Klamath-Trinity Rivers confluence comprise the Upper Klamath and Trinity Rivers Chinook salmon Evolutionarily Significant Unit (ESU). Populations downstream of the confluence comprise the Southern Oregon /Northern California Coastal Chinook salmon ESU. Neither of these Chinook salmon ESUs are currently listed under the Endangered Species Act. While Chinook salmon continue to be the most abundant salmonid species in the Klamath Basin, recent declines in Chinook salmon populations have had widespread impacts and have led to restrictions on important tribal, commercial, and recreational fisheries that the ESUs have historically supported. Furthermore, recent advances in understanding of genetic structure of Chinook salmon populations could potentially result in creation of a new ESU and may lead to the listing of Klamath River and Trinity River spring Chinook salmon under the ESA.

Spring Chinook Salmon

Historically, runs of spring Chinook salmon in the Klamath Basin likely numbered greater than 100,000 (Moyle et al. 2017), and likely outnumbered fall-run Chinook salmon (Spier 1930, Snyder 1931), but spring run Chinook salmon have been extirpated from a large portion of their historical range due to lack of accessible habitats (Hamilton et al. 2005). Since the 2012 EIS/R, the remaining naturally-produced populations of Klamath River spring Chinook salmon in the Salmon River and across the Upper Klamath and Trinity River (UKTR) ESU have continued a precipitous decline (CDFW 2016a).

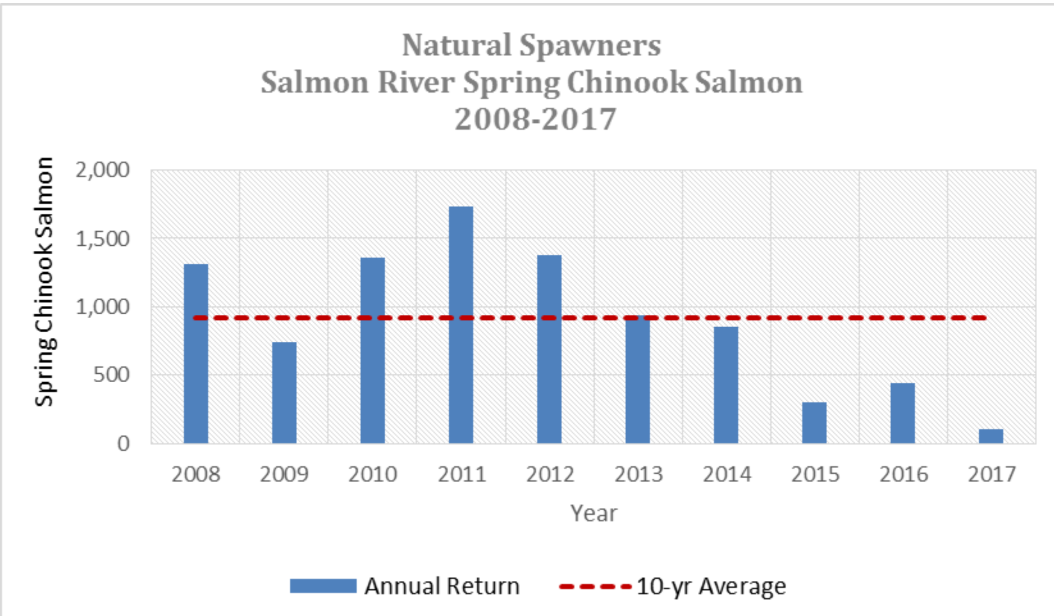
Total run size estimates from 2007-2016 (Figure 7.2-1) including both naturally and hatchery-produced spring Chinook salmon in the Klamath River basin, including the Trinity River, have ranged from a maximum of 35,326 in 2012 to a minimum of 8,815 in 2016, with an average of 18,817.



The recent 10-year average represented by the dotted red line is 18,817 fish.

Figure 7.2-1 Total run size estimates for Klamath Basin spring Chinook salmon from 2007-2016.

Only two viable naturally-spawned populations of wild spring Chinook salmon remain in the entirety of the Klamath Basin, one in the South Fork of the Trinity River, and the other in the Salmon River near Somes Bar, California. Summer holding pool adult counts have been conducted on the Salmon River annually for the past 23 years to estimate the total number of natural spring Chinook spawners available in that system. The contemporary effort includes snorkeling over 80 miles of the Salmon River mainstem, forks, and selected tributaries, and involves participation from federal and state agencies, tribes, watershed councils, and volunteers (CalTrout 2017). These counts show downward trends over time with a maximum of 1,736 spring Chinook salmon in 2011 decreasing to a low of 110 spawners in 2017. The 10-year average is 918 spring Chinook salmon (Figure 7.2-2). The Salmon River represents the last remaining viable natural spawning population of spring Chinook salmon in the Klamath Basin above the confluence of the Trinity River, and the nearest population to historical habitat upstream of Iron Gate Dam.



The recent 10-year average represented by the dotted red line is 918 fish.

Figure 7.2-2 Estimated natural spring Chinook salmon spawners based on summer resting pool counts for the Salmon River from 2008-2017.

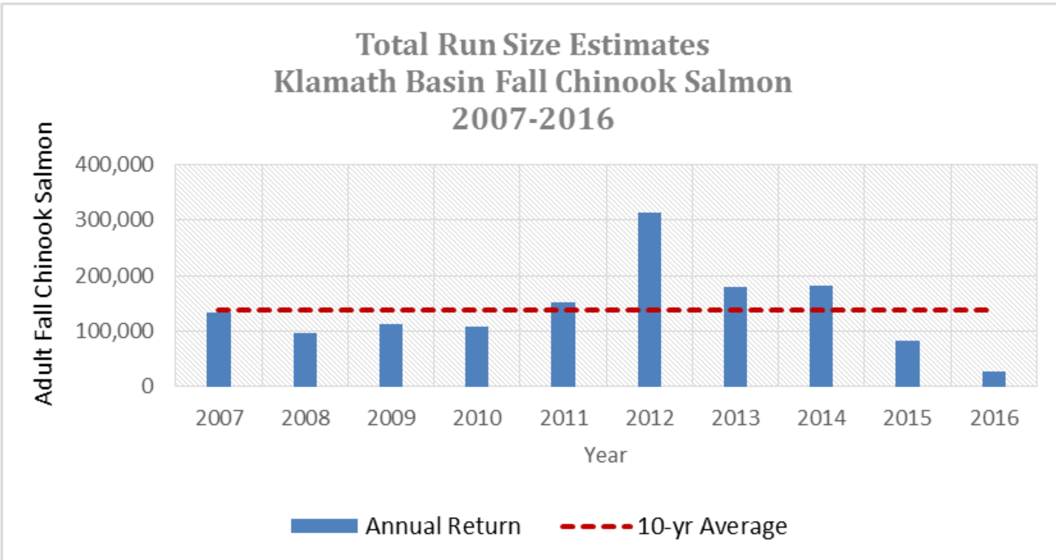
A 2013 status review of the UKTR Chinook salmon ESU conducted by NMFS in response to a petition for listing under the Endangered Species Act concluded that spring and fall run populations of Chinook salmon in the UKTR are included in a single ESU and that the ESU was at a low risk of extinction at the time of that determination (Williams et al. 2013). In their conclusions, the Biological Review Team included several concerns with Upper Klamath populations of spring Chinook salmon which provide additional insight into the overall status of the populations. The Biological Review Team concluded that the relatively few populations of spring Chinook salmon and the low number of spawners within those populations are limited by the availability and condition of currently accessible habitat. Deficient habitat restricts the expression of the spring run life history which typically provides diversity to the ESU. The Biological Review Team also stated that the low numbers of spring Chinook salmon are especially concerning given that the spring run life history was historically equal or larger than the fall run. In addition, the Biological Review Team suggested that the consequences of climate change may exert significant pressure on Chinook salmon populations in the UKTR unless habitat restoration and access to higher-elevation areas is achieved (Williams et al. 2013).

Recently published research by Prince et al. (2017) contests the current UKTR ESU configuration that defines spring and fall run Chinook salmon populations as a single ESU based on overall genetic structure that is primarily defined by geography. This configuration suggests that differences in premature (spring) versus mature (fall) migration timing within the same species and geographic range are replaceable in time frames that are consistent with conservation planning. The newly published research indicates that premature migration is defined by a single genetic variation that diverged approximately 15 million years ago, and that if the premature migration life history is lost in spring Chinook salmon or summer steelhead, it may not be replaceable for perhaps millions of years.

In November 2017, the Karuk Tribe and the Salmon River Watershed Council submitted a petition to NMFS to either list the UKTR Chinook ESU as endangered or threatened, or to create a new ESU for Klamath River spring Chinook salmon based on this new information. Without restored access to historical habitats that support the spring run life history, populations of spring Chinook salmon are expected to remain at a fraction of historical estimates (Moyle et al. 2008). Due to exceptionally low population abundance and the spatial distribution of existing populations being primarily located in the Salmon and Trinity rivers, it is likely that some intervention will be necessary to re-establish spring Chinook salmon populations in the Upper Klamath Basin (Goodman et al. 2011).

Fall Chinook Salmon

Run sizes of hatchery and naturally produced fall Chinook salmon in the Klamath Basin vary considerably from year to year. Current estimates of spawning escapement and run size are monitored by a combination of state, federal, and tribal agencies using a variety of methods including redd and carcass surveys, weir counts, and mark-recapture studies. Over 300,000 fall Chinook returned to the Klamath Basin in 2012 representing the largest recorded run since monitoring began in 1978 (CDFW 2016b). Conversely, preliminary data suggest that only approximately 27,000 fall Chinook salmon returned to the basin in 2016, representing the smallest run size during the same time period. The 2015 fall Chinook returns totaled approximately 84,000 which is substantially less than the recent 10-year average of approximately 140,000 fish (Figure 7.2-3).



The recent ten-year average is represented by the dotted red line and is 138,878.

Figure 7.2-3 Total run size estimates for the fall Chinook salmon for the Klamath Basin from 2007-2016.

Critical stressors on natural fall run Chinook salmon populations in the basin include water quality and quantity in the mainstem and spawning tributaries. Downstream of Iron Gate Dam, the mainstem Klamath River undergoes seasonal changes in flows, water temperature, dissolved oxygen, and nutrients, as well occasional blooms of *Microcystis aeruginosa*. During outmigration, juvenile Chinook salmon are vulnerable to contracting disease from pathogens, including the bacterium *Flavobacterium columnare*, and myxozoan parasites *Parvicapsula minibicornis* and *Ceratomyxa shasta* (USBR and CDFG 2012).

More recent trends show that the abundance of natural spawners is also variable between years, but have declined sharply since a large return of adult fall Chinook in 2014 (Figure 7.2-4). Estimates of naturally spawned fall Chinook salmon are based on monitoring surveys that include the mainstem Klamath River, the Salmon River basin, the Scott River basin, the Shasta River basin, Bogus Creek, and miscellaneous Klamath River tributaries on and above the Yurok Reservation (CDFW 2016b).

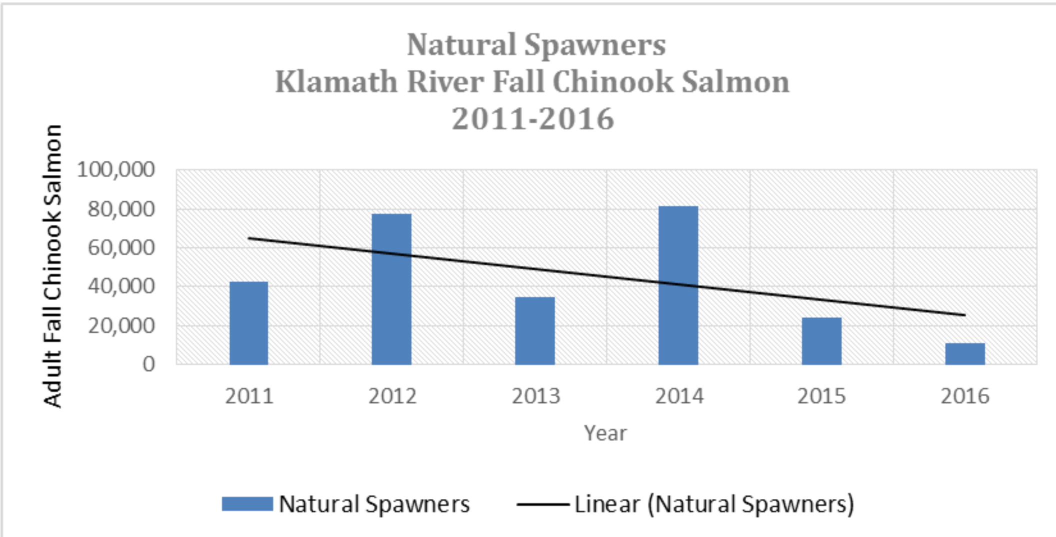


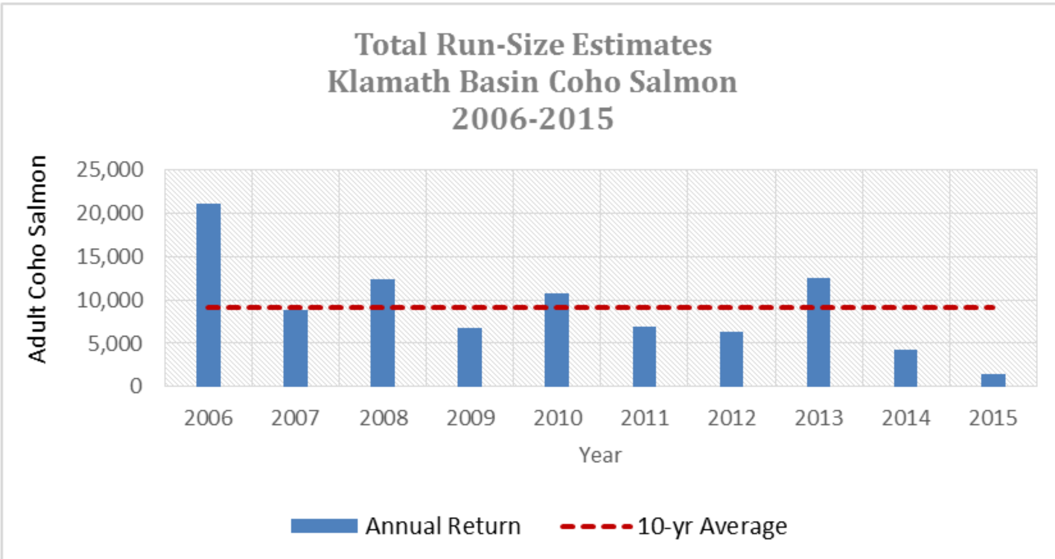
Figure 7.2-4 Natural fall Chinook salmon spawner estimates in the Klamath River and selected tributaries from 2011-2016.

In 2017, the predicted run size was estimated at approximately 12,000 natural spawners, the lowest prediction on record, and substantially less than the 40,700 natural spawner escapement goal. Fisheries managers closed all recreational fishing for Chinook salmon in the Klamath and Trinity rivers for 2017 and tribal and commercial fisheries were severely restricted as well.

Coho Salmon

Coho salmon in the Klamath Basin are a component of the Southern Oregon/Northern California Coast (SONCC) coho salmon ESU, which was listed as federally threatened in 1997. All nine coho salmon populations within the Klamath basin (i.e., Upper, Middle, and Lower Klamath River populations, Upper and Lower Trinity River populations, Scott, Shasta and Salmon River populations, and the South Fork of the Trinity River population) have declined relative to historical levels (NMFS 2014) some of these populations may not be viable, and all have a moderate or high estimated extinction risk (NMFS 2016).

Estimates for the total run size of naturally and hatchery produced coho salmon for the Klamath Basin between 2006-2015 have ranged from a high of 21,155 (2006) to a low of 1,431 (2015) (CDFW 2016c; Figure 7.2-5). Total run size estimates for 2016 and 2017 were not available at the time of this writing.



The dotted red line represents the recent 10-year average of 9,157 fish.

Figure 7.2-5 Total run size estimate for Klamath Basin coho salmon from 2006-2015.

Estimates of natural spawners in the Klamath River and select tributaries show the variability between different year classes, but illustrate how weak two of the three brood year classes have been with the exception of the 2013 brood year class (Figure 7.2-6). Estimates of naturally spawned coho salmon are based on monitoring surveys that include the mainstem Klamath River, the Salmon River basin, the Scott River basin, the Shasta River basin, Bogus Creek, and miscellaneous Klamath River tributaries below the Yurok Reservation (CDFW 2016c).

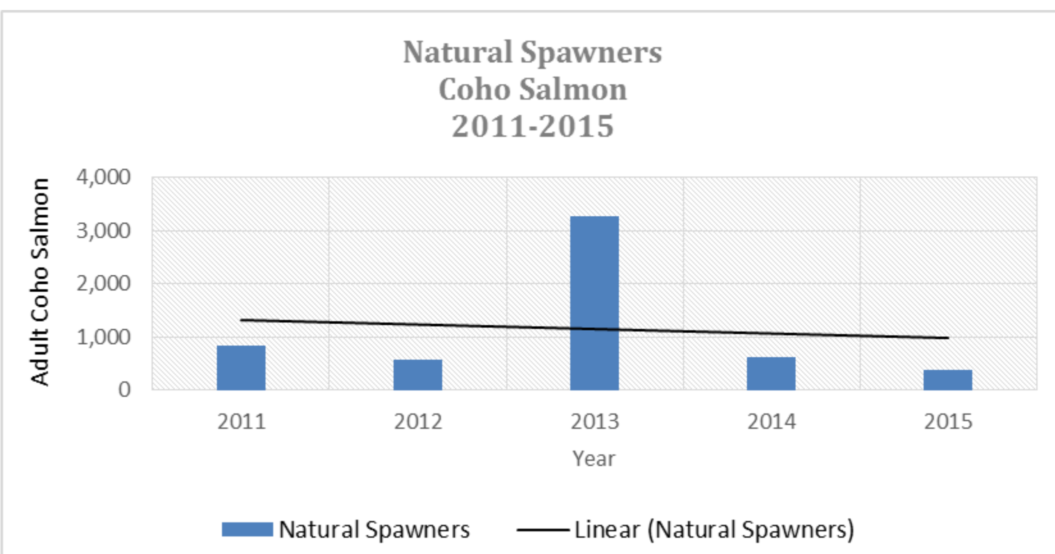
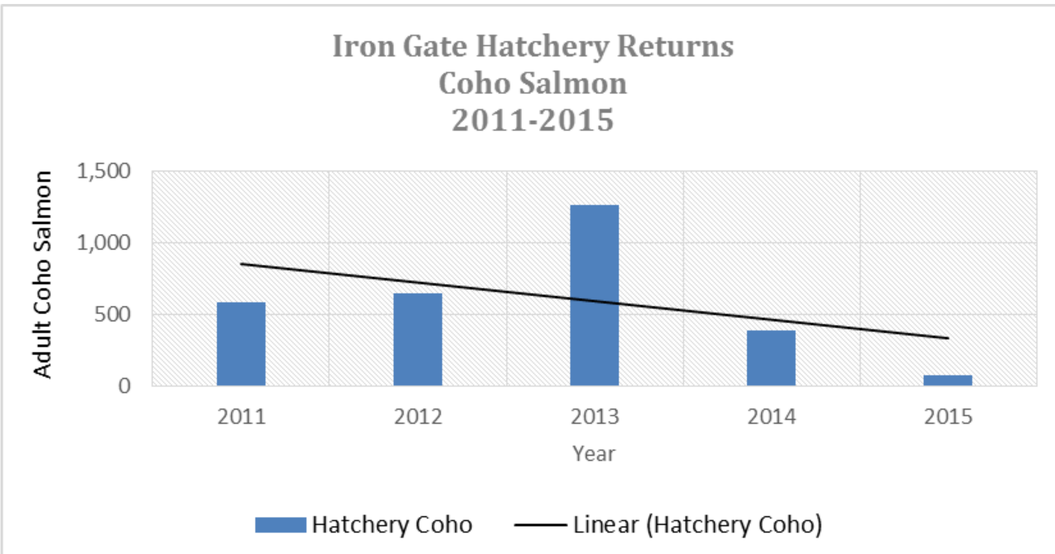


Figure 7.2-6 Estimates for coho salmon natural spawners in the mainstem Klamath River and selected tributaries from 2011-2015.

Hatchery coho production at Iron Gate Hatchery provides additional context to the status of populations within the Klamath River. The Iron Gate Hatchery coho program was initiated in the late 1960s to mitigate for impacts resulting from the construction of Iron Gate Dam, and currently operates to produce a program goal of 75,000 yearling coho salmon (California Hatchery Scientific Review Group 2012). The program currently operates under a Hatchery Genetics Management Plan finalized in 2014 to protect and conserve the genetic resources of the Upper Klamath River coho population unit (CDFW and PacifiCorp 2014).

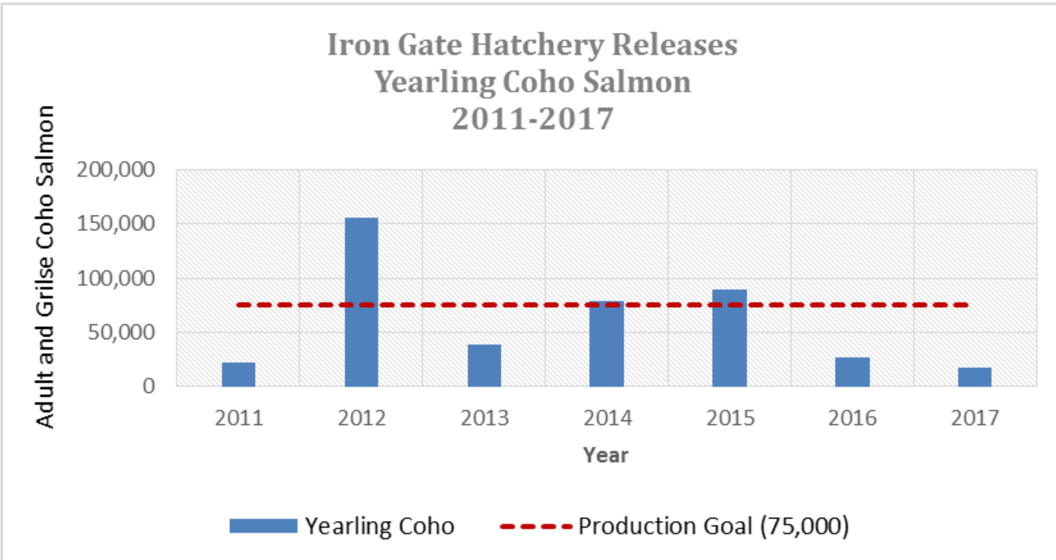
Adult returns to Iron Gate Hatchery between 2011 and 2015 display similar patterns to the estimates of natural spawners, with one year class (2013) substantially stronger than the other two year classes (Figure 7.2-7).



The count of hatchery coho includes adult and grilse (reproductively mature after one ocean year) salmon.

Figure 7.2-7 Returns of coho salmon to the Iron Gate Hatchery from 2011-2016.

Similarly, releases of yearling coho salmon from hatchery production at Iron Gate Hatchery between 2011-2017 have only met production goals in three out of the last seven years (Figure 7.2-8).



The red dotted line represents the IGH production goal of 75,000 yearling coho.

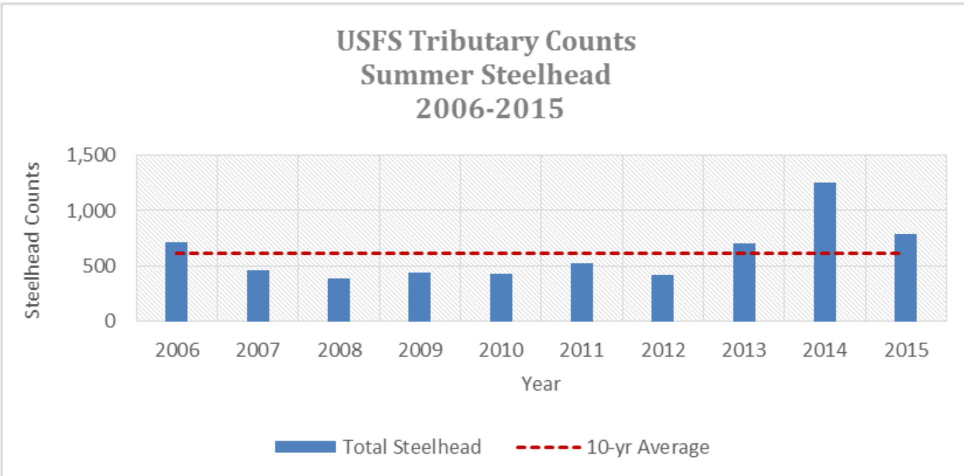
Figure 7.2-8 Yearling coho salmon releases from the Iron Gate Hatchery from 2011-2017.

Steelhead

Klamath Basin summer and winter steelhead populations comprise the Klamath Mountain Province ESU. In 2001, NMFS determined the Klamath River Basin steelhead were not warranted for listing under the ESA, despite declining populations (NMFS 2001). Recent research completed by Hodge et al. (2016) identified a total of 38 life history categories at maturity for steelhead in the Klamath River. Klamath River steelhead populations have declined despite having high life history diversity, a characteristic that typically increases population stability.

Recent data on Klamath River Basin steelhead populations outside of the Trinity River are limited. Recent trends in abundance of Klamath River steelhead populations were examined primarily using three datasets; summer steelhead counts from the Orleans and Happy Camp Ranger Districts on tributary streams located of U.S. Forest Service (USFS) lands; video monitoring results from Bogus Creek and the Shasta River; and Iron Gate Hatchery returns, although the Iron Gate Hatchery steelhead program has not operated since 2013 due to low adult returns.

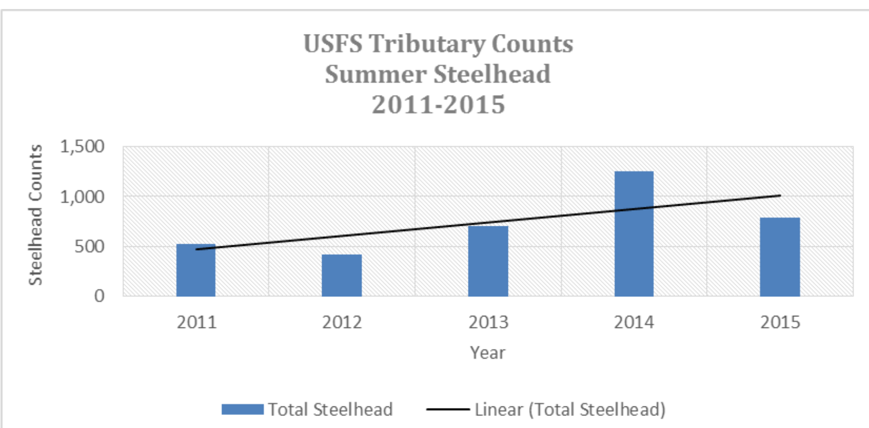
Since 1985, the Klamath Basin Collaborative Partnership has conducted summer steelhead holding counts on tributaries located on or adjacent to lands administered by the USFS Orleans and Happy Camp Ranger Districts in the middle Klamath River. Counts include adults and half pounders, and are a sum of the surveys conducted on Bluff Creek, Red Cap Creek, Camp Creek, Wooley Creek, Dillon Creek, Clear Creek, Elk Creek, Indian Creek, Thompson Creek, Grider Creek, and other small tributaries to the Klamath River located between Aikens Creek and Beaver Creek. Between 2006 and 2015, counts of adult and half pounder summer steelhead have ranged from a low of 384 to a high of 1255 with a recent 10-year average of 612 (Figure 7.2-9).



The dotted red line represents the recent 10-year average of 612 fish.

Figure 7.2-9 Summer steelhead counts on tributaries to the middle Klamath River from 2006-2015.

Between 2011 – 2015, summer steelhead counts in tributaries on USFS administered lands have shown a slight increase with the exception of 2012 (Figure 7.2-10). However, these summer steelhead populations likely represent only a fraction of their historical abundance (Moyle et al. 2017), and some populations such as Salmon River summer steelhead have declined significantly in the past several decades (Quiñones et al. 2013).

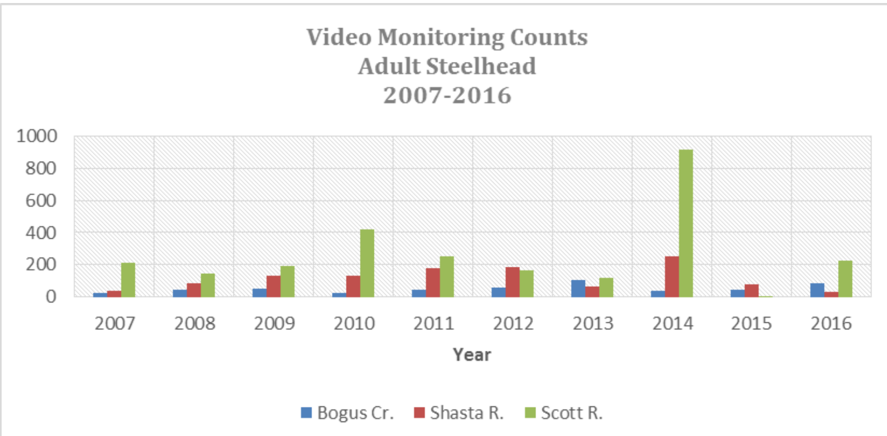


Note Wooley Creek was not surveyed in 2006, and Wooley and Dillon creeks were not surveyed in 2008.

Figure 7.2-10 Counts of holding summer steelhead on tributaries to the middle Klamath River from 2011-2015.

These data provide context to the recent trends of these populations on USFS administered lands in the middle Klamath River.

Video monitoring conducted in Bogus Creek and the Shasta and Scott rivers from 2007 to 2016 also provides context to the recent abundance of upper Klamath steelhead populations (Figure 7.2-11). Average returns of adult steelhead counted by video were 53 (Bogus Creek), 117 (Shasta River), and 265 (Scott River) during the 10-year period (CDFW, unpublished data, 2017). However, in many years, video monitoring was terminated in December or January and did not capture the full or peak steelhead migration period. In years where video monitoring or a combination of video counts and SONAR counts covered the full migration period (2013 and 2016 for Bogus Creek and 2012, 2015, and 2016 for Shasta River), total steelhead counted averaged 94 for Bogus Creek and 194 for the Shasta River (CDFW, unpublished data, 2017).

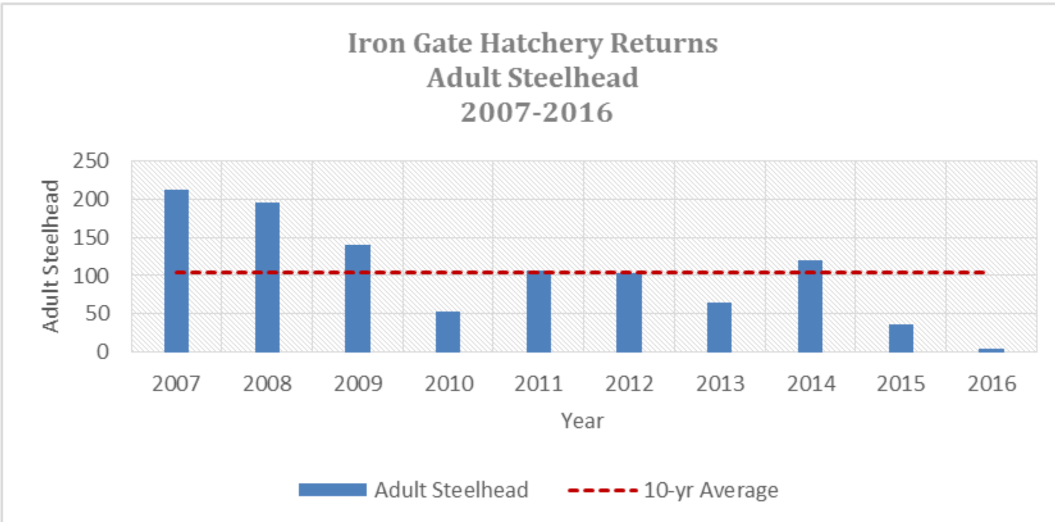


Note that most counts do not represent the peak of full steelhead migration periods.

Figure 7.2-11 Video counts of adult steelhead on Bogus Creek, Shasta River, and Scott River from 2007-2016.

Iron Gate Hatchery has produced steelhead since the early 1960s to mitigate for Iron Gate Dam impacts and to provide recreational fishing and harvest opportunities. Steelhead production has varied substantially over the years, with a high of approximately 643,000 yearlings in 1970 to a low of about 11,000 yearlings in 1997. The 200,000 yearling production goal was met in most years prior to 1991, but has not been achieved since then (California Hatchery Scientific Review Group 2012).

Adult steelhead returns to Iron Gate Hatchery typically ranged between 1,000 to 4,000 fish from the mid-1960s to the late 1980s. Returns declined substantially in 1990 and have steadily declined since (CDFW 2016d). Between 2007 and 2016, adult steelhead returns have ranged from a low of 4 (2016) to a high of 212 (2007) with a recent 10-year average of 104 fish (Figure 7.2-12). These returns have not been adequate to meet production goals for egg take and juvenile releases, and no steelhead have been produced at the Iron Gate Hatchery since 2012 (K. Pomeroy, CDFW, personal communication, 2017).



The dotted red line represents the recent 10-year average of 104 fish.

Figure 7.2-12 Adult steelhead returns to Iron Gate Hatchery from 2007-2016.

Summary

The Klamath River Basin historically supported robust and resilient populations spring and fall run Chinook salmon, coho salmon, and steelhead. The remaining populations of anadromous fish in the Klamath River are present at a fraction of their historical estimates, and have declined significantly in abundance and viability over the last century (NMFS 2009). Most recently, and since the development of 2012 EIS/R, these populations have continued to experience further declines in abundance. Coho salmon are the only anadromous salmonid in the Klamath Basin listed under the ESA, the nine coho populations in the basin continue to decline, with most of them being at a high risk of extinction. New research published on Chinook salmon suggests that it may be appropriate to create a separate ESU to distinguish spring-run Chinook from fall-run Chinook in the current Upper Klamath – Trinity River ESU, and that designation will almost assuredly place Klamath Basin spring Chinook salmon on the endangered species list. Fall Chinook salmon runs have demonstrated great variability in year to year run sizes over the last decade with historically large runs in 2012 and 2014, and record low returns in 2015 and 2016. Forecasted predictions for 2017 were for even smaller returns than the record setting low run of 2016, and have led to widespread restrictions on West Coast fisheries. Steelhead populations show variability from year to year and are more difficult to assess than those of coho and Chinook salmon. Some populations such as summer steelhead populations on USFS lands appear to be relatively stable with modest increases over the last few monitoring years, while other populations such as those in the Shasta River and Bogus Creek continuing to decline.

7.2.2 Understanding of Fish Diseases

Fish diseases are widespread in the mainstem Klamath River during certain time periods, and in certain years, disease prevalence has been shown to adversely affect productivity of Chinook (*Oncorhynchus tshawytscha*) and coho salmon (*O. kisutch*). Since 2012, researchers have focused on developing a better understanding of the life cycle, habitat characteristics, and effects of the myxozoan parasite *Certonova shasta* (previously *Ceratomyxa shasta*; *C. shasta*), and *Parviscapsula minibicornis*, on anadromous salmonids. *P. minibicornis* and *C. shasta* share the same invertebrate host, *Manayunkia speciosa*, and environmental variables such as temperature and flow are expected to affect parasite abundances similarly (Bartholomew and Foott 2010). The following document focuses on *C. shasta* as an indicator of mortality as a result of myxozoan infection in the Klamath River.

Certonova Shasta

Life Cycle

The parasite *C. shasta* is endemic to the Klamath Basin and is assumed to have co-evolved with the salmonid species it infects (Som et al. 2016a). The myxozoan parasite has a complex life cycle that includes two hosts and two spore stages. Waterborne actinospores released from the freshwater polychaete worm, *M. speciosa*, infect adult and juvenile salmonids and develop into myxospores that are then released from salmonids and infect the polychaete host.

C. shasta actinospores are released from infected polychaetes into the water column as temperatures rise above 10ºC in late March to early April (Bartholomew and Foott 2010). The actinospores are naturally buoyant and relatively short lived (days to weeks; Bjork 2010). Actinospores die unless they encounter a susceptible fish host. Fish become infected as the spores attach to the gills and travel through the bloodstream to reach the intestine. *C. shasta* infects the intestine of salmonids and can lead to necrosis of intestinal tissue that can be accompanied by a severe inflammatory reaction (enteronecrosis) and mortality (Bartholomew et al. 1989; Bartholomew et al. 2017). Myxospores develop within infected salmonids over a period of 18-25 days and are released into the environment at or soon after fish mortality (Benson 2014). Myxospores are denser than actinospores, allowing them to sink to the channel bed where they are consumed by suspension-feeding polychaetes (Bartholomew and Foott 2010). Consumption of myxospores infects polychaete worms, completing the *C. shasta* life cycle (Som et al. 2016a).

Habitat

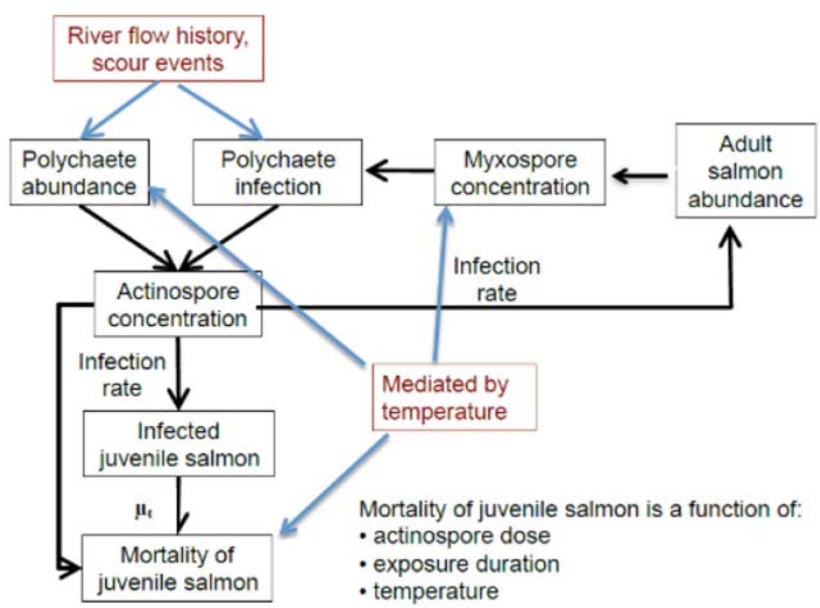
The polychaete worm *M. speciosa* is adapted to life as a semi-sessile benthic invertebrate and inhabits many types of macro and microhabitats. Inhabited macrohabitats include channel habitat such as riffle runs, pools, channel margins, and reservoir inflow zones. Identified microhabitats include channel bed sediment, freshwater sponge, aquatic vegetation, and periphyton (Stocking and Bartholomew 2007). Through laboratory and field studies, researchers have concluded higher flows could directly influence the distribution of polychaetes by restricting habitat use to stable substrates (Som et al. 2016b). However, the mobility of *M. speciosa* and the species' ability to persist after high flow events suggests *M. speciosa* is capable of moving to lower velocity, stable substrate habitats to avoid high flow effects (Alexander et al. 2014). Preliminary test results indicate that infected polychaetes are more likely to occur within a smaller range of peak flow depths and velocities than the general polychaete population, with infected polychaetes more associated with deeper and lower velocity depositional habitat (Som et al. 2016b).

Juvenile Salmonid Infection

Annual prevalence of the myxozoan parasite *C. shasta* has been documented in emigrating juvenile salmon populations during spring and early summer in the Klamath River (True et al. 2016). *C. shasta* in out-migrating juvenile salmonids has been well-studied (True 2013; True et al. 2013) and the processes that influence *C. shasta* impacts on Klamath River salmon are increasingly understood.

C. shasta infection of juvenile salmonids causes enteronecrosis, often resulting in death. Fish infected by *C. shasta* may experience enteronecrosis mortality, but are also prone to mortality caused by other pathogens such as *P. minibicornis*. Enteronecrosis may also weaken juvenile salmonids making them more susceptible to predation, and may compromise osmoregulatory systems that are essential for successful ocean entry. *C. shasta*-related mortality has been linked to population declines in fall Chinook salmon in the Klamath River (Fujiwara et al. 2011; True et al. 2013).

C. shasta infection rates of juvenile Chinook salmon are influenced by *C. shasta* spore densities, water temperature, flow rate, and juvenile salmonid residence time in areas of high spore densities (Ray et al. 2014). Figure 7.2-13 includes a conceptual model illustrating the variables and processes influencing *C. shasta* infection and juvenile salmonid mortality. *C. shasta* infections generally progress to clinical enteronecrosis over a 7-18-day period, depending on exposure and the time period fish spend in the infectious zone during their outmigration (True 2013). Mortality may occur between 13 days and 25 days post-exposure to *C. shasta* (Bartholomew et al. 2017).



Source: Foott et al. 2011 cited in Som et al. 2016

Figure 7.2-13 A conceptual model of variables and processes influencing C. shasta infection and mortality of juvenile Chinook salmon.

Studies over the last decade have focused on developing a better understanding of the parasite life cycle and the parasite's effects on juvenile salmonids in the Klamath River. Ray et al. (2014) evaluated in situ juvenile salmonid exposure using sentinel cages. Studies found that increasing parasite concentrations and water temperatures were positively associated with the proportion of juvenile fish that experienced infection and mortality. Spore concentration and water temperature were more important determinants of exposure and mortality of juvenile Chinook and coho salmon, than was river discharge. However, high velocities (Ray and Bartholomew 2013) and elevated flows may dilute spore densities and reduce transmission efficiency (Ray and Bartholomew 2013). Recent low water years associated with the 2013-2014 drought in California provided habitat conditions more favorable to *C. shasta* and *P. minibicornis* proliferation (True et al. 2015) compared to previous and subsequent higher flow years. Although high flow years may disrupt polychaete habitat, elevated flows may also redistribute polychaetes over a longer reach of the Klamath River (Bartholomew et al. 2017).

Table 7.2-1 includes a summary of juvenile Chinook salmon prevalence of infection over 10 years at the Kinsman rotary screw trap location (RM 147.6), located 45 river miles downstream from Iron Gate Dam (RM 193.1). The Kinsman trap is located between the Shasta River and the Scott River, a reach of the Klamath River often referenced as the "infectious zone" (True et al. 2015). The general pattern of annual parasite abundance in the Klamath River downstream from Iron Gate Dam remains relatively consistent from year to year, although the extent of the infectious zone and the magnitude of parasite densities change seasonally and annually (Bartholomew and Foott 2010; Bartholomew et al. 2017). Depending on river conditions (e.g., flow and water temperature) the infectious zone may extend from Iron Gate Dam to downstream of Seiad Valley (True 2013; Bartholomew et al. 2017). While high run-off years may reduce polychaete densities downstream of Iron Gate Dam, the redistribution of polychaetes by high flows may result in the downstream relocation of *C. shasta* 'hot spots' (Som et al. 2016c).

Table 7.2-1 Summary of estimates of annual-level C. shasta infection prevalence for wild and/or unknown origin juvenile Chinook salmon passing the Kinsman rotary screw trap site (RM 147.6).

Year	Origin	Prevalence of Infection	Infected Population Estimate Lower Confidence Limit	Infected Population Estimate	Infected Population Estimate Upper Confidence Limit
2005	All	0.41	0.26	0.38	0.47
2007	All	0.28	0.07	0.1	0.15
2008	All	0.6	0.43	0.51	0.58
2009	All	0.5	0.5	0.58	0.66
2010	Wild/Unknown	0.12/0.15	0.02	0.04	0.07
2011	Wild	0.2	0.07	0.11	0.17
2012	Wild/Unknown	0.06/0.00	0.04	0.08	0.14
2013	Wild	0.18	0.03	0.06	0.09
2014	Wild	0.67	0.12	0.18	0.26
2015	Wild/Unknown	0.66/0.96	0.2	0.29	0.39

Note: The lower and upper confidence limits account for the estimation uncertainty in abundance and weekly prevalence of infection rates.
Source: Som et al. (2016a).

Estimates of the annual proportion of infected Chinook salmon range from 2 percent to 66 percent (Som et al. 2016a). As the release of Iron Gate Hatchery juvenile Chinook salmon overlaps with the period of high infection potential, studies suggest that a high proportion of the Iron Gate Hatchery Chinook salmon stock can become infected with *C. shasta* (Som et al. 2016a). Infected juvenile fish that experience mortality lower in the Klamath River may become another source of myxospores to the lower Klamath River.

Spawner Influence on Prevalence of *C. shasta*

Returning adult salmon are exposed to myxospores when fish enter the Klamath River in the fall. Disease progression in adult fish is likely a function of temperature and infectious dose (Bartholomew and Foott 2010). Because adult fish have a low infection threshold, the prevalence of infection is high and infection rates may be high even in years of reduced infectious zone prevalence.

Adult salmonid carcasses play an important role in the lifecycle and prevalence of *C. shasta* in the infectious zone (Som et al. 2016a). Fall Chinook salmon returns to Iron Gate Hatchery and the blockage created by Iron Gate Dam, concentrate spawners and post-spawn carcass densities between Iron Gate Dam and the Shasta River confluence. Myxospore development occurs predominantly in decomposed carcasses rather than in recent post-spawned adults (Som et al. 2016a). Myxospore detection from carcasses ranges from 22 percent to 52 percent, however less than 13 percent of carcasses are significant contributors to myxospores production (produce >500,000 spores). Based on average adult returns to in the Shasta River to Iron Gate Dam reach, Chinook salmon carcasses potentially produce billions of myxospores. Myxospores remain viable in the channel bed sediments through the winter and early spring, and re-enter the water column over the winter when juvenile salmonids begin to emerge from the gravels.

Disease Reduction Benefits Associated with Dam Removal

Developments removal is expected to reduce fish disease in adult and juvenile salmon especially downstream from Iron Gate Dam. Among the salmon life stages, juvenile salmon tend to be most susceptible to *P. minibicornis* and *C. shasta* (Beeman et al. 2008). The main factors contributing to risk of infection by *C. shasta* and *P. minibicornis* include availability of habitat (pools, eddies, and sediment) and microhabitat characteristics (static flow and low velocities) for the polychaete intermediate host; polychaete proximity to spawning areas; increased planktonic food sources from Hydroelectric Reach reservoirs; water temperatures greater than 15°C (Bartholomew and Foott 2010); and juvenile salmonid residence time in the infectious zone (Som et al. 2016a).

Developments removal will restore natural channel processes including channel bed scour and sediment transport. Annual channel bed scour will disturb the habitat of the polychaete worm that hosts *C. shasta*

(FERC 2007). Reducing polychaete habitat will likely increase abundance of smolts by increasing outmigration survival, particularly for juvenile coho salmon (FERC 2007).

Dam removal will also broaden the distribution of adult pre-spawn fall Chinook salmon, reducing crowding and the concentration of disease pathogens that currently occurs in the reach between Iron Gate Dam and the Shasta River (Som et al. 2016a). A broader spawning distribution will also influence the distribution of post-spawn adult carcasses that contribute the bulk of the myxospores that enable the *C. shasta* life cycle within the infectious zone. Distributing adult carcasses over a longer reach of the Klamath River corridor will reduce myxospore densities likely leading to lower juvenile salmonid infection rates in the winter and spring rearing period (Som et al. 2016a). However, adult spawning upstream of the Klamath River dam sites could also expand habitat for *M. speciosa* and *C. shasta* effects. Both juvenile outmigrants and returning adult fish could be exposed to *C. shasta* over longer distances with dam removal.

In summary, water temperature and spore concentrations are positively correlated with infection and mortality of juvenile Chinook salmon and coho salmon. High spawner carcass concentrations downstream from Iron Gate Dam, contribute to high myxospore concentrations and the incidence of infection of juvenile fish. The timing of juvenile Chinook salmon from Iron Gate Hatchery and associated water temperatures may substantially contribute to the total myxospore load in the Klamath River. High spore concentrations in the Shasta River to Salmon River reach of the Klamath River, creates an “infectious zone” that increases outmigrating juvenile fish exposure to *C. shasta*. Developments removal is expected to reduce fish disease in adult and juvenile salmon especially downstream from Iron Gate Dam, by restoring natural channel processes (including channel bed scour and sediment transport), by broadening the distribution of adult pre-spawn fall Chinook salmon, and by broadening the distribution of post-spawn adult carcasses that contribute the bulk of the myxospores within the infectious zone.

7.2.3 Aquatic Resources Measures

The 2012 EIS/R identified significant short-term effects to the aquatic biological community. The 2012 EIS/R included aquatic resource (AR) measures to attempt to mitigate the possible short-term adverse effects of dam decommissioning. The Klamath River Renewal Corporation (KRRC) assembled an Aquatic Technical Work Group (ATWG) comprised of state and federal resource agencies, and tribal fisheries scientists in 2017 to review the 2010 EIS/R AR measures, determine the feasibility and effectiveness of those plans, and to provide input on refined proposed actions that would best meet the intent of the previous AR measures. The ATWG included fisheries scientists representing California Department of Fish and Wildlife (CDFW), Oregon Department of Fish and Wildlife (ODFW), U.S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA Fisheries), Yurok Tribe, Hoopa Valley Tribe, Karuk Tribe, and the Klamath Tribes.

Through a series of nine meetings between April 28 and August 15, 2017, the KRRC and the ATWG reviewed recent similar dam removal projects and new scientific information that has been developed since the 2012 EIS/R to update the 2012 AR measures. Updated AR measures are proposed to be implemented as part of the Project. These measures are subject to consultation with aquatic resource agencies and negotiation of the final Biological Opinions for the Project.

During the reservoir drawdown year, reservoirs will be drawn down by the end of March, followed by volitional fish passage by October 1, and free-flowing river conditions at all four facilities by December 31. Project effects are anticipated to be short-term in nature, with long-term benefits ultimately outweighing the project impacts to the aquatic biological community. The aquatic effects will primarily occur from the release of reservoir sediment during reservoir drawdown. Information in Appendix I – Aquatic Resource Measures, includes a review the 2012 EIS/R AR measures, lessons learned from other large dam removal projects, and provides the rationale for revising the AR plans to reduce the short-term project effects on aquatic resources.

Mainstem Spawning – Monitoring and Adaptive Management Plan

A monitoring and adaptive management plan is proposed to reduce effects to mainstem spawning. Survey and restoration actions included in the adaptive management plan are summarized below:

- **Action 1:** KRRC will evaluate tributary-mainstem confluences, four sites in the Hydroelectric Reach and five sites in the 8-mile reach from Iron Gate Dam (RM 193.1) to Cottonwood Creek (185.1), for 2 years (see Table 3-1 for proposed schedule). Monitoring frequency will be variable based on the season and year. Additionally, any 5-year flow event of 10,895 cfs or greater on the Klamath River recorded at the USGS Klamath River Below Iron Gate Dam CA gage (#11516530) within the first two years following reservoir drawdown, will trigger a monitoring effort. If tributary confluence blockages are identified during monitoring, necessary means will be employed to remove the obstructions to ensure volitional passage for adult Chinook salmon, coho salmon, steelhead, and Pacific lamprey. The ATWG will also convene periodically during the 2-year monitoring period to review monitoring frequency to ensure volitional passage is maintained between the Klamath River and select tributaries.
- **Action 2:** KRRC will complete a spawning habitat evaluation of the Hydroelectric Reach and newly accessible tributaries following reservoir drawdown. A target of 44,100 yd^2 of mainstem spawning gravel will be required to offset the effects to 2,100 mainstem-spawning fall Chinook salmon redds. If mainstem spawning gravel availability is less than the target values following reservoir drawdown, KRRC will consult with the ATWG to plan and implement spawning gravel augmentation in the former Klamath River reservoirs and Hydroelectric Reach. A target of 4,700 yd^2 of tributary spawning gravel is required to offset the effects to 179 tributary-spawning steelhead redds. If tributary spawning gravel habitat is less than the target values following reservoir drawdown, KRRC will meet with the ATWG to prioritize additional habitat restoration actions (e.g., gravel augmentation, gravel retention treatments) that will be implemented by KRRC to increase the amount of tributary habitat available to compensate for the loss of steelhead redds.

The proposed actions are intended to ensure adult salmonid and Pacific lamprey access to mainstem and tributary spawning habitat in the Hydroelectric Reach and between Iron Gate Dam and Cottonwood Creek following dam decommissioning.

Outmigrating Juveniles – Survey and Protective Measures

Surveys and measures proposed to reduce effects on conditions for outmigrating juveniles are summarized below:

- **Action 1:** KRRC will sample and salvage overwintering juvenile coho salmon from the Klamath River between Iron Gate Dam (RM 193.1) and the Trinity River (RM 43.4) confluence prior to reservoir drawdown. Sampling and salvage sites will focus primarily on alcoves, side channels, and backwatered floodplain features adjacent to the mainstem Klamath River. Up to 500 juvenile coho salmon are anticipated to be caught and relocated to off-channel ponds in order to protect this small, but important life history strategy in ESA-listed coho salmon population.
- **Action 2:** KRRC, with input from the ATWG, will prepare a monitoring and adaptive management plan to monitor tributary-mainstem connectivity. Beginning in January of the drawdown year and continuing for 2 years, tributary-mainstem confluences, including four sites in the Hydroelectric Reach and five sites in the 8-mile reach from Iron Gate Dam (RM 193.1) to Cottonwood Creek (RM 185.1), will be monitored with a variable frequency based on the season and year (see Table 4-1 for proposed schedule). Additionally, any 5-year flow event of 10,895 cfs or greater on the Klamath River recorded at the USGS Klamath River Below Iron Gate Dam CA gage (#11516530) within the first two years following reservoir drawdown, will trigger a monitoring effort. If KRRC identifies tributary confluence blockages during monitoring, KRRC will employ necessary means to remove the obstructions to ensure volitional passage for juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey. Juvenile salmonids are expected to benefit from the Project because it will restore access to at least 13.9 miles of key tributary rearing habitats in the Hydroelectric Reach and several recognized thermal refugia areas including Jenny and Fall creeks.
- **Action 3:** KRRC will prepare and implement a monitoring and adaptive management plan that will include detailed information related to monitoring juvenile salmonids and water quality conditions in 13 key tributary confluences between Iron Gate Dam (RM 193.1) and the Trinity River (RM 43.4). Tributary water temperatures and mainstem suspended sediment concentrations will be monitored by KRRC from March 1 to July 1 of the drawdown year. If water quality triggers are exceeded, KRRC and the ATWG will convene to evaluate the data and determine if juvenile salmonids will be salvaged from the tributary confluences and relocated to cool water tributaries, existing off-channel ponds, and/or to the Klamath River downstream from the Trinity River confluence.

The proposed actions are intended to reduce project effects on juvenile salmonids and Pacific lamprey during reservoir drawdown.

Iron Gate Fish Hatchery – Delayed Releases to Avoid Lethal Water Quality Conditions

Hatchery-reared yearling coho salmon to be released in the spring of 2021 could be held at Iron Gate Hatchery or at another facility by CDFW until water quality conditions in the mainstem Klamath River improve to sublethal levels. Based on the current Iron Gate Hatchery release schedules and suspended sediment predictions in the Klamath River following dam decommissioning, yearling coho salmon releases could be delayed approximately 2 weeks to avoid lethal water quality conditions. Water quality monitoring stations established prior to reservoir drawdown will be used to determine when conditions in the mainstem Klamath River are suitable for the release of hatchery-reared coho salmon.

The proposed action is intended to reduce project effects on outmigrating hatchery-origin yearling coho salmon released from Iron Gate Hatchery. Whether the measure is ultimately adopted is within the discretion of CDFW, and KRRC will coordinate closely with CDFW on potential implementation of this measure.

Sucker – Survey and Protective Measures

Surveys and measures proposed to reduce effects to suckers are summarized below:

- **Action 1:** Lost River and shortnose suckers will be sampled in the Klamath River and in Hydroelectric Reach reservoirs in 2018, 2019, and 2020. River sampling will be completed in spring of 2019 and 2020, and reservoir sampling will be completed in fall of 2018 and 2019. Each sampling will require approximately 6 days for an estimated 24 days of sampling across the 2018 to 2020 period. The purpose of sampling is to document the abundance and genetics of Lost River and shortnose suckers in the Hydroelectric Reach. Captured fish will be marked with a passive integrated transponder (PIT) tag, fin clipped for genetic material, measured, and released. Recaptured fish will be used to estimate sucker abundance in the sampled reservoirs. Fin clips will be used to determine the genetics of the sampled fish. USFWS is currently developing genetic markers for Lost River and shortnose suckers.
- **Action 2:** Adult Lost River and shortnose suckers in reservoirs downstream from Keno Dam will be captured and relocated to isolated water bodies in the Klamath Basin. The proposed relocation of rescued suckers to isolated waterbodies is to ensure hybridized suckers do not mix with sucker populations designated as recovery populations in Upper Klamath Lake. An estimated 14 days will be required for salvage and release efforts. Due to the poor current understanding of Lost River and shortnose sucker populations in the reservoirs, we are unsure of the number of adult suckers inhabiting the reservoirs. Based on past study results (e.g., Desjardins and Markle 2000), we anticipate salvaging and translocating 100 adult Lost River and 100 adult shortnose suckers from each of the three Klamath River reservoirs (600 fish total). The number of translocated fish will not exceed 3,000 fish, which is the capacity of the currently identified recipient waterbody (Tule Lake). The proposed actions are intended to reduce project effects on Lost River and shortnose suckers inhabiting the Hydroelectric Reach reservoirs. The following sections provide additional detail on the proposed actions.

The proposed actions are intended to reduce project effects on Lost River and shortnose suckers inhabiting the Hydroelectric Reach reservoirs.

Freshwater Mussels – Survey and Protective Measures

Proposed surveys and other measures proposed to reduce effects to freshwater mussels are summarized below:

- **Action 1:** KRRC will complete a reconnaissance in 2019 to assess the distribution and density of freshwater mussels in the 8-mile long bedload deposition reach from Iron Gate Dam (RM 193.1) downstream to the Cottonwood Creek confluence (RM 185.1). The reconnaissance effort will determine if the mussel beds identified in the 2007-2010 surveys are still present, and estimate abundance of a subset of the mussel beds in the reach.
- **Action 2**: Based on the reconnaissance, KRRC will salvage and relocate a portion of the freshwater mussels located between Iron Gate Dam and Cottonwood Creek prior to drawdown to reduce project effects to the mussel community. Up to 20,000 mussels are planned for translocation to appropriate habitats in the Klamath River between the upstream extent of J.C. Boyle Reservoir (RM 234.1) and Keno Dam (RM 239.2).

The proposed actions are intended to reduce project effects on freshwater mussels located downstream from Iron Gate Dam.

7.3 Terrestrial Resources Measures

KRRC has consulted with state and federal regulatory agencies and stakeholders to develop the following measures that KRRC proposes to reduce potential impacts to terrestrial resources. KRRC will implement these measures as part of the Project.

- **Habitat Rehabilitation Plan:** Section 6 and Appendix H summarize the restoration plan for the Project.
- **Nesting Bird Surveys:** Appendix J discusses surveys in several sections including Northern Spotted Owl, Bald and Golden Eagles, and Special Status Wildlife Species. KRRC will implement avoidance and minimization measures to the extent feasible, including monitoring, exclusion, buffers, and construction planning to time activities for less sensitive times of the year.
- **Nesting Habitat of Bald and Golden Eagle and Other Migratory Birds:** Appendix J discusses surveys for bald and golden eagles and special status wildlife species. KRRC will implement avoidance and minimization measures to the extent feasible, including monitoring, buffers, and construction planning to time activities for less sensitive times of the year.
- **Special Status Plants:** Appendix J discusses surveys for special status plant species. KRRC will implement avoidance and minimization measures to the extent feasible, including propagation and establishment in new locations as part of the site restoration as described in Section 6 and Appendix H.
- **Wetlands at Reservoirs:** KRRC will comply with regulatory requirements for delineating and protecting wetlands, as described in Appendix J in the Wetlands and Vegetation Communities section. KRRC will evaluate all areas within the limits of construction for the presence of wetlands in the project area, including potential disposal areas. KRRC will confirm the acreages through the field surveys. The restoration plans for the reservoir and non-reservoir areas, described in Sections 6.1 and 6.2, respectively, include designs for wetland and riparian habitat restoration to result in no net loss of wetland or riparian habitat functions.

- **Special Status Bats:** The bats section of Appendix J describes the field surveys that KRRC has conducted and that KRRC plans for the remainder of 2018 and for 2019. KRRC will implement avoidance and minimization measures to the extent feasible, including monitoring, exclusion, seasonal restrictions on demolition, preservation of existing habitat, and development of alternative habitat.
- **Northern Spotted Owl:** Appendix J discusses survey protocols for the Northern Spotted Owl. KRRC will implement avoidance and minimization measures to the extent feasible, including seasonal restrictions on certain activities and a prohibition of aircraft or helicopter flights over sensitive areas as identified through the surveys. These restrictions will be incorporated into the project description and construction planning.

Appendix J discusses the full terrestrial resource work plans and planned avoidance and minimization measures.

7.4 Road Improvements

This section describes the proposed road improvements the KRRC will implement as part of the Project. Sections 5.2.2, 5.3.2, 5.4.2 and 5.5.2 discuss construction access assessments and related transportation improvements and maintenance. This Section 7.4 discusses proposed post-construction transportation improvements and maintenance. Table 7.4-1 provides a summary of the all pertinent road segments, bridges, and culverts and the associated improvements.

Several road, intersection, structure and culvert improvements are proposed as part of the Project to:

- Facilitate access for project-related vehicles and equipment associated with dam removal (Section 5)
- Provide safety measures for both public and project roads used during the dam removals
- Return roads used by project-related vehicles to the respective owners and users in a state that equals or exceeds existing condition/function

KRRC performed a site visit and desktop study to assess the state of road infrastructure expected to be used throughout the Project. Tables in Appendix K show the findings of this assessment.

KRRC completed a further assessment of which elements require improvement for either construction access or post -construction restoration. KRRC will implement the improvements at various phases throughout the Project. Some will require completion prior to the dam removals, and others will be contingent on a future assessment of road elements once reservoir drawdown or hauling activities are complete. There will also be some ongoing activities throughout the Project to maintain roads heavily trafficked by project construction vehicles.

Table 7.4-1 Roadway and Access Improvements

Location	Improvements	Purpose		
		Construction Access	Post-Drawdown	Road Rehabilitation
J.C. Boyle				
The Dalles California Highway (US97)	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Green Springs Highway (OR66)	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Spencer Bridge	• None (Section 5.2.2)			
Keno Worden Road	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Keno Access Road	• None (Section 5.2.2)			
Unnamed Culvert at Unnamed Road near J.C. Boyle Reservoir	• None (Section 7.4.3)			
Topsy Grade Road	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Culvert at Unnamed Creek	• Potential sediment removal and downstream erosion protection (Section 7.4.3)		X	
J.C. Boyle Dam Access Road from OR66	• Regrading uneven or rutted areas (Section 5.2.2)	X		
Junction of OR66 and J.C. Boyle Dam Access Road	• Intersection widening (Section 5.2.2) • Tree removal (Section 5.2.2) • Signage (Section 5.2.2)	X		
J.C. Boyle Powerhouse Road	• None (Section 5.2.2)			
Timber Bridge	• Remove (Section 5.2.2)	X		
Power Canal Access Road	• Periodic roadway maintenance grading during construction (Section 5.2.2)	X		
J.C. Boyle Disposal Access Road	• Regrading (Section 5.2.2) • Minor widening (Section 5.2.2)	X		

Location	Improvements	Purpose		
		Construction Access	Post-Drawdown	Road Rehabilitation
J.C. Boyle Left Abutment Access Road	• None (Section 5.2.2)			
Copco and Iron Gate				
Interstate 5 (I-5)	• None (Section 5.2.2)			
Copco Road (I-5 to Ager Road)	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Cottonwood Creek Bridge	• None (Section 5.2.2)			
Copco Road (Ager Road to Lakeview Road)	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Dry Creek Bridge	• Replace or provide temporary bridge for construction access during Project (Section 5.2.2)	X		
Copco Road (Lakeview Road to Daggett Road)	• Roadway maintenance during construction (Section 5.2.2) • Potential pavement rehabilitation during or post-Project (Section 5.2.2)	X		X
Brush Creek Bridge	• None (Section 5.2.2)			
Unnamed Culverts between Brush Creek and Scotch Creek	• Potential rehabilitation or replacement post-construction (Section 7.4.3)			X
Scotch Creek Culvert	• Replace (Section 7.4.3)		X	
Camp Creek Culvert	• Replace with bridge or culvert (Section 7.4.3)		X	
Jenny Creek Bridge	• Replace (Section 7.4.3)		X	
Copco Road (Daggett Road to Copco Access Road)	• Potential road surface maintenance during or post-Project (Section 5.2.2)			X
Fall Creek Bridge	• Replace or provide temporary bridge for construction access during Project (Section 5.2.2)	X		
Copco Road (Copco Access Road to Copco Road Bridge)	• Potential road surface maintenance during or post-Project (Section 5.2.2)			X

Location	Improvements	Purpose		
		Construction Access	Post-Drawdown	Road Rehabilitation
Beaver Creek and E.F. Beaver Creek Culverts	• Potential erosion protection (Section 7.4.3)		X	
Raymond Gulch Culvert	• Potential erosion protection (Section 7.4.3)		X	
Copco Road Bridge	• Potential abutment erosion protection (Section 7.4.3)		X	
Copco Access Road	• Clear, grub and regrade (Section 5.2.2) • Minor widening into hillside if possible (Section 5.2.2) • Maintain after construction is complete to allow access for monitoring	X		
Copco Cove Access	• Minor works to enable barge mobilization (Section 5.2.2)	X		
Patricia Avenue	• None			
Culverts at Unnamed Creeks (Copco Lake)	• Potential erosion protection (Section 7.4.3)		X	
Ager Beswick Road	• None (Section 5.2.2)			
Mallard Cove Boat Ramp Access	• Minor works to enable barge mobilization (Section 5.2.2)	X		
Daggett Road	• Minor grading improvements (Section 5.2.2) • Potential road surface maintenance during and post-Project (Section 5.2.2)	X		X
Daggett Road Bridge	• Replace (Section 5.2.2)	X		
Lakeview Road (Copco Road to Iron Gate disposal site)	• Potential road surface maintenance during and post-Project (Section 5.2.2)			X
Lakeview Road Bridge	• Replace or provide temporary bridge for construction access during Project (Section 5.2.2)	X		
Iron Gate Powerhouse Access Road	• Signage • Potential road surface maintenance during construction (Section 5.2.2) • Remove after construction is complete and restore area to native vegetation (Section 5.2.2)	X		X

Location	Improvements	Purpose		
		Construction Access	Post-Drawdown	Road Rehabilitation
Iron Gate Left Abutment Access Road	• Remove after construction is complete and restore area to native vegetation (Section 5.2.2)	X		
Iron Gate Upstream Left Abutment Access Road	• Remove after construction is complete and restore area to native vegetation (Section 5.2.2)	X		

7.4.1 Construction Access Improvements

KRRC proposes various improvements to provide adequate access and haul routes associated with project construction. These all require completion prior to the commencement of dam removals. Sections 5.2.2, 5.3.2, 5.4.2, and 5.5.2 provide a detailed discussion.

7.4.2 Ongoing and Post-Project Maintenance Activities

Some roads will require ongoing maintenance at various points throughout the Project or post-Project to maintain an acceptable road surface. See Table 7.4-1 for a list of the road segments where KRRC proposes pavement rehabilitation or road surface maintenance during or post-Project. Pavement rehabilitation is for asphalt concrete paved roads and includes overlay or localized pavement replacement. Road surface maintenance is for gravel and dirt roads and includes minor regrading and gravel placement.

KRRC's contractor will conduct a baseline and a post-project pavement condition assessment to the determine extent of maintenance required. KRRC's contractor will provide temporary traffic control on public roads during roadway surface maintenance, and this will involve one-way traffic control with flaggers and construction area signs.

7.4.3 Long Term Road Infrastructure Improvements

KRRC proposes some improvements to maintain existing roads in their pre-project condition. The proposed improvements will restore any reduction in functionality of road infrastructure caused by a reduction in flood protection or a reduction in embankment or culvert stability following the drawdown of the reservoirs and dam removal. The reservoir drawdown creates the potential for creek bed levels to readjust down to their pre-dam state. This will, in some areas, cause incision into fine sediments that have settled during the operation of the reservoirs. Where road infrastructure was constructed atop these sediments, the erosion of sediments from beneath or near road elements could result in damage or failure.

KRRC will complete the construction of improvements at various stages throughout the Project depending on the timeline for completion requirements, but many will require implementation prior to drawdown. The following sections summarize proposed permanent improvements to roads and bridges included in the Project.

Spencer Bridge (OR66/Green Springs Highway)

The Spencer Bridge left abutment embankment was constructed with highly pervious, strong basalt material, and it is expected that the embankment will remain stable during and following the drawdown of J.C. Boyle Reservoir, but some minor erosion of the riprap outer layer, not affecting stability, could occur. KRRC will inspect the embankment following the drawdown, and any damage to the riprap outer layer will be repaired. KRRC anticipates the restored Klamath River channel to locate between the 2nd and 3rd bridge bents, both of which were constructed on bedrock. KRRC does not anticipate scour at the bents following dam removal. Temporary traffic control will be required during these improvements.

Timber Bridge

A timber bridge spans the Klamath River immediately downstream of J.C. Boyle Dam. KRRC's contractor will remove this structure after dam removal. KRRC does not propose traffic control as the bridge is not a public road.

Topsy Grade Road Culvert at Unnamed Creek

Topsy Grade Road crosses an unnamed creek, roughly 1,900 feet to the east of the J.C. Boyle Dam. The road is found on an embankment roughly 400 feet long with three 24-inch culverts draining a watershed of roughly 5 square miles. Reservoir sediment currently covers and obscures the culverts. The culverts may have been constructed prior to J.C Boyle Dam, and if so, they will likely not be impacted by reservoir sediment sloughing. However, the J.C. Boyle as-built drawings indicate that the culverts do not align with the original thalweg of the creek. KRRC's contractor will monitor this location during and following drawdown. If erosion of reservoir sediments affects this culvert, KRRC's contractor will install riprap armor on the downstream face of the embankment and remove sediment and debris from the culverts, if needed, to protect the road embankment. See Figure 5.1-1(C) for the limits of work associated with these improvements. KRRC's contractor will provide minor temporary traffic control during these improvements.

Unnamed Culvert at Unnamed Road (near J.C. Boyle Reservoir)

Approximately 0.9 mile north of OR66, off Keno Access Road, an unnamed road crosses an unnamed creek. The road is found on an embankment, with two 36–inch-diameter corrugated metal pipe (CMP) culverts allowing drainage of the creek. The culverts are well above the reservoir water level, so KRRC does not anticipate they are built on reservoir sediments. The upstream and downstream ends have silt build-up. KRRC's contractor will monitor this location during and following drawdown. If erosion of reservoir sediments affects this culvert, KRRC's contractor will place riprap armor on the downstream face of the embankment and remove sediment and debris from the culvert, if needed, to protect the road embankment. KRRC's contractor will provide minor temporary traffic control during these improvements.

Copco Road Bridge

Copco Road Bridge crosses Copco Lake immediately north of the junction of Copco Road and Ager Beswick Road. Section 5.3.2.2 includes additional information on the bridge. Both drawdown and post-project flows have the potential to cause erosion at the abutments or central pier. KRRC will further evaluate this during the detailed design phase, KRRC's contractor will provide erosion protection at the abutments or pier, if needed. KRRC's contractor will provide minor temporary traffic control during these improvements.

Copco Road Culvert at Raymond Gulch

A 60–inch-diameter CMP culvert pipe passes beneath Copco Road at Raymond Gulch adjacent to Copco Lake. The culvert is elevated well above the reservoir level, and KRRC does not expect that it is built on reservoir sediments. KRRC's contractor will monitor this location during and following drawdown. If erosion of reservoir sediments affects this culvert, KRRC's contractor will place riprap armor on the downstream face of the embankment. KRRC's contractor will provide minor temporary traffic control during these improvements.

Copco Road Culverts at Beaver Creek

60–inch-diameter CMP culvert pipes pass beneath Copco Road at both Beaver Creek and East Fork Beaver Creek adjacent to Copco Lake. Both pipes are elevated well above the reservoir water level, and KRRC does not expect that it is built on reservoir sediments. KRRC's contractor will monitor this location during and following drawdown. If erosion of reservoir sediments affects this culvert, KRRC's contractor will place riprap armor on the downstream face of the embankment. KRRC's contractor will provide minor temporary traffic control during these improvements.

Patricia Avenue Culverts at Unnamed Creek (Copco Lake)

Patricia Avenue passes over two unnamed creeks near Copco Lake and the Copco Lake Fire Department. Beneath each crossing is a 60–inch-diameter CMP culvert. The drainage culverts are elevated well above the reservoir water, and KRRC does not expect that it is built on reservoir sediments. KRRC's contractor will monitor this location during and following drawdown. If erosion of reservoir sediments affects this culvert, KRRC's contractor will place riprap armor on the downstream face of the embankment. KRRC's contractor will provide minor temporary traffic control during these improvements.

Jenny Creek Bridge

Jenny Creek Bridge crosses the mouth of Jenny Creek at Iron Gate Reservoir. Section 5.3.2.2 includes further details of the bridge. The abutments are built on material deposited after the dam construction and the dam removal may cause significant erosion that could possibly undermine the abutments. KRRC's contractor will construct a new bridge on the upstream side of the existing structure, on a modified alignment, to preclude damage to the structure after the drawdown (Figure 7.4-1).

The new bridge will be a multi-span bridge long enough to span over the creek sediments and/or reservoir deposited material and the design will found the bent supports on native soil or rock. The design will place the abutment supports for the replacement structure away from the area that is susceptible to reservoir sediment erosion. This approach will minimize realignment of the existing Copco Road and potential impacts to right of way. KRRC's contractor will build the new bridge 'offline' so the impact to traffic will be limited to the traffic switch from the existing road alignment to the new realigned road.

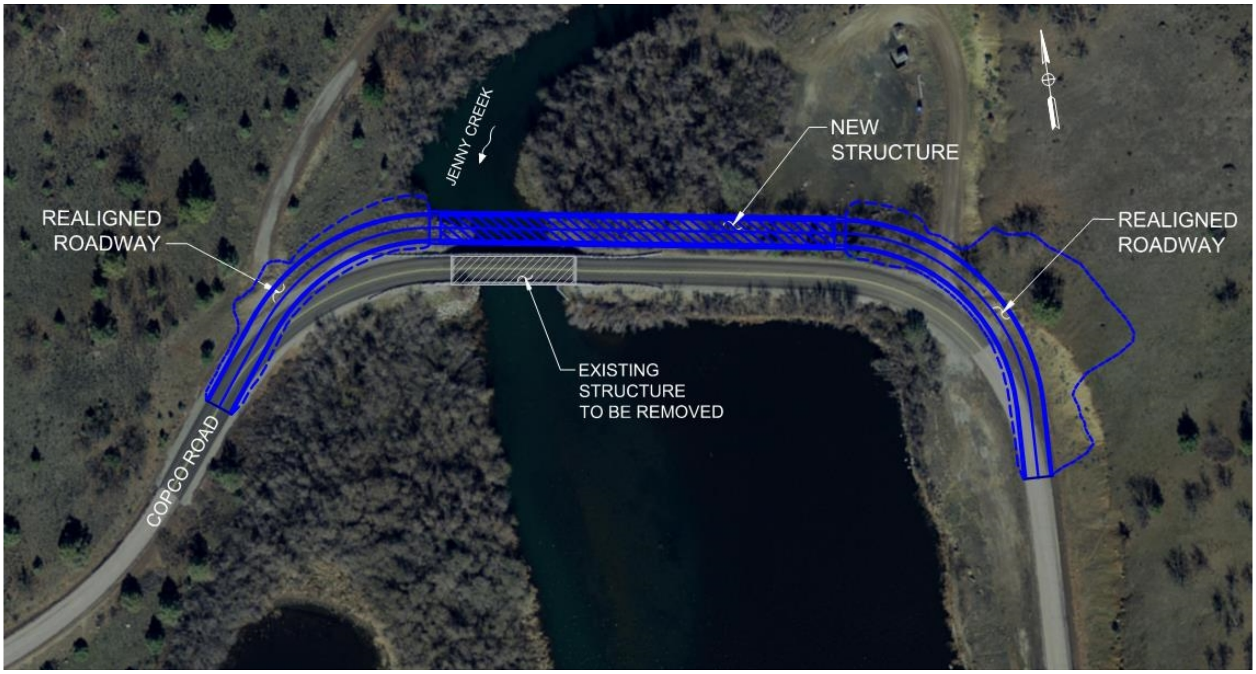


Figure 7.4-1 Copco Road Realignment and Jenny Creek Bridge Replacement

Copco Road Culverts at Camp Creek

A 10 foot diameter CMP arch culvert passes beneath Copco Road at Camp Creek adjacent Iron Gate Reservoir. KRRC anticipates erosion in this area following drawdown of the reservoir due to incision into reservoir sediments. Due to the difficulty in knowing exactly when the erosion will occur, KRRC will replace the culvert with a bridge, and provide suitable erosion protection to account for the potential drop in creek bed elevation, prior to drawdown. KRRC's contractor will construct a temporary structure and detour road just upstream of the culvert to maintain through-traffic during the work. Figure 7.4-2 shows a potential temporary detour alignment.

Copco Road Culvert at Scotch Creek

A 120–inch-diameter CMP culvert passes beneath Copco Road at Scotch Creek, adjacent to Iron Gate Reservoir. KRRC anticipates erosion in the vicinity of the culvert following drawdown of the reservoir due to incision into reservoir sediments. KRRC will replace the culvert, and provide suitable erosion protection to account for the potential drop in creek bed elevation, prior to drawdown. KRRC's contractor will construct a temporary structure and detour road just upstream of the culvert to maintain through-traffic during the work. Figure 7.4-3 shows a potential temporary detour alignment.

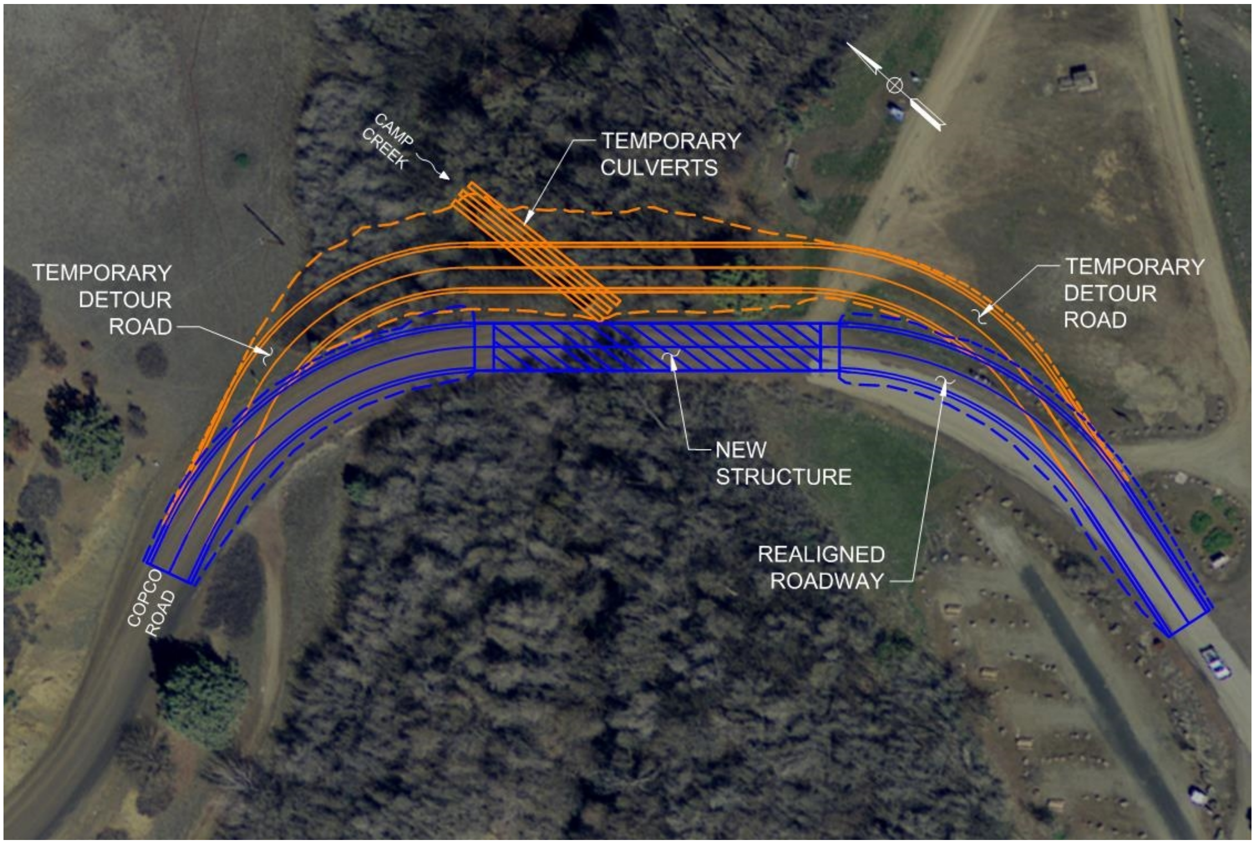


Figure 7.4-2 Temporary Culverts and Detour Road at Camp Creek

Copco Road Drainage Culverts between Brush Creek and Camp Creek

A number of culverts ranging in diameter from approximately 12–inch-to 18–inch-diameter pass beneath Copco Road between Brush Creek and Camp Creek. KRRC's contractor will monitor this location during and following drawdown. If erosion of reservoir sediments affects these culverts, KRRC's contractor will place riprap armor on the downstream faces of the embankments. KRRC's contractor will provide minor temporary traffic control during these improvements.

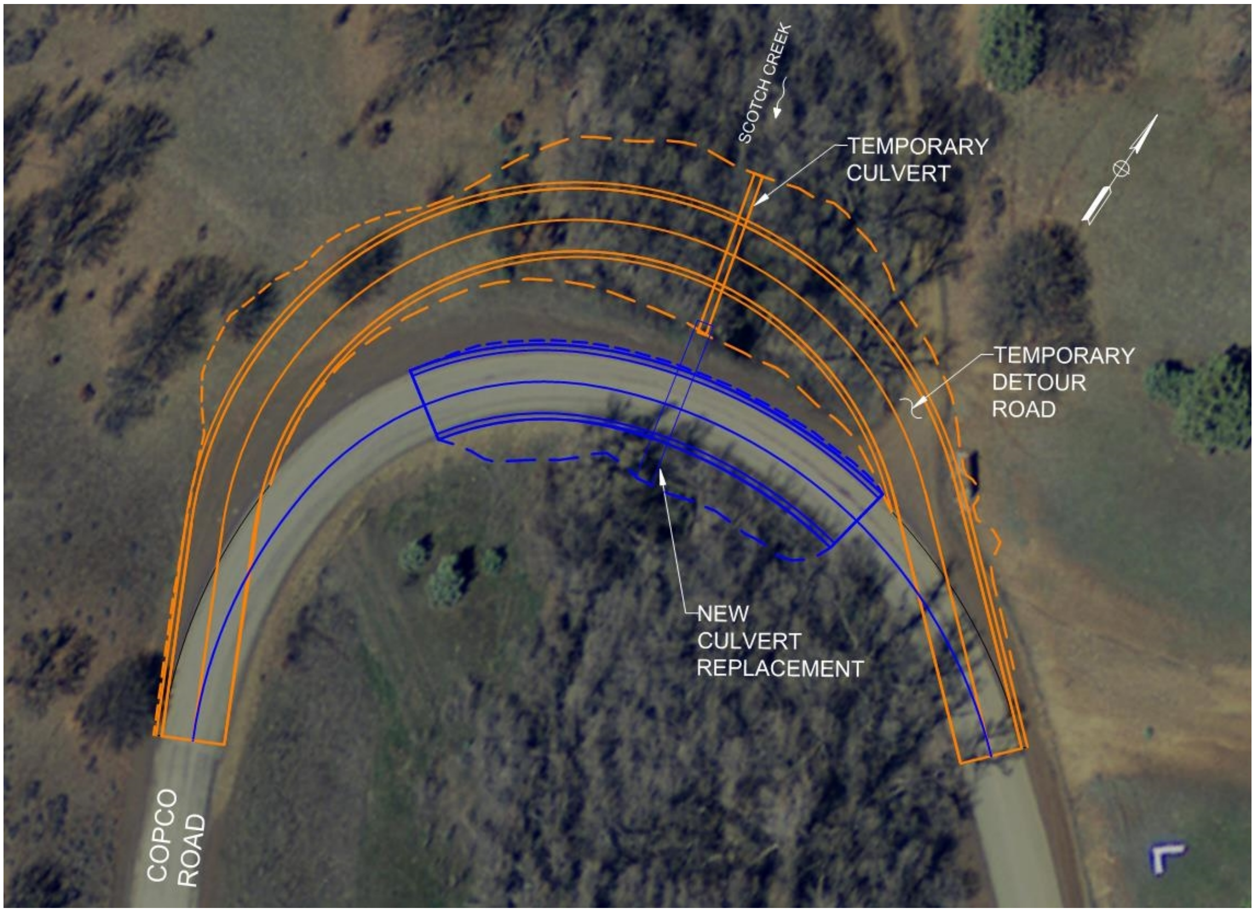


Figure 7.4-3 Temporary Culvert and Detour Road at Scotch Creek

7.5 Yreka Water Supply

This section describes the proposed improvements to the City of Yreka water supply the KRRC will perform as part of the Project. There are three options for the water supply pipeline, and the KRRC will select one for implementation in consultation with the City of Yreka. A 24-inch-diameter water supply pipeline for the City of Yreka, California, crosses the Klamath River near the upstream end of the reservoir impounded behind Iron Gate Dam. The 24-inch-diameter steel water supply pipeline crosses the Klamath River near the upstream end of Iron Gate Reservoir as shown on Figure 7.5-1 and is minimally buried in the reservoir bed. When KRRC's contractor removes Iron Gate Dam, high velocity river flows will expose the pipe, and it will likely sustain damage. During preparation of the Detailed Plan, USBR used a HEC-RAS model to estimate the hydraulic properties at the pipe crossing post-dam removal, and predicted scour ranged from 5 to 10 feet (USBR, 2012). KRRC will provide a replacement pipe crossing before dam removal and reservoir drawdown to ensure uninterrupted water supply for the City of Yreka.

The primary water intake for this water pipeline is at Dam A, located downstream of a PacifiCorp power plant near Fall Creek and diverts flow to a pumping station further downstream along Fall Creek. A secondary intake at Dam B located on Fall Creek is used when the power plant is shut down and supplies water through a pipeline to the intake at Dam A. Based on the Detailed Plan (USBR, 2012), the existing flat panel fish screens for the water supply intakes at Dams A and B may not meet current regulatory agency screen criteria for anadromous fish. It appears that the fish screens have recently been updated, but their compliance with current regulatory agency screen criteria for anadromous fish still needs to be confirmed, and the screens will require updates, if found to be non-compliant.

7.5.1 Water Supply Pipeline

Existing Conditions

At the Klamath River crossing, the existing steel pipe is minimally buried in the reservoir bed. The published surface geology by USGS (Wagner and Saucedo 1987) on both sides of the Klamath River at the location of the existing Yreka Pipeline Crossing is mapped to be Western Cascade Volcanic (*Tv*) rock unit, predominantly Andesite with some basalt and dacite (Tv^a), Andesite and basalt intrusions and plugs (Ti^a) and Andesite tuff breccia (Tv^p) units. The as-built records of the existing pipeline (Piemme, Neill, and Bryan and Clair A. Hill Associates, 1968) indicate that the existing pipeline was constructed by directly laying the pipe on the then existing reservoir bed within a riprap berm. The static and static & surge hydraulic internal pressures at this location on the Klamath River are approximately 306 and 374 psi, respectively (Drawing GP-3, Piemme, Neill, and Bryan and Clair A. Hill Associates 1968).

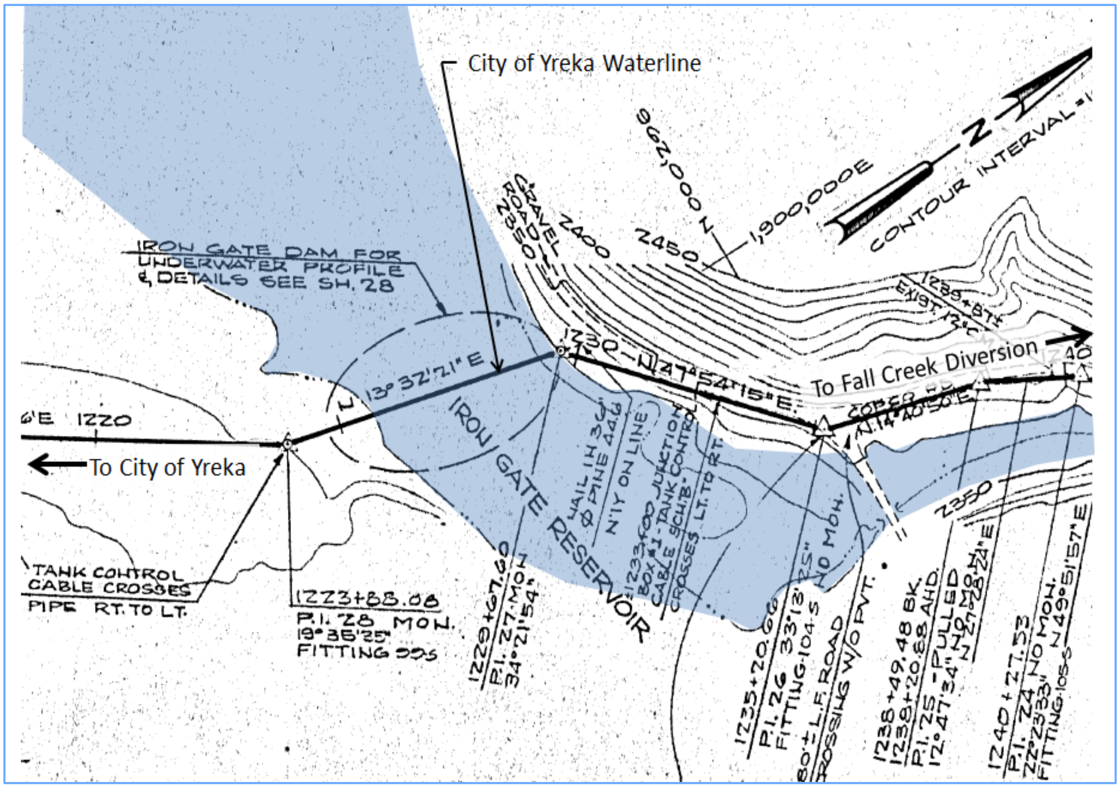


Figure 7.5-1 City of Yreka Pipeline Crossing

Proposed Modifications

Either KRRC or the City of Yreka will design the pipeline modifications, and either entity will construct the modifications, but KRRC will provide the funding.

KRRC has identified conceptual level buried and aerial relocation crossings of the pipeline across the Klamath River for feasibility and further evaluation. KRRC and City of Yreka desire the buried crossing should have adequate cover to compensate for the vertical scour during dam removal and the subsequent variations in the river flows and longitudinal profile. As the construction of the relocated crossing needs to happen prior to Iron Gate Dam removal, the cover over the pipe will likely have to exceed 12 feet. An open-cut construction approach would therefore, potentially require significant sediment and rock excavation under water and KRRC does not consider this a viable option. KRRC has identified three options for the reconstruction of the Klamath River crossing of the Yreka pipeline and are proposed as a range of potential actions to accomplish the objective of maintaining a pipeline to supply water to the City of Yreka. These potential actions are:

1. A new buried pipeline by micro-tunneling in the immediate vicinity of the existing waterline crossing
2. A new aerial pipeline on a dedicated utility pipe crossing in the immediate vicinity of the existing waterline crossing

3. A new buried pipeline and an aerial pipeline crossing on the existing timber traffic bridge along Daggett Road located approximately 2,000 feet upstream of the existing waterline crossing

Figure 7.5-2(C) shows the alignments for the three options, and detailed descriptions for each are presented below. KRRC will determine the preferred option in consultation with the City of Yreka.

Figure 7.5-2 Alignments for Klamath River Crossing (Appendix C)

Option 1 – Micro-tunneled Crossing

Option 1 consists of the installation of either a new 24-inch-diameter steel pipeline within a tunnel casing or a larger diameter carrier pipe constructed using a micro-tunnel construction approach. Figure 7.5-3 (C) shows the pipeline profile for this concept level alternative. The micro-tunnel will be approximately 550 feet long, at least 36-inch internal diameter, and will be at least 30 feet below the current bottom of Iron Gate Reservoir. The tunnel would be aligned parallel to, but offset approximately 25 feet downstream from the existing pipeline crossing to avoid damage to the existing pipe. The design would connect the new pipe to the existing pipeline on both the north and south sides of the Klamath River through new piping and fittings as shown in Figures 7.5-2(C) and 7.5-3(C). Based on the surface geology map and the rock outcrops observed at the site, portions of the entire micro-tunnel alignment will likely be through bedrock formations. Rock hardness and abrasiveness of the bedrock will have an impact on wear of cutting tools, which and type of the micro-tunnel equipment would impact the maximum drive length. Therefore, selection of the micro-tunnel diameter, type of the micro-tunnel equipment, and the actual elevation of the micro-tunnel crossing as well as the locations and depths of the driving and receiving shafts would depend on the subsurface profile and surface topography of the on-shore and off-shore ground surface. Based on the concept profile illustrated, the driving and receiving shafts would be approximately 58 feet and 56 feet deep, respectively.

Figure 7.5-3 Profiles for Klamath River Crossing (Appendix C)

To advance the final design, KRRC will complete a geotechnical subsurface investigation, topographic survey, and bathymetric survey of the site. Based on the subsurface investigation, KRRC will evaluate the location of the tunnel profile and selected to minimize the micro-tunneling installation risks and costs and to avoid or minimize and mitigate effects to cultural resources. Also, other types of trenchless approaches such as Direct Pipe, which is a hybrid method combining micro-tunneling and horizontal directional drilling (HDD) approaches, may become attractive alternatives with lower cost and/or risk. KRRC will complete on-shore borings at the proposed locations of the driving and receiving shafts and three off-shore borings to establish the subsurface profile along the tunnel alignment as part of the geotechnical explorations. These borings will extend to at least a depth 50 feet below the thalweg of the river (i.e., lowest elevation of the lake bed at the crossing location).

Option 2 – Aerial Crossing on New Utility Bridge

Option 2 is a prefabricated steel 7.5-foot-wide box truss bridge as was proposed in the Detailed Plan (USBR 2012b). This utility bridge would be just wide enough to accommodate the new 24-inch-diameter pipeline and an adjacent walkway for maintenance purposes. The height would provide a minimum of three feet of freeboard above the eventual water surface for the 100-year flood in the river channel. KRRC selected three bridge spans, with a center span of 200 feet and end spans of 100 feet each to minimize the height of the two concrete support piers. Reinforced concrete abutments would support the two ends. This option includes founding the bridge abutments and piers upon drilled shafts backfilled with concrete.

This option would align the bridge parallel to, but offset from the existing pipeline to avoid damage to the existing pipeline during construction. Access into the river for bridge pier construction would be from clean, dumped gravel access pads placed in the river and extending from the banks. The gravel access pads would be removed after construction. Figures 7.5-2(C) and 7.5-3(C) show the proposed alignment and profile for Option 2, respectively.

If this option moves forward, as in Option 1, KRRC will complete a geotechnical subsurface investigation, topographic survey, and bathymetric survey of the site to advance the final design. The geotechnical explorations will include on-shore borings near the proposed locations of the bridge abutments and three off-shore borings near the proposed locations of the bridge support piers. These borings will extend to at least an elevation 50 feet below the thalweg of the river (i.e., lowest elevation of the lake bed at the crossing location).

Option 3 – Aerial Crossing on Daggett Road Bridge

Option 3 is construction of an aerial crossing using the existing timber traffic bridge along the Daggett Road located approximately 2,000 feet upstream of the existing waterline crossing as was proposed in the Detailed Plan (USBR 2012b). However, USBR did not evaluate the suitability of the existing timber bridge to house this 24-inch pipeline during the development of the Detailed Plan.

Option 3 would also require that the pipeline crosses Fall Creek. The existing Fall Creek culvert under the Daggett Road has very little cover; therefore, placing the pipeline crossing above the culvert within the road fill is not viable without significant regrade of Daggett Road. Installing the new pipeline below the existing culvert using either a trenchless construction approach or open-cut construction approach is possible. Figures 7.5-2(C) and 7.5-3(C) show the proposed alignment and profile for Option 3, respectively

Option 3 includes an approximate 300-foot-long aerial portion and an approximate 3,600-foot-long realigned buried pipe, and it will be installed using open-cut construction approach, including Fall Creek crossing. Option 3 adds significant length to the relocated pipeline alignment. KRRC will provide either a new bridge or temporary bridge at Daggett Road due to structural deficiency for construction access, and the new bridge design and construction could incorporate this new pipeline option in the design.

Connections to Existing Pipeline

In all three options, KRRC's or City of Yreka's contractor would connect the new pipeline to the existing buried pipeline at each end of the river crossing. The design may replace adequate additional length along the existing pipeline with welded steel pipe to provide sufficient length of restrained piping to resist any thrust forces arising from the bends. The contractor could install valves at each end to divert water from the old to the new pipe crossings. Making final connections and installing valves on the new pipe crossing would involve a short water delivery outage. After completion of the new pipe crossing, the City of Yreka will operate the valves to divert flow from the old to the new pipe. The contractor may remove the old pipeline after reservoir drawdown.

Permissible Water Delivery Outage

A short water delivery outage will be required to make the final connections following construction of any of the new pipe crossings. Based on preliminary discussions with City of Yreka (Taylor, R., Personal Communications, August 15, 2017), the permissible outage period will be planned and limited to 12 hours and should preferably occur during the winter to avoid a disruption to the City of Yreka water supply. KRRC or City of Yreka will base the permissible outage period on the available storage capacity for Yreka, which should be able to meet demand for up to 60 hours in the winter and 18 hours in the summer, and up to an additional 27 hours with implementation of water rationing in the summer.

7.5.2 Water Supply Intake

Existing Conditions

The City of Yreka's water supply system diverts water from Fall Creek, a tributary to the Klamath River. The primary diversion, called Dam A, is located just downstream from the PacifiCorp Fall Creek powerhouse on a bypass reach from Fall Creek and consists of a low concrete dam with spillway notch and sluice gate. The dam provides head for diversion to a 24-inch-diameter supply pipe through a concrete headworks structure. The headworks structure has four 3-foot-wide bays. Removable fish screen panels screen up to three bays of the intake. Subsequent to the preparation of the Detailed Plan (USBR 2012b), the City of Yreka appears to have made some fish screen modifications, but their compliance to current regulatory agency screen criteria for anadromous fish needs to be determined. The bays at the headworks structure connect into a common channel leading to the gated supply pipeline. The City's water right and diversion capacity at the site is 15 cfs.

City of Yreka uses a secondary diversion point on Fall Creek whenever the power plant is shut down. This diversion, called Dam B, supplies water through a pipeline to bay 4 within the headworks structure at Dam A. A manually-operated slide gate is opened at Dam B to discharge water through the Dam B trash-racked intake and into the pipeline. A bulkhead is opened in bay 4 at Dam A so that water can flow into the dam forebay, then through the Dam A fish screens to the City of Yreka water supply pipeline. Electric power is not currently provided to Dam B.

Proposed Modifications

Either KRRC or the City of Yreka will design the fish screen modifications, and either entity will construct the modifications, but KRRC will provide the funding.

The existing screens for the water supply intakes at Dam A need to be evaluated to confirm that the current regulatory agency screen criteria from NMFS, USFWS, and CDFW, for anadromous fish are met. If the existing fish screens are non-compliant, they will need to be updated. Dam B does not have a fish screen and is located about 100 feet downstream of the Fall Creek falls which are not passable by salmonids. Dam A is located in an artificially created bypass reach serving the powerhouse. Both streams feeding Dams A and B have little to no salmonid habitat. Ideally, both locations should be blocked to prevent anadromous fish migration into either of these reaches that contain limited viable habitat for redds or juveniles. If anadromous screens are required, the concepts presented in the Detailed Plan (USBR 2012b) for each intake will be used as described below.

The replacement fish screen at each dam location will consist of a cylindrical Tee screen having a diameter of 30 inches and a length of 128 inches. Each Tee screen will be sized for a design flow of 15 cfs. To meet the screen criteria, the Tee screen will provide an approach velocity not greater than 0.33 fps, and the screening cylinder at each end of the Tee will use stainless steel wedge or profile wire screen surfaces with 1.75-mm slot openings. Water flows through the screen cylinders, into the common screen header, and then into the intake bay. For cleaning, the cylinders rotate on their horizontal axis and are powered by internal geared propeller drives turned by water moving through the screen. Internal and external brushes remove trash from the screen surfaces as they rotate. The Tee screen is mounted onto a track frame and can be raised out of the water for maintenance and inspection using a battery-powered winch. During maintenance, a slide gate can be closed to stop flow from entering the intake or the flow can pass through the open slide gate and trash rack built into the screen track frame.

At Dam A, the contractor will remove the existing upstream slide gates/weirs and fish screen panels and seal bays 1, 2, and 4 by three steel bulkheads. The Tee screen will discharge through bay 3. The contractor will add a manually-operated 30- by 42-inch slide gate between bays 3 and 4 and opened when Dam B is used for diversions.

To install the Tee screen system for Dam A, the contractor will remove a small concrete deck over bay 3. KRRC assumes that all construction work at Dam A will be accomplished without the need for cofferdams. To accommodate the raising and lowering of the Tee screen, a new building enclosure will be required at Dam A with a roll-up door over the Tee screen. The contractor will demolish and replace the existing wood-frame building with a new 12- by 16-foot wood-frame building. The new building will have a second roll-up door on the opposite wall, similar to the existing building.

At Dam B, the contractor will modify the existing trash-racked intake to accommodate the cylindrical Tee screen system. The contractor will remove the existing trash racks and seal the bay with a steel bulkhead. The contractor will add an additional intake bay at the upstream end and cut a 2-footsquare opening through the upstream wall of the existing intake connecting the two bays. KRRC assumes that a cofferdam will be required in the stream at Dam B during construction, and that access improvements to the site will be required. The contractor will install the Tee screen and a 12-foot-long mounting track/frame at the new intake bay. The Tee screen would only be lowered into position when operation of the Dam B supply pipeline is required. A new fish screen at Dam B will require a new power line and drop connection.

7.6 Recreation Facilities Removal & Draft Plan

This section describes the proposed recreation facilities removal and the Draft Recreation Plan, which the KRRC will finalize in 2019 as part of the Project. PacifiCorp currently provides recreation facilities at J.C. Boyle Reservoir, Copco Lake, and Iron Gate Reservoir. There are no recreation facilities associated with Copco No. 2 Dam. The following descriptions are based on the information presented in the Detailed Plan (USBR 2012b) and are not anticipated to change significantly through detailed design. Confirmation of facility features and removal components will occur during the Project detailed design phase.

The Project includes the transfer of approximately 8,000 acres of real property located in Klamath County, Oregon and Siskiyou County, California to the respective states (or to a state designated third-party transferee) for public interest purposes such as fish and wildlife habitat restoration and enhancement, public education, and public recreational access. KRRC will accomplish these property transfers in accordance with the procedures set forth in Section 7.6.4 of the KHSA.

7.6.1 J.C. Boyle Reservoir

Developed recreation sites at J.C. Boyle Reservoir include campgrounds, day use areas, and boat launches (Figure 5.1-1(C)). The J.C. Boyle development also includes Spring Island boat access downstream of J.C. Boyle powerhouse (managed by BLM). The key elements of these recreation sites are summarized below, including a description of the recreation facilities available at these developed sites, and proposed removal requirements. Estimated annual use for 2014 was 15,500 recreation days for daytime visits and 1,700 recreation days for nighttime visits. Developed public recreation sites discussed in this section include the following:

- Pioneer Park (East and West units)
- Topsy Campground
- Spring Island River Access

Pioneer Park

Owned and managed by PacifiCorp, Pioneer Park consists of two separate day use areas on the western and eastern shoreline of J.C. Boyle Reservoir. Both sites have access from SR 66 and are located on each side (west and east) of the SR 66 Bridge over a narrow point of the reservoir.

Pioneer Park West has 12 picnic tables and 12 fire rings with grills. There are two portable toilets (one ADA-accessible), one trash receptacle, one trash dumpster, and informational signs at the site. The shoreline is used for fishing and an unimproved boat ramp is used primarily to launch car-top boats. The main access road into Pioneer Park West is 200 feet long and paved, but the undefined parking area is gravel and dirt and can accommodate approximately 25 vehicles without trailers.

Pioneer Park East has three interpretive signs with information regarding the Applegate Trail. The site had a concrete boat launch before the SR 66 bridge was replaced in 2005 by the Oregon Department of

Transportation (ODOT). A large stretch of gravel along the shoreline provides car-top boat launching and shoreline fishing opportunities. The access road to Pioneer Park East and the parking area are gravel. While undefined, the parking area can accommodate approximately 40 vehicles without trailers or 15 to 20 vehicles with trailers.

KRRC will remove all features, and the access roads and parking areas will regrade, seed, and plant the approximate 4.5-acre affected area as described in Section 6.2.

Topsy Campground

Owned and managed by BLM, Topsy Campground (or Recreation Site) is located on the southeastern shoreline of J.C. Boyle Reservoir and can be accessed via the Topsy Grade Road off of SR 66. The site consists of a campground, small day use area, and a boat launch. All roads within the campground are asphalt. User fees are collected by BLM at the site.

Topsy Campground has approximately 15 campsites, all of which have some degree of ADA-accessibility. All but two of the campsites have tent pads. Additionally, there are restroom facilities, an RV dump station, five water faucets, two drinking fountains, 14 trash receptacles, and one trash dumpster associated with the campground. These facilities are also shared by the day use and boat launch areas at the site. The small day use area provides two sites with a picnic table and grill, one of which is an ADA-accessible site. The boat launch has two concrete lanes, a concrete abutment, and a floating dock. There is also an ADA-accessible fishing pier with two benches. A paved parking area near the boat launch can accommodate three vehicles with trailers for day use parking.

KRRC will remove the boat launch, floating dock, and fishing pier, including approximately 68 cubic yards of concrete, and will regrade, seed, and plant the approximate 0.5-acre affected area as described in Section 6.2. BLM will retain the remainder of the campground for public use.

Spring Island River Access

Spring Island River Access is a Special Recreation Management Area owned and managed by BLM-Klamath Falls Field Office. It is a small riverside recreation day-use site located approximately 0.3 miles downstream of J.C. Boyle powerhouse at the upstream terminus of the Upper Klamath Wild and Scenic River section. The site has informational signage, paved parking and carry down boat launch, picnic tables, and vault toilets. It is the primary staging area for the Upper Klamath whitewater boating trip, a popular and well-known destination activity. It serves as a portal to the Upper Klamath WSR corridor, and is also used by visitors for fishing, wildlife viewing, and picnicking.

This site will be retained for public use.

7.6.2 Copco Lake

Developed recreation sites at Copco Lake include camping areas, day use areas, and boat launches (Figure 5.5-1(C)). The key elements of these recreation sites are summarized below, including a description of the recreation facilities available at these developed sites, and proposed removal requirements. Estimated annual use for 2014 was 3,300 recreation days for daytime visits and 0 recreation days for nighttime visits. Developed public recreation sites discussed in this section include the following:

- Mallard Cove
- Copco Cove

Mallard Cove

Located on the south shore of Copco Lake, off Ager-Beswick Road at Keaton Cove, Mallard Cove is owned and managed by PacifiCorp. The site consists of a day use/picnic area and a boat launch. While not an official campground, this site is also used for camping. The naturally wooded site has 8 wood-plank picnic tables, 12 cooking grills, and seven concrete fire rings or foundations. There is a toilet building with two vault toilets and two trash receptacles at the site. The boat launch has a 100-foot-long, 25-footwide single-lane concrete ramp. The site also has a 25-foot-long, 5-foot-wide dock made of composite decking and poly floats, with concrete abutment, located adjacent to the boat ramp, and a 20-foot-long, 5-foot-wide gangway with aluminum frame and pipe railing. There are six informational signs with concrete bases at the site. The access road and parking area are gravel. The parking area, while undefined, has eight concrete wheel-stops and parking for approximately 25 vehicles.

KRRC will remove all features, including approximately 106 cubic yards of concrete, and will regrade, seed, and plant the approximate 2.5-acre affected area as described in Section 6.2.

Copco Cove

Owned and managed by PacifiCorp, Copco Cove is located on the western shoreline of Copco Lake, off Copco Road. The site has a picnic area and a boat launch. While not an official campground, this site is also used for camping. The picnic area is naturally wooded and has two wood-plank picnic tables with one user-defined fire ring at each. The site has one portable toilet and one trash receptacle. The boat launch has an 80–foot-long, 25–foot-wide single-lane concrete ramp. While the boat ramp is in good condition, the approach is steep and maintaining a proper turning radius is difficult when there are other vehicles parked at the site. There is also a 14-foot-long, 5-foot-wide concrete boat dock adjacent to the boat ramp, with pipe railing. There are six informational signs with concrete bases at the site. The access road and parking area are gravel. There are approximately five spaces for vehicles in the undefined parking area.

KRRC will remove all features, including approximately 84 cubic yards of concrete, and will regrade, seed, and plant the approximate 2.3-acre affected area as described in Section 6.2.

7.6.3 Iron Gate Reservoir

Developed recreation sites at Iron Gate Reservoir include campgrounds, day use areas, and boat launches (Figure 5.5-1(C)). The key elements of these recreation sites are summarized below, including a description of the recreation facilities available at these developed sites, and proposed removal requirements. Estimated annual use for 2014 was 8,300 recreation days for daytime visits and 3,600 recreation days for nighttime visits. Developed public recreation sites discussed in this subsection include the following:

- Fall Creek (including Fall Creek Trail)
- Jenny Creek
- Wanaka Springs
- Camp Creek (including Dutch or Scotch Creek)
- Juniper Point
- Mirror Cove
- Overlook Point
- Long Gulch
- Iron Gate Fish Hatchery Public Use Areas

Fall Creek

Owned and managed by PacifiCorp, Fall Creek is located on the far northeast shore of Iron Gate Reservoir. The site is primarily a day use area, although some camping does occur. The site has two picnic tables, two cooking grills, two fire rings, and one user-defined fire ring. There is also one trash receptacle, an older single-vault toilet building (closed in 2002), and one portable toilet at the site. User-defined trails provide access to shoreline fishing opportunities. Parking at this site is undefined and generally occurs along the interior gravel road. Approximately eight vehicles could be accommodated at this site. A graveled boat launch is also provided. Large pine trees provide shade.

The recreation site at Fall Creek is located near the river channel and could be removed and restored or could be retained following the removal of Iron Gate Dam. A separate portion of the site is near the Fall Creek fish hatchery and provides access to the Fall Creek Trail, where visitors can hike up to Fall Creek Falls. The ultimate disposition of this facility is uncertain.

Jenny Creek

Located between Copco Road and Jenny Creek on the northern shoreline of Iron Gate Reservoir, Jenny Creek is owned and managed by PacifiCorp. The site provides primitive day use and camping opportunities. The site has six day-use/campsites, four of which are separated by boulders at the southern end of the parking area, while the remaining two are located along the shoreline of Jenny Creek. There are four steel frame/wood plank picnic tables and four user-defined fire rings at the site. Additionally, the site has two trash receptacles, a storage building, and a single-vault toilet building with a 25-foot-long wooden privacy screen. Several user-defined trails provide shoreline fishing access to Jenny Creek. There are two informational signs with concrete bases at the site. The gravel parking area can accommodate approximately 20 vehicles.

There is also a large gravel parking area across from this site, on the shoreline of the reservoir that is used for shoreline fishing access. This parking area can accommodate about 12 vehicles, but is not considered to be part of the Jenny Creek recreation site.

The recreation site at Jenny Creek with adjoining parking area could be removed and restored or could be retained following the removal of Iron Gate Dam, as it provides a creekside setting for picnicking and bank fishing. However, the ultimate disposition of this facility is uncertain.

Wanaka Springs

Located on the north shore of Iron Gate Reservoir, Wanaka Springs is owned and managed by PacifiCorp. The naturally wooded site is used for day use and camping and consists of a small upper use area and a larger lower use area. The upper use area can be accessed by vehicle via a gravel road through the lower use area and has two wood-plank picnic tables, a concrete fire ring, a trash receptacle, and provides parking for about two vehicles. The lower use area has a large gravel parking area that can accommodate approximately 16 vehicles, three wood-plank picnic tables and one concrete picnic table, two concrete fire rings, a trash receptacle, two single-vault toilet buildings, and a portable toilet. A dirt pedestrian trail connects the upper and lower use areas and provides access to the vault toilets. Additionally, a dirt pedestrian trail provides access to a 25-foot-long, 5-foot-wide wooden dock with concrete pier and pipe railing, 15-foot-long gangplank, and a concrete walkway on the reservoir shoreline. There are three informational signs with concrete bases at the site.

KRRC will remove all features, including approximately 28 cubic yards of concrete, and will regrade, seed, and plant the approximate 4.5-acre affected area as described in Section 6.2.

Camp Creek

Camp Creek is located on Copco Road along the northern shoreline of Iron Gate Reservoir and is owned and managed by PacifiCorp. The site accommodates camping, day uses, and boat launching and is generally split into three use areas. The first use area is located on the shoreline and consists of developed campsites and a boat launch. The second use area is located across Copco Road from the first use area and is used as a day use area and for overflow camping and parking. The third use area is located on the shoreline to the northwest of the first use area and provides for day use activities, including ADA access to the shoreline, as well as overnight camping. There are seven informational signs with concrete bases at this site.

The first use area at Camp Creek has about 12 developed campsites each with a concrete picnic table, concrete fire ring, and a parking space. Three-foot boulders separate the campsites. There are two water faucets, a 10- by 16-foot concrete block well house, and six trash receptacles at this use area. There is also a boat launch with an 80-foot-long, 25-foot-wide single-lane concrete ramp, and a wooden walkway leading to a 25-footlong, 4-foot-wide boat dock with concrete abutment and piers, next to the boat ramp. The interior access road is used for parking and can accommodate approximately six to eight vehicles. Additionally, there are two 20-foot-long, 5-foot-wide floating boat docks with composite decking and aluminum frames located to the north and south (on an existing jetty) of the boat launch, each with a 20-foot-long, 5-foot-wide gangplank with composite decking and aluminum frame rails. Each of these boat docks provides shoreline fishing opportunities.

The second use area at Camp Creek is located directly across Copco Road from the first use area. The site has three concrete picnic tables and two steel frame/wood plank picnic tables with concrete foundations, two timber shelters for shade, one concrete fire ring, and at least five user-defined fire rings. An RV dump station with estimated 2,000-gallon buried concrete tank, a 10- by 16-foot wood-frame double toilet building, a portable toilet, a trash receptacle, and a water faucet are located in this area and are shared facilities with the other use areas at Camp Creek. Overflow camping occurs at this site when the developed campsites in the first use area are full. Additionally, a large grassy area provides overflow parking for the first use area. There is space for approximately 60 vehicles in the overflow parking area. There is an interpretive display at this use area that provides a brief discussion of the Wilkes Expedition that stopped at this site in 1841.

The third use area at Camp Creek is located along the reservoir shoreline to the northwest of the first use area, and has been referred to as the “Scotch Creek” or “Dutch Creek” site. This area is small and has one steel pipe/wood plank picnic table and a concrete fire ring. There is a 50-foot-long, 4-foot-wide ADA-accessible concrete fishing pier with pipe railing, and a boat ramp for launching car-top boats at this use area. This site often receives use as a single campsite and is occasionally used as a group campsite.

KRRC will remove all features, including electric power lines on three poles and approximately 110 cubic yards of concrete, and will regrade, seed, and plant the approximate 4.5-acre affected area as described in Section 6.2. Additional earthwork includes the removal or regrading of an estimated 180-foot-long, 16-foot-wide, and 8-foot-high earth jetty, and the burial of approximately 75 boulders.

Juniper Point

Located on the northwestern shoreline of Iron Gate Reservoir, Juniper Point is owned and managed by PacifiCorp and provides approximately nine semi-primitive campsites. The camping area has eight steel frame/wood plank and wooden picnic tables, one concrete picnic table, fifteen concrete fire rings and foundations, two 4- by 4-foot concrete single-vault toilets (located across Copco Road from this site), and two trash receptacles. There is also an I-shaped boat dock at this site for shoreline fishing opportunities, which consists of a 25-foot-long concrete abutment, a 50-foot-long composite dock with poly floats and pipe railing, and a 20-foot-long composite gangplank with pipe railing. There are four informational signs with concrete bases at the site. The gravel access road into this site is very steep.

KRRC will remove all features, including approximately 19 cubic yards of concrete, and will regrade, seed, and plant the approximate 2.5-acre affected area as described in Section 6.2. Additional earthwork will include the removal or burial of approximately 50 boulders.

Mirror Cove

Mirror Cove, owned and managed by PacifiCorp, is located on the western shoreline of Iron Gate Reservoir. The site has a camping area and a boat launch. The camping area has ten campsites, with 12 concrete fire rings and eight picnic tables, accessible by gravel road. This site has one 10- by 16-foot vault toilet building with concrete steps located across Copco Road, a portable toilet in the parking area, and four trash receptacles. The boat launch at Mirror Cove has an 80-foot-long, 25-foot-wide concrete ramp with two lanes. Two 30-foot-long, 5-foot-wide composite gangplanks with aluminum frames and pipe railing lead to a 30-foot-long concrete boat dock and abutment with pipe railing adjacent to the boat ramp. There are seven informational signs with concrete bases at the site. The gravel parking area at this site can accommodate approximately 20 vehicles.

KRRC will remove all features, including approximately 89 cubic yards of concrete, and will regrade, seed, and plant the approximate 3.0-acre affected area as described in Section 6.2. Additional earthwork will include the removal or burial of approximately 120 boulders.

Overlook Point

Overlook Point, owned and managed by PacifiCorp, is located on the western shoreline of Iron Gate Reservoir. The site has one concrete picnic table and one steel frame/wood plank picnic table. There are also one portable toilet and two trash receptacles at this site. An 800foot-long, steep gravel road provides access to the site. Parking at this site is undefined, but can generally accommodate approximately six vehicles.

KRRC will remove all features, and will regrade, seed, and plant the approximate 2.0-acre affected area as described in Section 6.2.

Long Gulch

Long Gulch, owned and managed by PacifiCorp, is located on the southern shoreline of Iron Gate Reservoir. The site has a picnic area that is occasionally used for camping and a boat launch. The picnic area has two steel frame/wood plank picnic tables and two user-defined fire rings. The boat launch has an 80-foot-long, 25-foot-wide two-lane concrete ramp. The site has one portable toilet and two trash receptacles. The undefined gravel parking area at this site can accommodate approximately 16 vehicles.

KRRC will remove all features, including approximately 25 cubic yards of concrete, and will regrade, seed, and plant the approximate 1.0-acre affected area as described in Section 6.2.

Iron Gate Hatchery Public Use Areas

The Iron Gate fish hatchery is located downstream of Iron Gate Dam and is owned by PacifiCorp and operated by CDFW, with PacifiCorp currently providing funding for 100 percent of the fish hatchery's annual operating expenses. A public day use area is provided adjacent to the fish hatchery and an undeveloped boat launch is located across the river from the hatchery. Fishing is prohibited in this area and to 3,500 feet downstream of the dam. The day use area has a covered picnic shelter, six picnic tables, three trash receptacles, a small visitor center/interpretive kiosk (providing information on dam construction, salmon, and regional wildlife), two flush toilets in restrooms, and an ADA-accessible trail to the river shoreline (near Bogus Creek). A gravel parking area provides spaces for approximately 20 vehicles. The undeveloped boat launch is used primarily to launch car-top boats (hand launch); however, the launch does receive some boat trailer use. The gravel shoulder along Copco Road provides undefined parking for the boat launch.

KRRC will not remove these recreation facilities.

7.6.4 Dispersed Recreation Sites in the Study Area

In addition to the developed recreation facilities in the study area, the undeveloped reservoir shorelines provide numerous dispersed recreational use opportunities, both for land-based and water-based activities. Many visitors and local residents use the reservoir shorelines for dispersed activities such as boating, fishing, swimming, sunbathing, and camping. Twenty-seven dispersed recreation sites or use areas on or adjacent to the reservoir or river shorelines were identified during a field inventory conducted in 2004. The majority (17) of dispersed sites were identified at J.C. Boyle Reservoir, while two were located at Copco Lake, and four were located at Iron Gate Reservoir. Many of the identified dispersed sites are located along roads on or near the reservoir shoreline, and appear to have been used for camping and day use activities, although camping is specifically prohibited at a few of the sites. Fires are limited seasonally at most dispersed sites in the study area. These sites do not have developed facilities such as picnic tables, grills, or boat launches. KRRC will not disturb or modify the dispersed recreational sites.

7.6.5 Draft Recreation Plan

The Draft Recreation Plan provided in Appendix Q identifies the types of recreation opportunities and facilities consistent with pre-hydropower development conditions that KRRC will develop to achieve the goals of the plan. The Draft Recreation Plan also describes the process envisioned by KRRC to evaluate these opportunities and identify the proposed facilities that will ultimately be recommended for implementation in the Final Recreation Plan.

Based on the anticipated removal of reservoir recreation sites and reduced whitewater rafting use under the Project, KRRC has identified the need to implement, in the Klamath River Basin, recreation facility upgrades and/or new facility developments to provide, at minimum, the types of facilities that are proposed in this Draft Recreation Plan. KRRC configured these proposed opportunities to offset the anticipated effects on recreation access associated with dam and associated reservoir removal.

Proposed Recreation Facilities

KRRC has identified two types of recreation access facilities that if developed will offset recreation access that will be eliminated by implementation of the Project – whitewater boat put-in/take-out sites and fishing access sites. KRRC also intends to collect input from stakeholders on new recreation opportunities beyond the new and upgraded access sites identified in this draft plan.

KRRC will develop these river access sites for whitewater boating to include at a minimum:

- An area near or along the adjacent roadway for the parking of trucks with trailers used to transport whitewater rafts, large passenger vans and buses for transporting commercial whitewater rafters,
- If necessary, an access road between any new parking areas and the adjacent existing roadway, and
- If necessary, developed paths from the area designated for parking to the river edge wide enough to support the portage of rafts.

KRRC will develop these river access sites for fishing to include at a minimum:

- An area near or on a road shoulder for the parking of personal vehicles,
- If necessary, an access road between any new parking areas and the adjacent existing roadway, and
- If necessary, developed trails from the area designated for parking to the river edge.

KRRC intends to continue to collect input on other recreation facilities in the Klamath River Basin from stakeholders that could be developed in addition to or potentially in place of the facilities identified for implementation in this draft plan to offset impacts on reservoir recreation and whitewater recreation access in the Hell's Corner Reach associated with implementation of the Project.

7.7 Downstream Flood Control Improvements

This section describes KRRC's proposed flood control improvements.

7.7.1 Habitable Structures

USBR developed a preliminary 100-year floodplain map from Iron Gate Dam to Happy Camp for both the current conditions (i.e. existing conditions with dams) and for the with-project conditions (i.e. altered conditions without dams). USBR calculated reach-averaged changes in water surface elevation (WSE) and depth between the with-project conditions and current conditions as indicated in Table 7.7-1 below, based on estimates of sediment deposition.

KRRC has categorized structures in the affected area below Iron Gate Dam as follows:

1. Within the preliminary 100-year floodplain for current conditions with dams, as determined by USBR
2. Within the preliminary altered 100-year floodplain without dams, as determined by USBR

The structures and their appropriate categories were field checked and some of the structures were re-classified. KRRC only categorized the structures in the reaches between Iron Gate Dam (RM 193.1) and Humbug Creek (RM 174.0). This is because the tributaries below Iron Gate increasingly dominate the flood discharges as one travels downstream from Iron Gate, and the impact of dam removal on the 100-year flood is less than 0.5 foot[23] below Humbug Creek.

Table 7.7-1 Changes in River Stage with Dam Removal

River Reach	Average WSE Change (feet)
Iron Gate to Bogus Creek	1.65
Bogus Creek to Willow Creek	1.51
Willow Creek to Cottonwood Creek	0.90
Cottonwood Creek to Shasta River	0.72
Shasta River to Humbug Creek	0.58
Humbug Creek to Beaver Creek	0.45
Beaver Creek to Dona Creek	0.41
Dona Creek to Horse Creek	0.43
Horse Creek to Scott River	0.36
Scott River to Indian Creek	0.28
Indian Creek to Elk Creek	0.32
Elk Creek to Clear Creek	0.34

A total of 34 habitable structures are located within the preliminary 100-year floodplain for current conditions between Iron Gate Dam and Humbug Creek.[24] These 34 structures will be subject to an increased risk of flooding following dam removal when compared to existing flood elevations. An estimated 2 additional habitable structures would be subject to flooding during a 100-year event following dam removal when compared to the existing floodplain (see Figure 7.7-1). A total of 36 habitable structures would be located within the preliminary altered 100-year floodplain between Iron Gate Dam and Humbug Creek following dam removal. KRRC will work with the owners of these structures to move or elevate legally established structures, where feasible. FEMA will make the final determination of the future 100-year floodplain after dam removal, and the KRRC is coordinating with FEMA to initiate the map revision process.

Figure 7.7-1 Structures in 100-Year Floodplain Following Dam Removal (Appendix C)

7.7.2 River Crossings

An estimated three river crossings in the downstream reach between Iron Gate Dam and Humbug Creek could also be affected by the increase in flood depths: two pedestrian bridges and the Central Oregon and Pacific Railroad Bridge. Both pedestrian bridges are below the existing 100-year flood elevation, and there is

[23] FEMA, the agency that will determine the future floodplain extent, does not recognize changes in flood elevations less than 1 foot. Utilizing a 6-inch change in flood elevation is a conservative approach to determining which structures are affected.
[24] Note that the current FEMA mapped floodplain Zone A (effective 1/19/2011) is different from the floodplain modeled by Reclamation because the FEMA mapping was not prepared based on a detailed hydraulic study of the river.

a potential increase in scour depth at the railroad bridge. Pedestrian Bridge #1 is dilapidated and is not structurally safe. Pedestrian Bridge #2 and the railroad bridge are in good condition. KRRC proposes to remove Pedestrian Bridge #1, with the owners' permission. KRRC proposes to consult with the owner of Pedestrian Bridge #2 during the detailed design phase to determine whether this bridge should be removed or replaced, at KRRC's expense. KRRC proposes to perform more analysis to confirm the effects of scour on the railroad bridge. The following sections provide additional information on these proposals.

Pedestrian Bridge #1

Pedestrian Bridge #1 spans the Klamath River just upstream of the confluence with Cedar Gulch. The bridge is a cable suspension structure of unknown origin, with no connection to any approach roads. The bridge is in very poor condition. The bottom chord of the bridge is not high enough to pass neither the existing nor the anticipated 100-year flood following the removal of the dams. KRRC proposes to remove Pedestrian Bridge #1, with the owner's permission.

Figure 7.7-2 Pedestrian Bridge #1

Pedestrian Bridge #2

Pedestrian Bridge #2 is a cable suspension bridge that spans the Klamath River next to the Klamath River County Estates (KRCE). The structure is on the KRCE Campground private property on the north bank of the river. KRRC understands the structure was built by the previous owners of the campground and is maintained by the campground. The structure is in good condition and appears to be well maintained.

The bottom chord of the bridge is not high enough to pass the existing 100 year flood with any freeboard or the anticipated 100 year flood after the removal of the dams. KRRC will evaluate the structure during the detailed design phase. KRRC proposes to consult with the owner of Pedestrian Bridge #2 during the detailed design phase to determine whether this bridge should be removed or replaced, at KRRC's expense.

Figure 7.7-3 Pedestrian Bridge #2

Central Oregon and Pacific Railroad (CORP) Bridge

The CORP Railroad Bridge is a 7-span ballasted concrete bridge that spans the Klamath River between the Ager Road Bridge and Cottonwood Creek. The structure is supported on stone masonry seat type abutments and the bents are composed of steel H-pile extensions with reinforced concrete caps. No information is available regarding foundation type.

The Detailed Plan estimated the Project will result in approximately 1.2 feet of scour at the bridge. KRRC anticipates this is unlikely to affect the structural integrity of the bridge; however, KRRC will perform a more detailed assessment at detailed design to confirm this, and KRRC will make any needed improvements.

Figure 7.7-4 Rail Road Bridge

7.8 Fish Hatchery Plan

The existing Iron Gate fish hatchery (IGH) facilities are part of the Lower Klamath Project, and is operated by CDFW. KRRC proposes modifications or improvements to infrastructure and operation to the IGH facility as part of the hatchery plan for the Project. KRRC's obligations with respect to IGH and Fall Creek Hatchery (FCH), and those of PacifiCorp and other parties to the KHSA, are summarized as follows:

- The IGH facilities shall be transferred to the State of California at the time of transfer to the DRE of the Iron Gate Hydro Development or such other time agreed by the Parties, and thereafter operated by the CDFW with funding from PacifiCorp.
- PacifiCorp will fund 100 percent of hatchery operations and maintenance necessary to fulfill annual mitigation goals developed by the CDFW in consultation with NMFS. This includes funding the IGH

facility as well as funding of other hatcheries necessary (e.g. FCH) to meet ongoing mitigation goals following facilities removal.

- Funding will be provided for hatchery operations to meet mitigation requirements and will continue for eight years following the decommissioning of Iron Gate Dam.

- PacifiCorp will fund a study to evaluate hatchery production options that do not rely on the current IGH water supply.

- Based on the study results and with the approval of the CDFW and NMFS, PacifiCorp will provide one-time funding to construct and implement the measures identified as necessary to continue to meet agency-developed mitigation production objectives for a period of eight years following the decommissioning of Iron Gate Dam.

The KHSA establishes a framework to allow for CDFW's continued hatchery operations at a level determined by NMFS and CDFW to be sufficient for purposes of implementation of the Definite Plan. The KHSA also establishes a source of funding that is needed to achieve this objective. KRRC's role in accomplishing these objectives is to cooperate and facilitate the transfer of the IGH (and any improvement to be made to IGH or other hatcheries necessary to meet ongoing mitigation objectives) to CDFW, and to cooperate with CDFW in its implementation of the Definite Plan so as to facilitate ongoing hatchery operations for a period of eight years following the removal of Iron Gate Dam.

7.8.1 Existing IGH Facility and Operations

IGH was constructed in 1962 to mitigate for lost anadromous salmonid spawning and rearing habitat between Copco No. 2 Dam and Iron Gate Dam. The historic mitigation goals include a release of 6,000,000 Chinook salmon (5,100,000 fingerlings and 900,000 yearlings), 75,000 Coho salmon yearlings, and 200,000 steelhead trout yearlings, annually. The Southern Oregon Northern California Coast (SONCC) Coho salmon Evolutionarily Significant Unit (ESU), which includes Coho salmon produced at IGH, is listed as threatened under the California Endangered Species Act (CESA) and the federal Endangered Species Act (ESA). A Hatchery and Genetics Management Plan (HGMP) and Section 10(a)(1)(A) Enhancement of Survival Permit was issued to the CDFW in 2014 for the IGH Coho salmon artificial propagation program (Section 10(a)(1)(A) Permit 15755). Under the HGMP, the purpose of the Coho salmon program is to aid in the conservation and recovery of the Upper Klamath Population Unit of the SONCC Coho salmon ESU by conserving genetic resources and reducing short-term extinction risks prior to future restoration of fish passage above Iron Gate Dam. Adult steelhead returns declined dramatically during the 1990's for unknown reasons and IGH has produced no steelhead since 2012. Chinook returns continue to be variable but generally sufficient broodstock return to IGH to produce the mitigation goals.

The IGH spawning/trapping facility is located approximately ½ mile downstream of Iron Gate Dam, adjacent to the Bogus Creek tributary. The main hatchery complex includes an office, incubator building, rearing/raceway ponds, fish ladder with trap, settling ponds, visitor information center, and four employee residences (see Figure 7.8-1). The collection facility is located at Iron Gate dam and includes a fish ladder consisting of 20 ten-foot weir-pools that terminates in a trap, a spawning building and six 30-foot circular holding ponds.

The IGH operates with a gravity fed, flow-through system that has five discharge points into the Klamath River. The IGH obtains its water supply from Iron Gate Reservoir. Two subsurface influent points at a depth of seventeen feet and seventy feet deliver water to IGH. Up to 50 cfs is diverted from the Iron Gate Reservoir to supply the 32 raceways and fish ladder.

The existing spawning facility discharges through the main ladder, and steelhead return line. An overflow line drains excess water from the aeration tower. The hatchery facility also has a discharge at the tail race that supplies the auxiliary ladder or fish discharge pipe, and two flow-through settling ponds for hatchery effluent treatment which converge to a single discharge point.

CDFW operates IGH. Per the license, PacifiCorp must fund at least 80 percent of operations and maintenance costs, but PacifiCorp currently funds 100 percent of those costs pursuant to the KHSA.

KRRC will demolish the existing fish collection facility located at the toe of Iron Gate Dam as part of the Project.

Due to the reservoir drawdown and dam removal, the existing water supply intake will become unusable, as its elevation will be above the water level post-draw down and high suspended sediment concentrations during drawdown. KRRC's contractor will demolish the water supply intake and associated infrastructure along with the dam and hydropower developments. These existing functions will be replaced by the reopening and operation of the Fall Creek Hatchery (FCH) by CDFW and by making improvements to IGH. The cost of these improvements will be borne by PacifiCorp, to the extent of its funding obligations under the KHSA.

Figure 7.8-1 Iron Gate Hatchery

7.8.2 Existing Fall Creek Hatchery

California Oregon Power Company built the FCH in 1919 as compensation for lost of spawning grounds due to the construction of Copco No. 1 Dam. Six of the original rearing ponds remain (two above Copco Road and four below the road). CDFW last used these ponds from 1979 through 2003 to raise 180,000 Chinook salmon yearlings, which they released into the Klamath River at Iron Gate Hatchery. Although the raceways remain and CDFW continues to run water through them, they have not produced fish since 2003 when CDFW moved all mitigation fish production to IGH. The facility has retained its water rights but will need substantial renovation to become operational.

7.8.3 Proposed Fish Hatchery Plan

NMFS and CDFW have determined the priorities for the proposed Fish Hatchery Plan. As a state and federally listed species in the Klamath River, coho production is the highest priority for NMFS and CDFW, followed by Chinook salmon, which support tribal, sport, and commercial fisheries. Steelhead production is the lowest priority. Due to limited available water and rearing capacity to meet Chinook yearling mitigation goals, and recent low steelhead returns, NMFS and CDFW have determined that steelhead production will be discontinued.

NMFS and CDFW have recommended and KRRC proposes a Fish Hatchery Plan a plan for hatchery operations for the 8-year period following dam removal. In order to implement this plan, IGH and FCH must be operational prior to drawdown of the Iron Gate Reservoir. The Fish Hatchery Plan will be implemented in a manner that is consistent with the North Coast Regional Water Quality Control Board (RWQCB) “Policy in Support of Restoration in the North Coast Region.” The plan also requires CDFW to employ Best Management Practices to minimize discharge at IGH and FCH during hatchery operations.

Table 7.8-1 summarizes the NMFS/CDFW goals for fish production at IGH and FCH.

Table 7.8-1 Comparison of Previous Mitigation Goals and Revised NMFS/CDFW Production Recommendation

Species/Life Stage	1960's Mitigation Goal (at IGH)	Production Goal Post-Dam Removal	Release Dates
Coho Yearlings	75,000	75,000 at FCH	March 15 – May 1
Chinook Yearlings	900,000	115,000 at FCH	Oct 15 – Nov 20
Chinook Smolts	5,100,000	3,400,000 at IGH	April 1 – May 31
Steelhead	200,000	0	NA

Source: NOAA Fisheries and CDFW Technical Staff Recommendation for Klamath River Hatchery Operations in California Post-Dam Removal, May 31, 2018.

Improvements at IGH

PacifiCorp will transfer IGH to CDFW with funding provided by PacifiCorp under terms of the KHSA section 7.6.6 and 7.6.6 A. CDFW will continue to operate IGH. CDFW will retain operational components of IGH. To the extent necessary to maximize use of available water supplies, CDFW will implement water use efficiency improvements such as water aeration as it enters the pond headboxes, mid-raceway water aeration and water reuse. IGH will utilize a riparian water right and divert water from Bogus Creek to operate the hatchery incubation building, two 300-foot adult holding ponds configured from two existing raceways, three 400-foot raceways, and the auxiliary fish ladder and trap. IGH will use between 3.75 to 8.75 cfs from October through May (see Table 7.8-2) to rear a targeted goal of 3.4 million Chinook smolts for release in April through May of each year. Adult Coho salmon and Chinook salmon broodstock will be collected by CDFW using the existing auxiliary ladder and held at IGH in the adult trap and holding ponds. The Chinook salmon program will use a maximum of 4,000 adult Chinook broodstock fish to meet the production goals. The Coho salmon program will use a maximum of 270 adult broodstock fish to meet the conservation goals identified in the HGMP and Section 10(a)(1)(A) Permit 15755. A new spawning facility will be constructed at PacifiCorp expense that utilizes, to the extent possible, components of the spawning facility at Iron Gate Dam.

Table 7.8-2 Estimated Water Needs at IGH rearing 3.4 million Chinook smolts (cfs)

Facility	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Rearing Ponds	2.25	2.25	2.25	6.75	6.75	0.00	0.00	0.00	0.00	0.00	0.00	2.25
Hatchery Building	1.50	1.50	1.50	1.50	1.50	0.00	0.00	0.00	0.00	1.50	1.50	1.50
Spawning	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50
Adult Holding & Ladder	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.50	4.50	4.50
Total	**3.75**	**3.75**	**3.75**	**8.25**	**8.25**	**0.00**	**0.00**	**0.00**	**0.00**	**6.50**	**6.50**	**8.75**

Source: NOAA Fisheries and CDFW Technical Staff Recommendation for Klamath River Hatchery Operations in California Post-Dam Removal, May 31, 2018.

Water Needs

As shown in Table 7.8-2, the maximum amount of Bogus Creek water necessary to meet IGH needs is 8.75 cfs in December and 8.25 cfs in April and May. In April and May, the IGH hatchery incubation building requires 1.5 cfs of water for Coho egg incubation and fry rearing. The three raceways will need up to 2.25 cfs each (6.75 cfs total). The adult trap and two raceway holding ponds will need 2.25 cfs each (4.50 cfs total) during October, November, and December. Because anadromous salmonids currently use Bogus Creek as a natural spawning area, the water supply from Bogus Creek will need to be filtered and treated with ultra violet (UV) light to reduce the potential threat of disease introduction into the hatchery. Figure 7.8-2 shows the potential footprint options for the treatment system.

To reduce the potential adverse effects of diverting water from Bogus Creek on naturally produced Coho salmon, the pump station for the hatchery water supply will be constructed as far downstream towards the Klamath River confluence as practicable. This will reduce the length of Bogus Creek rearing habitat affected by water withdrawals downstream of the pump station. Figure 7.8-2 shows an envelope for the potential pump station location on Bogus Creek system.

Water availability

CDFW will operate the Bogus Creek water diversion to maintain a minimum of 50% of the instream flow in the creek at the point of diversion. Table 7.8-3 includes a summary of Bogus Creek flows based on available monitoring data from August 2013 to April 2018. This limited data set indicates that there are four months where hatchery water needs could exceed 50 percent of instream flow (October, November, April, and May). The Fish Hatchery Plan includes measures (discussed below) that will be implemented by CDFW to address these shortages, if they occur. Tables 7.8-4 through 7.8-7 further separate the first and second half of each of these four months and compare the maximum, minimum, and average Bogus Creek flows to IGH flow requirements. Cells highlighted in grey indicate time periods when flows are insufficient to meet total hatchery demand and maintain minimum (50 percent) creek flow. Flow deficient periods over the 2013-2018 data set include:

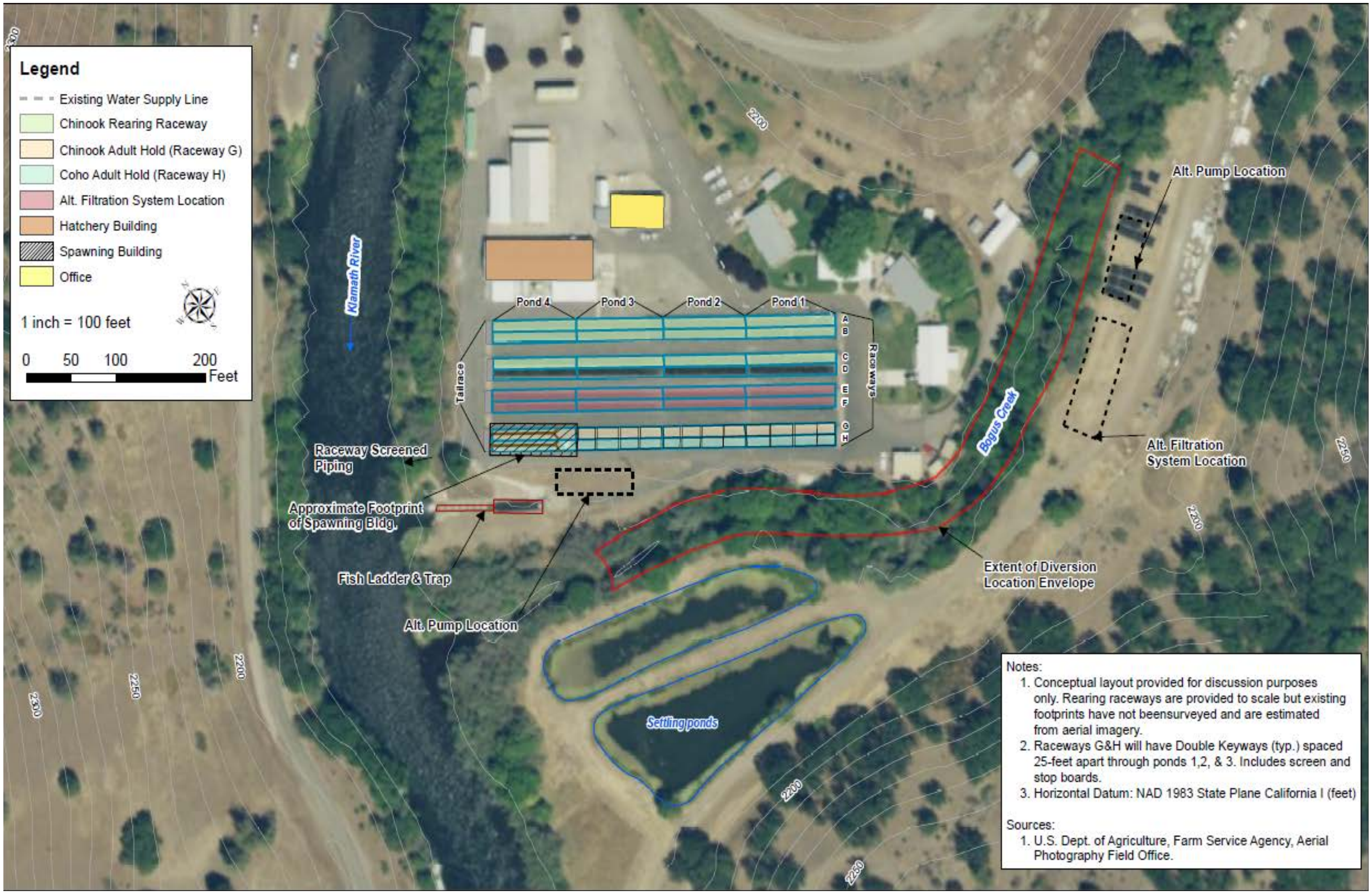


Figure 7.8-2 Conceptual Layout of Iron Gate Hatchery Improvements

- In April 2014, minimum and average Bogus Creek flows fall below the hatchery requirement for both the first and second halves of the month. In 2015 the minimum flow rate for the first half of the month falls below the hatchery requirement and the minimum and average flows fall below the requirement for the second half of the month.
- In May, minimum hatchery flows were not available in all years for the first half of the month and maximum, minimum, and average flows were insufficient in 2014 and 2015. In the second half of the May 2014, the maximum, minimum, and average creek flows are insufficient to meet hatchery requirements while maintaining 50 percent creek flow.
- In October, the first half of the month creek flows are insufficient to meet hatchery requirements for all four years and average flows do not meet the requirement in 2014 and 2016. In the second half of October, minimum and maximum flows in 2014 do not meet hatchery requirements.
- In November, the first half of the month shows that the 2013 minimum and average flows and the 2014 minimum flow did not meet hatchery requirements. In the second half of November, minimum flows were insufficient to meet hatchery requirements in 2013 and 2014.

Table 7.8-3 Observed minimum, maximum, and 4-year average flow in cfs by month in Bogus Creek from 8/8/2013 to 4/16/2018

Flow	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Minimum	12.14	13.90	17.35	8.23	7.20	3.57	2.19	1.77	1.78	7.40	10.96	14.89
Maximum	253.2	184.9	144.3	80.94	48.85	28.99	11.53	11.49	28.00	52.10	32.94	288.6
4-year Average	**32.92**	**39.26**	**37.30**	**28.97**	**18.92**	**9.94**	**5.46**	**5.72**	**8.98**	**16.99**	**20.80**	**27.79**

Note: Minimum and maximum values represent the absolute minimum and maximum values observed in each month.
Source: NOAA Fisheries and CDFW Technical Staff Recommendation for Klamath River Hatchery Operations in California Post-Dam Removal, May 31, 2018.

Table 7.8-4 April Juvenile Rearing Water Availability and Requirements

Year	1st Half April						2nd Half April						IGH Req (cfs)
	Total Flow (cfs)			50% of Flow (cfs)			Total Flow (cfs)			50% of Flow (cfs)			
	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	
2013	NA	NA	NA	NA	NA	NA	NA	NA	0.00	NA	NA	NA	8.25
2014	18.61	9.77	16.01	9.30	4.89	8.01	19.56	8.23	13.31	9.78	4.12	6.65	
2015	22.53	13.64	19.42	11.27	6.82	9.71	18.58	11.31	14.80	9.29	5.65	7.40	
2016	42.95	32.77	36.45	21.48	16.39	18.23	36.52	23.94	30.66	18.26	11.97	15.33	
2017	80.94	42.73	49.89	40.47	21.36	24.95	51.05	37.98	45.57	25.52	18.99	22.79	

Notes: 2013 to 2018 dataset begun in August 2013; Greyed cells indicate Bogus Creek flow less than IGH requirement for 50% of base flow.
Source: NOAA Fisheries and CDFW Technical Staff Recommendation for Klamath River Hatchery Operations in California Post-Dam Removal, May 31, 2018.

Table 7.8-5 May Juvenile Rearing Water Availability and Requirements

Year	1st Half May						2nd Half May						IGH Req (cfs)
	Total Flow (cfs)			50% of Flow (cfs)			Total Flow (cfs)			50% of Flow (cfs)			
	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	
2013	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.25
2014	16.33	10.15	13.23	8.16	5.07	6.61	8.25	12.64	12.64	4.13	6.32	6.32	
2015	16.33	9.95	13.15	8.16	4.98	6.58	30.36	30.36	30.36	15.18	15.18	15.18	
2016	23.39	10.10	19.28	11.69	5.05	9.64	19.14	19.14	19.14	9.57	9.57	9.57	
2017	48.85	9.52	37.78	24.43	4.76	18.89	39.58	39.58	39.58	19.79	19.79	19.79	

Notes: 2013 to 2018 dataset begun in August 2013; Greyed cells indicate Bogus Creek flow less than IGH requirement for 50% of base flow.
Source: NOAA Fisheries and CDFW Technical Staff Recommendation for Klamath River Hatchery Operations in California Post-Dam Removal, May 31, 2018.

Table 7.8-6 October Adult Holding Water Availability and Requirements

Year	1st Half October						2nd Half October						IGH Req (cfs)
	Total Flow (cfs)			50% of Flow (cfs)			Total Flow (cfs)			50% of Flow (cfs)			
	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	
2013	15.36	10.70	13.75	7.68	5.35	6.88	14.84	10.26	12.74	7.42	5.13	6.37	6.5
2014	21.42	9.79	12.83	10.71	4.89	6.42	26.27	15.35	17.40	13.13	7.68	8.70	
2015	20.03	13.63	17.03	10.01	6.81	8.51	22.06	16.75	20.01	11.03	8.37	10.01	
2016	33.38	7.40	12.97	16.69	3.70	6.49	52.10	14.62	25.12	26.05	7.31	12.56	
2017	19.01	8.87	14.29	9.51	4.44	7.14	30.96	17.58	22.84	15.48	8.79	11.42	

Notes: Greyed cells indicate Bogus Creek flow less than IGH requirement for 50% of base flow.
Source: NOAA Fisheries and CDFW Technical Staff Recommendation for Klamath River Hatchery Operations in California Post-Dam Removal, May 31, 2018.

Table 7.8-7 November Adult Holding Water Availability and Requirements

Year	1st Half November						2nd Half November						IGH Req (cfs)
	Total Flow (cfs)			50% of Flow (cfs)			Total Flow (cfs)			50% of Flow (cfs)			
	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	
2013	13.01	10.96	12.35	6.51	5.48	6.17	16.45	12.87	14.38	8.22	6.43	7.19	6.5
2014	16.89	12.75	13.87	8.44	6.38	6.94	25.50	12.72	15.23	12.75	6.36	7.62	
2015	24.12	19.78	21.45	12.06	9.89	10.73	23.36	20.91	22.14	11.68	10.45	11.07	
2016	28.61	28.61	28.61	14.31	14.31	14.31	28.61	28.61	28.61	14.31	14.31	14.31	
2017	29.92	23.57	24.87	14.96	11.79	12.43	32.94	23.49	26.53	16.47	11.75	13.27	

Notes: Greyed cells indicate Bogus Creek flow less than IGH requirement for 50% of base flow.
Source: NOAA Fisheries and CDFW Technical Staff Recommendation for Klamath River Hatchery Operations in California Post-Dam Removal, May 31, 2018.

In summary, there were periods in all 5 years of Bogus Creek flow data in each of the four months where IGH flow requirements were not met if 50 percent of flow was maintained in Bogus Creek. Hatchery flows were met more often in April and November than May and October. The first halves of May and October met the hatchery requirements less often. It was not expected that the first half of May would show less availability than the second half of the month. This may be explained by the short duration of the dataset or drought conditions between 2013 and 2017 that may not represent long-term conditions. For these reasons, KRRC considers this analysis conservative and is indicative of the need for additional Bogus Creek flow data prior to dam removal and implementation of operational strategies to reduce hatchery water use during these shoulder months while maintaining hatchery production.

Water rights for water diverted from Bogus Creek are already secured as a riparian right available to the owner of the property at the time of diversion.

Shoulder Month Water Conservation Measures

As Bogus Creek flow data show, there may be times in April, May, October and November (shoulder months) where Bogus Creek provides inadequate flow for IGH while also maintaining 50 percent of base flow in the creek. If shortages occur, CDFW will implement the following measures to maintain creek flow and hatchery production objectives.

- Adult hold in October and November: As shown in Table 7.8-2, 4.5 cfs is needed for adult holding in October and November to operate two adult hold ponds. Individual adults return at different times beginning in October and lasting through December. Consequently, operating two adult hold ponds in the early return period (October to mid-November) may not be necessary in most years. During periods of low creek flow, adult salmon will be selectively collected (i.e. green spawners returned to the river, ripe spawners retained) and held in numbers/densities consistent with available flow and temperature in Bogus Creek so that a minimum of 50% of instream flow is maintained. As a guideline, if October daily average flows in Bogus Creek are less than 8.5 cfs, water will not be diverted for adult holding. When flows reach a daily average of 8.5 cfs, one adult hold raceway would be operated at 2.25 cfs, with 1.5 cfs for the hatchery building and 0.5 cfs for spawning, for a total facility water need of 4.25 cfs. When flows reach a daily average 13 cfs or greater (second half of October in most years), two adult hold raceways could be operated (4.5 cfs) for a total facility water need of 6.5 cfs (see Table 7.8-6). CDFW will not implement these water diversion rates unless a daily average maximum water temperature trigger of 14 degrees C in Bogus Creek is met for egg incubation purposes.

- Juvenile rearing in April and May: As shown in Tables 7.8-4 and 7.8-5, 8.25 cfs is needed in April and May for juvenile rearing and Coho egg/fry production for Fall Creek. If insufficient water is available in Bogus Creek, CDFW may employ early release strategies to maintain 50 percent of the creek's base flow. CDFW may also employ early release strategies if Bogus Creek and/or Klamath River water temperatures are above 18.3 degrees C (65 degrees F) for a prolonged period to assist with the survivability of juvenile fish. As with adult holding, CDFW will hold juvenile salmon in numbers/densities consistent with available flow and temperature in Bogus Creek. CDFW may also recirculate and reuse of a portion of the raceway tailwater to augment hatchery water supplies during low creek flow years, as further described below.

Water Aeration Needs

Since water used by IGH for post-dam removal operations will be pumped from Bogus Creek (Table 7.8-3), aeration at the head of the raceway ponds will be provided to dissipate unwanted gasses from the water supply. Aeration will off-gas the water and allow re-oxygenation. Additional mid-raceway aeration will also be needed to maintain dissolved oxygen levels near saturation.

Chinook Salmon Tagging and Marking

Application of Coded Wire Tags (CWTs) and adipose fin-clip marking will be conducted by CDFW at IGH as fish reach the minimum size for tagging (200 fish/lb). The mark and tag rate will be at the CDFW standard of 25%. CDFW anticipates tagging will occur between March and May. The existing tagging trailer is adequate to meet tagging and marking objectives for Chinook salmon.

Fish Feeding and Rearing

CDFW will feed fish a high-quality feed to optimize growth and improve health to meet a minimum marking/tagging size of 200 fish/lb on schedule. CDFW's feed storage will be at IGH, for both IGH and FCH. IGH will continue to use the existing bulk feed bins and cool room storage.

Filtration and UV

The new facility will filter and UV disinfect water from Bogus Creek used within the rearing facilities. Anadromous salmonids bring disease and pathogens to the supply water, and water used for rearing of fish in the raceways must be filtered and UV disinfected to avoid spreading disease to the hatchery and hatchery produced fish. The hatchery building currently has a filtration and UV system in place for egg rearing. The adult holding pond, trap, and ladder will not require treatment.

Specific design criteria for the treatment system are still under consideration. The filtering system will need to remove high Total Suspended Sediment (TSS) resulting from winter/spring storm events that can directly affect fish health, as well as remove low ambient TSS that can inhibit the effectiveness of the UV disinfection system. From 2008-2013, Bogus Creek exhibited average turbidity of 4.5 nephelometric turbidity units (NTU) equivalent to approximately 5- 11 mg/L TSS. On April 8, 2018, the Karuk Tribe measured Bogus Creek turbidity during a flushing flow event at Iron Gate Dam, where flow in Bogus Creek was greater than 100 cfs during a storm event. Turbidity in Bogus Creek was measured at 64 formazin nephelometric units (FNU). FNU is equivalent to NTU but uses a different method of measurement. The maximum turbidity in Bogus Creek resulting from a storm event is unknown and requires further monitoring.

To identify and evaluate the appropriate setting requirements and filtration technologies, the KRRC, NMFS, and CDFW will establish temporal TSS exposure goals for the rearing ponds and incubation that will include the 24-hour average, six-day average, 30-day average, 1-day maximum and instantaneous maximum. Exposure goals will be developed with an understanding of current IGH water quality criteria and through review of salmonid exposure to TSS in scientific literature (e.g. Newcombe and Jenson 1996; Bash, et. al.,2001). The KRRC's goal is to identify a treatment process capable of removing TSS to a level protective of fish that is also not reliant upon settling or flocculating agents or chemicals (e.g. alum and potassium permanganate). Options include:

- Slow sand filtration
- Rapid media filtration
- Membrane or alternative filtration technology

CDFW will adopt the UV disinfection requirements from other CDFW hatcheries and will include target pathogens, levels of disinfection, UV transmittance, the need for redundancy and lamp fouling. Independent of the treatment technology used, KRRC, CDFW, and NMFS anticipate that the new equipment footprint (filtration and UV) will be entirely constructed within the footprint of the existing IGH facility.

In 2018-2019, comprehensive sampling and bench-scale testing will be conducted to characterize the particulates and settling rates of Bogus Creek storm water; and possibly pilot-scale filtration tests and UV effectiveness using Bogus Creek water.

Adult Collection and Holding

CDFW will use the existing fish ladder and auxiliary trap at IGH located south of the rearing raceways for adult trapping (See Figure 7.8-2). Extending the existing ladder into the river with a slight turn down river, may create better attraction water for the returning adults. However, this extension will occur within the approach channel to the auxiliary fish ladder and this channel has been excavated to a depth of approximately 20-feet, which could complicate the extension.

Adult fish will enter the ladder and be trapped in the adult collection area. The adult trap and hold area will consist of the existing fish ladder, adult collection pond trap and a fish-lift with a fish return line to the river. A submersible pump in the Klamath River will be added with a 1.5-inch line running to the top of the fish ladder to add Klamath River water for added attraction.

Using a mechanical crowder, fish that have entered the trap will be pushed into the fish-lift, where they will be sorted and slid into a truck for transport to the G or H adult holding raceways, depending on species. From the truck, a portable slide will be used to dump the fish from the truck into the raceways.

The adult holding ponds (ponds 1-3 of raceways G and H, see Figure 7.8-2) will have head box and head screens and provide adequate aeration with water flowing through screens and over wooden dam boards placed in double keyways every 25 feet. These existing raceway ponds will continue to have the standard grade of 0.5-foot elevation decrease over each 100-foot of pond length.

CDFW will segregate adult Chinook and Coho, with Coho in ponds 1 through 3 of raceway H and Chinook in ponds 1 through 3 of raceway G. Coho will be contained in PVC numbered tubes in pond H1, moved to G 3 and through an access door, lifted within the tubes into the spawning house. A barrier will be needed to be attached on the outside wall of H, and on the North side of center wall, and then outside wall of G ponds, possibly a 4-foot chain link fence, to keep fish from jumping out of their ponds. This also allows for use of the mechanical crowder within H ponds. Slide gates will be needed where each of the flumes enters piping under the spawning house. Screens will also be required to keep fish out of the pipes. Keyways at 25-foot intervals will be required in each of the raceways for screens and checkboards. The center wall will be cut just above each 25-foot keyway section to provide a 46-inch portal slot to move fish from G or H pond and crowded to the end of H-3 where the fish will enter the through a hinged door to the spawning house. Each portal slot will need keyways for boards, or screen, to create a barrier, plus a steel support will be needed over each portal slot to provide a sturdy surface for the mechanical crowder that rides atop the pond walls. Raceway flow should be at the established 2.25 cfs, for a total of 4.5 cfs for the two raceways. Pumped water from Bogus Creek will require an aeration tower to remove excess carbon dioxide and other gasses that may be entrained in the water during pumping. Mid-pond aerators may be required in the holding ponds if dissolved oxygen falls below required concentration. If needed, portable aerators can be acquired and used.

Spawning House

Once in the spawning building, CDFW will sort the fish by gender, mark/unmarked, jacks and sexual maturation. They will then be placed into the adult holding ponds, or if needed, returned to the river through the fish return line. The spawning house will be located over pond 4 of raceways G and H. Pond 4 flows will continue under the facility to convey flow to the tailrace; however, flow will be conveyed in pipes to eliminate the need for periodic cleaning. The new spawning house will be laid out in the same manner as the existing spawning house below the dam. It is anticipated at this time that all internal components of the existing fish trap and spawning building will be reused at the new facility at IGH as much as possible, including:

- Auxiliary trap lift

- Sort apron
- Drug tank with submersible pump and UV disinfection
- Sort table
- Egg table
- Miscellaneous work table
- Storage closet
- KRP data area
- Electro-anesthesia (e-shock) tank
- Rinse sink
- Water hardening tank
- 2-1/2-foot wide conveyor belt
- Access door of sufficient height and width to allow entry into the facility by a forklift.

The structure will be located on a slab spanning ponds G4 and H4. In addition to the house, the slab will include a lift for Chinook and door for the Coho tubes, a trap lift and an access ramp for a forklift or other vehicular access. The house itself will include a sorting apron, an electric anesthesia tank (e-shock tank), sort table with sides that connect to the conveyor belt, spawning table, storage area, egg rinsing and water hardening station, rinse sink for egg processing, e-shock equipment area, and flume water supply area to hold processed adults. A garage door and person-door will be provided at the front of the building for ease of access and equipment. CDFW will sort Coho prior to the e-shock tank and prevented from entering the tank. CDFW will sort Chinook after they have been anesthetized in the tank.

The auxiliary trap door will open inward so wet fish may slide down the sorting apron. Chinook, not Coho, will fall into a basket and be anesthetized in the e-shock tank. Then fish will be lifted onto the wet sorting table where some will be moved to the right for lethal research sampling and put on conveyor belt used to transport the fish out of the spawning house; others will be put onto the spawning table to be euthanized, rinsed, spawned, then put onto right side table for research sampling and then placed onto the conveyor belt out of the spawning house. This conveyor belt will extend beyond the tailrace to the driveway for storage and/or disposal.

CDFW will take egg collection pans from the spawning table to the egg processing stations where they will be rinsed, disinfected and water hardened for 1 hour. Eggs will then go directly to the hatchery building for processing.

Ponds G4 and H4, over which the spawning house will span, measure 97 feet by 10 feet; therefore, the spawning house can be as large as 20 feet wide by approximately 100 feet long. However, if the pond walls cannot support the house slab, it may have to extend beyond them. The roof line of the existing facility at the dam measures 47 feet by 24 feet. The new facility can measure slightly narrower (20 feet vs. 24 feet) and longer, if necessary. If a 24-foot width is needed, an additional 2 feet can be obtained on each side of the ponds. The driveways between the raceways are approximately 14 feet wide. If 2 feet is taken from the driveway between raceways F and G, the remaining 12 feet should be adequate for most truck traffic. Although the width of the drive needs to accommodate the feed truck with its side extension tubes.

Coho Eggs

Based on an annual evaluation of rearing conditions, a decision will be made by CDFW and NMFS as to whether Coho salmon eggs and fry will be hatched and reared at FCH, IGH, or a portion at each facility. Coho salmon at IGH will be hatched and reared within the hatchery building existing rearing tanks until they reach a size of approximately 300 fish per pound. Coho salmon will then be transported to FCH for rearing until release.

Chinook Eggs

During the first through third years of operation post dam removal and potentially beyond, CDFW will incubate Chinook salmon eggs collected from broodstock within the IGH hatchery building. The hatchery building has an adequate filtration and UV system; however, sediment pretreatment will be needed to remove high TSS during storm events in Bogus Creek to protect the hatchery building filter from fouling. When Chinook return to Fall Creek, CDFW may collect and incubate eggs at Fall Creek to raise the approximately 140,000 Chinook yearlings at FCH. The entire smolt production (3.4 million) will occur at IGH and egg rearing for smolts will occur exclusively at IGH.

IGH Fish Releases

In general, CDFW will release Chinook salmon smolts between April 1 and May 31. However, early release of smolts prior to April 1st may occur based on water quality and quantity thresholds. Bogus Creek water reliability and quality can diminish in late spring and can exhibit very low flows in dry years that would be insufficient to operate the hatchery. In response, CDFW and NMFS have identified physical and biological parameter at IGH that would trigger early release of fish to reduce or avoid hatchery related fish mortality. These release thresholds include Bogus Creek water availability, Bogus Creek water temperatures, and threat of disease epizootics in rearing ponds. CDFW and NMFS will establish numeric trigger thresholds to determine whether CDFW will release some or all fish early (e.g. Bogus Creek 24-hour average water temperature exceeds 18 to 19 degrees C; see Figure 7.8-3). CDFW would also utilize water reuse/recirculation as described below to extend release dates when Bogus Creek flow is low, but water temperature is sufficient to recirculate in the raceways without exceeding trigger thresholds.

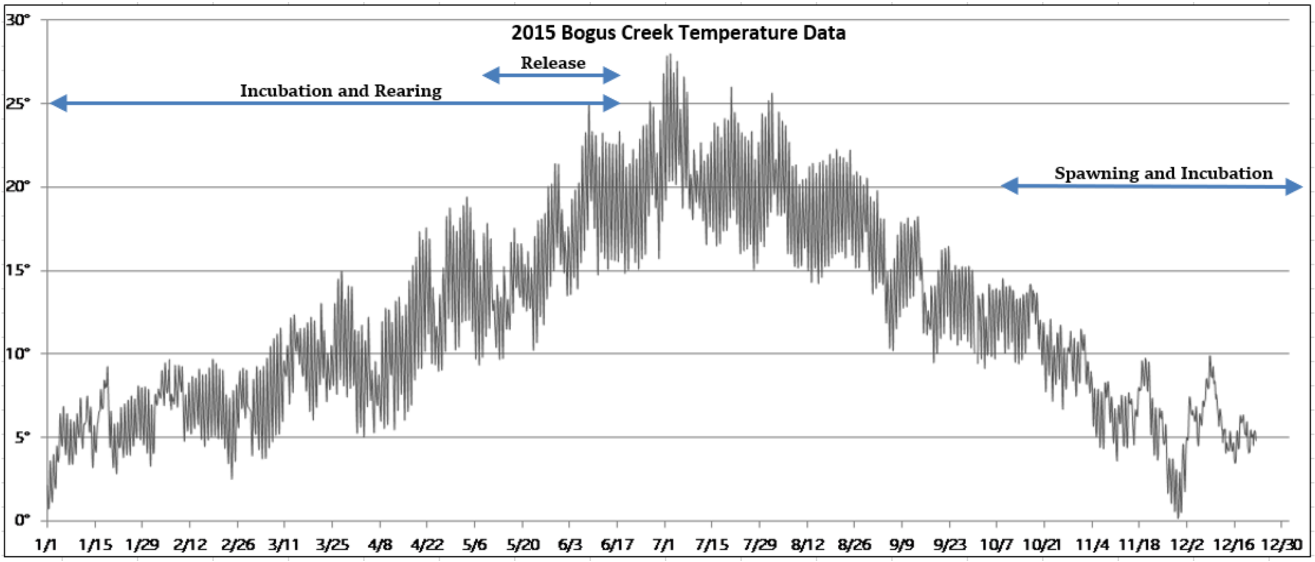


Figure 7.8-3 Bogus Creek Continuous Water Temperature for 2015 (CDFW)

Bogus Creek Flow to IGH

NMFS and CDFW will coordinate to minimize effects of Bogus Creek diversions on Coho salmon and their critical habitat. CDFW will monitor water diversion rates from Bogus Creek to ensure at least 50% of creek flow remains in the creek at the point of diversion. However, CDFW and NMFS will evaluate Bogus Creek to assess habitat below the proposed hatchery diversion to determine the minimum amount of in-stream flow necessary to provide connectivity in Bogus Creek, and to ensure anadromous salmonid spawning and rearing habitat. CDFW and NMFS will conduct hydraulic modeling and a geomorphic assessment in conjunction with habitat assessment to site the approximately 4,000 gpm pump station. This assessment will include:

- Assessment of Bogus Creek habitat: NMFS and CDFW will examine the anadromous fish spawning and rearing habitat in Bogus Creek below the proposed diversion at various low-flow levels to determine effects to habitat of various levels of water diversion.
- Monitoring of flow and TSS: KRRC will monitor flow and develop stage discharge relationships at key transects to determine if adequate fish passage conditions are provided. Data collection will begin in the spring and summer of 2018 and will continue as natural flow conditions in the stream vary. KRRC will monitor winter storm conditions in 2018/2019 to understand TSS concentration and sediment grain size distribution to optimize a sediment removal treatment system.
- Geomorphic and hydraulic assessment: Using an open channel model like HEC-RAS will provide depth and velocity predictions to determine the ideal location for the pump station including a starting water surface elevation at the Klamath River confluence to determine any backwater effects that could occur during high flow.

- Coordination between agencies: Following the habitat assessment, NMFS and CDFW will determine the appropriate flow level or percentage of diversion permitted each month given seasonal hatchery needs and fish development.
- Adjustments to diversions: Based on the results of Bogus Creek evaluation, NMFS and CDFW may coordinate to change the percentage of flow permitted diverted from Bogus Creek to IGH so it is protective of both Bogus Creek habitat and the hatchery program.
- Reporting: NMFS and CDFW will coordinate to determine reporting specifications for Bogus Creek diversions.

Settling Pond Operations and Permitting

CDFW will use the existing settling ponds for hatchery operations and does not anticipate modifications in layout or function. The North Coast RWQCB will continue to permit IGH discharge to the Klamath River as part of the existing 13267 Order modified with the proposed modifications to the facility.

Water Reuse/Recirculation

CDFW may reuse water (recirculation) from the rearing raceways if Bogus Creek flows are insufficient to meet minimum operational needs while balancing flow requirements in the creek. Depending upon Bogus Creek water temperatures and flow, CDFW will recirculate a portion of the raceway discharge back through the raceways reducing reliance on Bogus Creek. CDFW will couple recirculation with the early release thresholds described above to extend the rearing period. Water temperatures are below 19 degrees C in May (see Figure 7.8-3), rising above 20 degrees C in June and 25 degrees C in July and hatchery staff report that water can warm approximately 2 degrees C when passed through the raceways. KRRC and CDFW will further analyze Bogus Creek water as part of the design process to understand the effectiveness of recirculation given annual variations in flow and temperature during the early release period (April 1 and May 31).

Improvements at FCH

To raise yearling Coho and Chinook salmon, the FCH facility will be upgraded by modifying plumbing to accommodate the installation of circular tanks and a UV treatment system, including primary filtration similar to the UV system used at IGH (collectively the UV system). KRRC and CDFW anticipate modifications will occur within the existing facility footprint (see Figure 7.8-4) to minimize environmental and cultural resource disturbances. The FCH UV system will treat and disinfect the egg incubation water source only. KRRC and CDFW do not propose UV treatment for rearing at this facility. CDFW will need additional space not depicted on Figure 7.8-4 for the purposes of operations (e.g. a settling basin, vehicle parking, pertinent buildings, tagging trailer, etc.); these, except for the settling basin, can be accommodated on existing developed or disturbed areas around the hatchery and powerhouse. Use of these spaces will require coordination and concurrence with PacifiCorp. Non-consumptive water diversion from Fall Creek will support hatchery operations using a combination of the existing CDFW water right on Fall Creek and riparian rights, and the water will return to the creek at the settling pond location or fish ladder, minimizing adverse effects to Fall Creek aquatic resources. To protect the quality of the City of Yreka's water supply and prevent fish pathogen introduction into the hatchery, fish will not be allowed upstream of both Dam A (main diversion point) or Dam B (alternate diversion point).

CDFW may divert up to 10 cfs of water from PacifiCorp's hydro-generation tail race canal supplied from either Dam A or B, below the City of Yreka's diversion facility. Water will be gravity fed and plumbed to each rearing location and all circular tanks, pending KRRC's confirmatory site survey. During periods when the powerhouse tail race is not flowing, hatchery water will be diverted from Dam B to Dam A. KRRC and CDFW will perform hydraulic analysis to assess depths and velocities in Fall Creek, which CDFW and NMFS will use to determine threshold criteria for resident and migrating Chinook and Coho salmon.

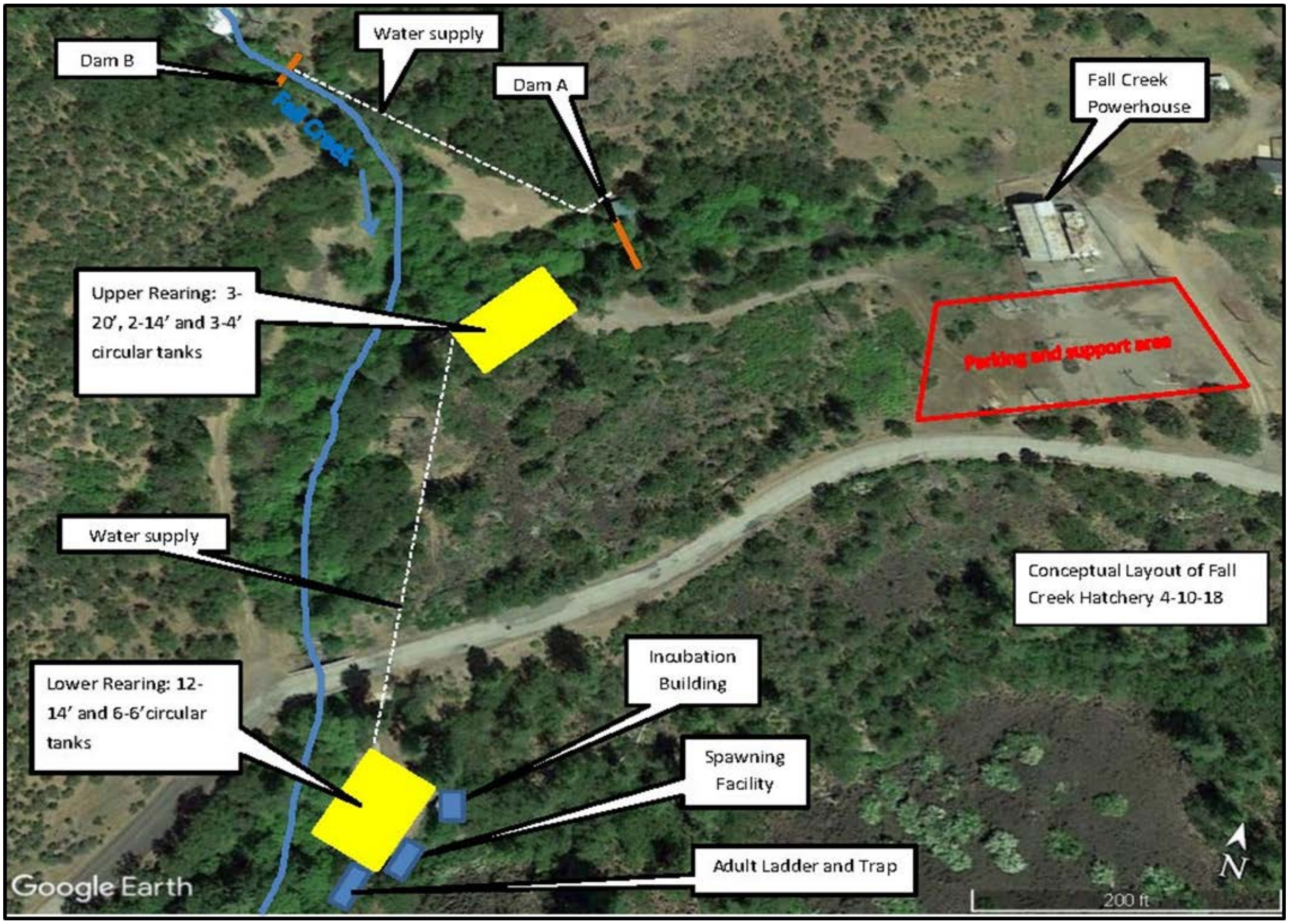


Figure 7.8-4 Conceptual Layout of Fall Creek Hatchery Improvements

Adult Collection and Holding

It is not anticipated that salmon will return to Fall Creek in sufficient numbers for broodstock until at least three years following dam removal (the first fish raised at FCH will return as three-year old's in 2024).

Between 2021 and 2024, or until fish return to FCH, spawning and egg collection will occur at IGH. CDFW and NMFS will develop a separate protocol to transfer eggs to FCH from IGH to reduce transportation mortality. Once FCH salmon returns begin to occur, CDFW and NMFS have identified two options to collect fish:

- Option 1: An adult ladder and trap will be constructed in the lower rearing location. Adult holding will include one or two new 14-foot diameter or smaller circular tank(s). A new fish ladder and trap will allow fish access to this tank(s).
- Option 2: Adult trapping will be at the mouth of Fall Creek using a new picket weir and trap. Once adults are trapped they will be transferred either by truck, or possibly by a Whooshh™ fish transfer system, to the new adult fish ladder and trap located in the lower rearing area.

The fish ladder and adult holding tanks will be supplied with water from the lower tanks (4.33 cfs) excluding periods of cleaning, feeding, and therapeutic use when water will be discharged to the settling pond. If pass through water from the lower tanks is insufficient to meet fish ladder and adult holding needs, CDFW may need to divert additional water (UV treatment not required) into the fish ladder.

Spawning

CDFW will manage spawning at FCH to meet the joint program goals at both IGH and FCH. When adult Chinook and Coho return to Fall Creek, CDFW will sort the adults for ripeness and spawned according to production goals for Chinook salmon and conservation goals described in the HGMP for Coho salmon.

A facility needs to be designed and constructed for future spawning operations at FCH. Migrating Coho and Chinook salmon will need 3-4 years to imprint, so a FCH spawning house is not an immediate necessity; however, the design should be developed now.

Egg Incubation

CDFW will incubate Coho salmon and Chinook salmon eggs in a new incubator building using eight vertical flow incubator stacks. Each stack will use up to 10 gpm, for a total of 80 gpm (0.18 cfs). CDFW will treat the incubator water using a 100 gpm in-line UV system. CDFW will discharge water from egg incubation to the settling pond.

Circular Tanks

Rearing at FCH will occur in the upper and lower ponds. For each location, circular tanks will be installed within the existing concrete rearing pond footprints. The upper ponds will consist of three 20-foot circular tanks, two 14-foot circular tanks, and three four-foot circular tanks. The lower ponds will consist of twelve 14-foot circular tanks, and six 6-foot circular tanks. The incubation building, fish ladder, adult capture and holding ponds and spawning house will be located adjacent to the lower raceways (Figure 7.8-4). CDFW will discharge water from the rearing ponds either to Fall Creek through the fish ladder or if treatment is needed, to the settling pond as described below.

Water Needs

CDFW will divert water from Dam A to provide 2.2 cfs to the upper rearing area, and 5.65 cfs to the lower rearing area. CDFW will divert up to 2.2 cfs for the fish ladder and adult capture area during the months of October through January. The maximum total flow of water required to operate the FCH is 9.24 cfs (Table 7.8-8) which occurs in November and includes additional water from unused tanks to operate the fish ladder and trapping area. The SWRCB has confirmed that CDFW's non-consumptive water right permit of 10 cfs is valid for hatchery operations.

Table 7.8-8 Estimated Water Needs at FCH rearing 115,000 Chinook yearlings and 75,500 Coho (cfs)

Facility	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Round Tanks	1.26	1.29	1.58	1.66	1.08	0.58	1.01	1.48	2.29	3.30	4.06	1.14
Hatchery Building	0.18	0.18	0.18	0.18	0	0	0	0	0	0.18	0.18	0.18
Spawning	0	0	0	0	0	0	0	0	0	0.67	0.67	0.67
Adult Holding & Ladder	4.33	0	0	0	0	0	0	0	0	4.33	4.33	4.33
Total	**5.77**	**1.47**	**1.76**	**1.84**	**1.08**	**0.58**	**1.01**	**1.48**	**2.29**	**8.48**	**9.24**	**6.32**

Source: NOAA Fisheries and CDFW Technical Staff Recommendation for Klamath River Hatchery Operations in California Post-Dam Removal, May 31, 2018.

Settling Pond

A settling pond will be constructed for FCH for post-use water treatment. However, the FCH footprint will not support a settling pond, so KRRC and CDFW identified two nearby sites, both located on Parcel B, for further evaluation as shown in Figure 7.8-5. These include:

1. A location approximately 1/2 mile downstream of the FCH lower raceways on the left Fall Creek overbank at the access road to the PacifiCorp electrical substation across from the City of Yreka chlorination facility.
2. A location also on the left Fall Creek overbank just north of and along Daggett Road, approximately 4,300 feet downstream of the of the lower FCH raceways. This site is also adjacent to the Klamath River. This site is located within the FEMA-designated approximate Zone A floodplain of the river.

Because these locations are offsite and downstream of the FCH, a conveyance pipeline with either minimum burial or at-grade, will be constructed to transport flows from the hatchery to the pond. Sufficient hydraulic head exists for gravity flow to all sites.

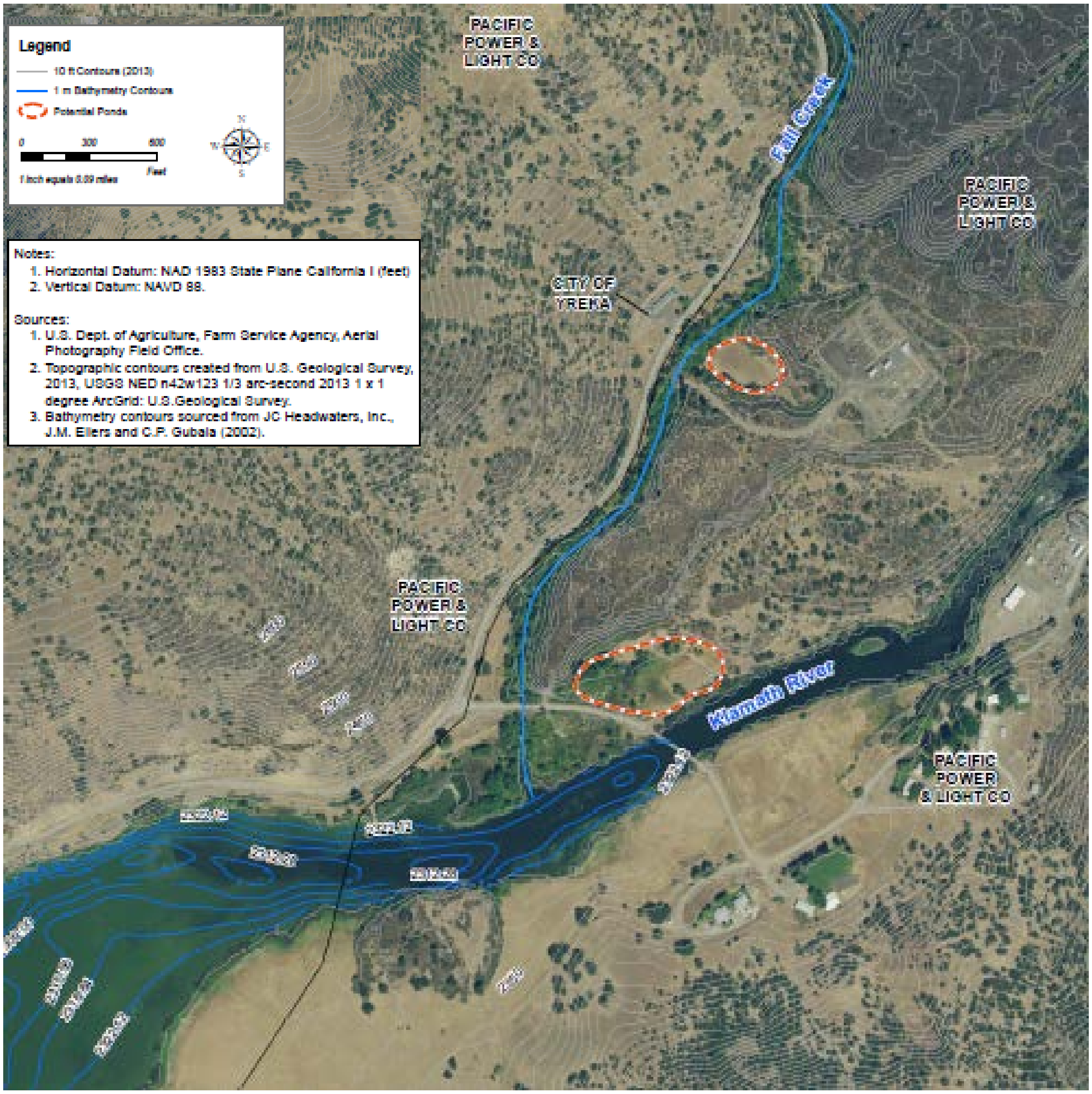


Figure 7.8-5 Potential Settling Pond Locations for FCH

The settling pond will treat water discharged from the incubation and spawning building at all times and from all circular tanks during cleaning, following feeding or use of therapeutics. Otherwise, CDFW will discharge water from the rearing tanks through the fish ladder located in the lower pond area. From the new pond location, CDFW will discharge water back to Fall Creek. At this time, KRRC and CDFW anticipate that the North Coast RWQCB will permit the discharge under the general NPDES permit for hatcheries with effluent discharge requirement phased in over eight years via a companion compliance order. Selection of a settling pond location and pond layout is pending cultural resources investigations and consultation with tribes with historic and cultural connection to the area.

Coded Wire Tags and Marking

CDFW will apply CWTs and perform adipose fin clip marking of the Chinook salmon yearlings reared at FCH at the CDFW standard 25% constant fractional mark rate and are proposed to be processed by hand using Mk IV CWT tagging machines. CDFW can complete hand processing these Chinook yearlings with two CWT machines in 7 to 15 days. CDFW will mark 100% of Coho salmon with a left maxillary clip by hand and can complete this in roughly 10 to 20 days.

FCH Fish Releases

CDFW and NMFS are still evaluating release strategy for Coho and Chinook salmon produced at the FCH. CDFW and NMFS plan release dates of October 15 through November 20 for Chinook salmon yearlings, and March 15 through May 1 for Coho salmon yearlings. Options include direct release at FCH or IGH.

General Hatchery Plan Assumptions

KRRC makes the following assumptions regarding technical criteria at both IGH and FCH:

- For the purposes of planning and designing hatchery operations, all hatchery production at IGH and FCH is limited to the eight years following dam removal. After eight years, the hatcheries will cease operations and be decommissioned.
- IGH and FCH must be operational prior to draw down per the Klamath Hydroelectric Settlement Agreement (KHSA 2016, see section 7.6.6.B).
- CDFW will employ Best Management Practices to minimize discharges at IGH and FCH.

7.9 Cultural Resources Plan

KRRC is preparing a Cultural Resources Plan. The tasks described in the Cultural Resources Plan in Appendix L provide FERC with a framework for understanding the cultural resources studies that KRRC has completed, those that are currently ongoing, and others that KRRC anticipates to comply with regulatory requirements under Section 106 of the NHPA as well as California's AB 52. The plan also provides the status of consultation completed to date by KRRC and PacifiCorp, acting as FERC's non-federal representatives, for carrying out consultation pursuant to Section 106 and the status of consultation with affected Indian Tribes and other tribal organizations. The plan also provides an update of the status of SWRCB's consultation with California Native American tribes under AB 52.

7.10 Other Plans

Several other plans are proposed and included in this Definite Plan to support the construction and management of effects from the Project. Table 7.10-1 provides a list of plans and their location in the appendices.

Table 7.10-1 Summary of Other Plans for Construction, Water Quality and Groundwater Management

Plan	Location in Definite Plan
Fire Management Plan	Appendix O1
Traffic Management Plan	Appendix O2
Hazardous Materials Management Plan	Appendix O3
Emergency Response Plan	Appendix O4
Noise and Vibration Control Plan	Appendix O5
Water Quality Monitoring Plan	Appendix M
Groundwater Well Management Plan	Appendix N

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Chapter 8: Project Costs and Schedule

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8. PROJECT COSTS AND SCHEDULE

This section provides a summary of the Estimate of Project Costs report, which is provided as Appendix P to this Definite Plan. The full report in Appendix P documents the estimated cost for the Project, which in addition to construction cost, includes costs for management, administration and legal support, environmental compliance and permitting, engineering design, procurement, mitigation and monitoring before, during and following construction, as well as construction management. The estimated project cost is based on the Definite Plan, in addition to ongoing coordination and consultation with project stakeholders and regulatory agencies.

8.1 Objectives

Section 7.2 of the Klamath Hydroelectric Settlement Agreement, as amended (KHSA) sets forth required elements of the Definite Plan, which include:

- A detailed estimate of the actual or foreseeable costs associated with: the physical performance of Facilities Removal[25] consistent with the Detailed Plan; each of the tasks associated with the performance of the [KRRC]'s obligations as stated in Section 7.1; seeking and securing permits and other authorizations; and insurance, performance bond, or similar measures, as set forth in Appendix L to this Settlement;
- The [KRRC]'s analysis demonstrating that the total cost of Facilities Removal is likely to be less than the State Cost Cap, which is the total of Customer Contribution and California Bond Funding as specified in Section 4[26]; and
- A detailed statement of the estimated costs of Facilities Removal.

The full report in Appendix P addresses these elements of the KHSA and documents both the engineer's opinion of construction cost, based on the project design elements and construction plan summary provided herein, as well document the total estimated project implementation cost. In addition to reporting the estimated project costs, Most Probable Low (MPL) and Most Probable High (MPH) estimates were prepared using a Monte Carlo analysis to account for uncertainties associated with the estimated project costs and identified project risks. The MPL and MPH estimates represent more optimistic and more conservative opinions of project costs, respectively.

8.2 Cost Categories

For organizational purposes, the project costs have been summarized using the following cost categories:

[25] "Facilities Removal" is defined in the KHSA as the "physical removal of all or part of each of the Facilities to achieve at a minimum a free-flowing condition and volitional fish passage, site remediation and restoration, including previously inundated lands, measures to avoid or minimize adverse downstream impacts, and all associated permitting for such actions."
[26] The State Cost cap is $450,000.000.

- **Project Oversight:** Support services providing administration, project management and controls, contract management, BOC, outreach, insurance and legal support.
- **Environmental Compliance and Permitting**: Environmental compliance support and permitting.
- **Engineering and Procurement:** Field studies, engineering design, and construction procurement for the various project work packages. Design and procurement estimates assume a Progressive Design-Build (PDB), performance security, construction delivery method for the large dam removal work package.
- **Construction Management:** Full construction management services for implementation of all project components.
- **Construction:**
  + Dam removals: Sequential removal of all four dams, including dam modifications, reservoir drawdown and removal of all associated dam infrastructure (including spillways, fish ladders, intake structures, penstocks, turbine units, electrical installations, buildings)
  + Reservoir area improvements: Removal, grading and shaping of portions of reservoir sediment, bank stability measures
  + Reservoir area restoration: Seeding, planting, weeding, monitoring and maintenance. Hydroseeding methods include by barge along the reservoir bank, by helicopter along steep slopes, by airplane along uneven large areas and by trailer mounted blower for areas easily accessible by truck
  + Yreka water supply improvements: Improvements to the City of Yreka's water supply intake and relocation of their water supply pipeline.
  + Transportation infrastructure: Improvements to, or replacement of, bridges, culverts and road resurfacing to mitigate any project or construction related impact
  + Recreation demolition: Demolition of existing recreation infrastructure and restoration of disturbed area to native vegetation
  + Recreation improvements: New recreation infrastructure (e,g, water access, day-use areas, etc.) to avoid or minimize project impacts
  + Downstream flood improvements: Improvements to existing structures and facilities to avoid or minimize adverse downstream flood-related impacts.
- **Anticipated Mitigation Measures**: Anticipated cultural resource measures, groundwater improvements, and water supply improvements required by regulatory agencies to mitigate project-related impacts.
- **Monitoring and Reporting:** Aquatic resource, terrestrial resource, water quality, and sediment monitoring and reporting.

Detailed summaries of methods, assumptions and results of the estimate development for the various cost categories and subcategories is provided in Section 3 of Appendix P.

8.3 Construction Procurement Approach

KRRC based estimates for the various cost categories on a PDB construction procurement of the large dam removal work package, which includes construction access road and bridge accommodations, dam modifications, dam and hydropower facility removal, recreation demolition and reservoir and other restoration. KRRC will use a qualifications-based selection approach and hire a PDB contractor in late 2018/early 2019, followed by the PDB's completion of the final design in 2019.

There is a possibility that smaller work packages, including downstream flood control improvements, City of Yreka water supply improvements and proposed recreation facilities, may be procured separately using a design-bid-build, or similar, procurement strategy. For these packages, final design will proceed in 2018 and 2019, with request for construction proposals being issued in mid- to late-2019.

8.4 Basis of Estimate

8.4.1 Construction Pricing

The construction estimates summarized herein are intended to capture the most current pricing for materials, wages and salaries, equipment, accepted productivity standards, and typical construction practices, procurement methods, current construction economic conditions, and site conditions for the current level of design. Detailed construction cost breakdowns for both Full Removal and Partial Removal alternatives are provided in Appendix P. Pay item cost detail worksheets, describing the calculation of individual cost estimate line items rates and prices are also provided in Appendix P.

Construction cost estimates were prepared based on less than complete designs, and have inherent levels of risk and uncertainties. Section 2.3 in Appendix P contains a detailed description of the methods and assumptions that were utilized to address Contractor direct costs, overhead, profit, risk markup, subcontractor markup, insurance markup and bond markup.

8.4.2 Consulting Services Pricing

Outside of construction costs, other implementation activities such as project oversight, field studies, design, permitting, mitigation measures and monitoring generally involve labor and associated other direct costs (ODCs). ODCs can include office space, travel, meals, postage, specialty reproduction, and vendor quotes for materials, supplies or services. For each of the implementation activities referenced above, KRRC developed independent estimates using standard labor rates and ODC values based on the latest understanding of the scope or work for the life of the Project. Details for each cost category are provided in Appendix P.

8.4.3 Escalation

KRRC based estimates on contemporary market information at the time of estimate preparation. As such it is necessary to include escalation to account for cost increases over the duration of the Project, particularly as this Project spans multiple years. KRRC escalated each line item in the cost estimate based on scheduled construction and other implementation activities. KRRC utilized an escalation rate of 4% per year. This is based on cost index references and current cost trends observed in the industry, described in more detail in Appendix P.

8.4.4 Design and Construction Contingency

Design contingencies are intended to account for three types of uncertainties which directly affect the estimated cost of a project as it advances from the planning stage through final design. These include: (1) unlisted items, (2) design and scope changes, and (3) cost estimating refinements. Based upon the apparent completeness of the listed items for the dam removal estimates, the design contingency was set at ±10 percent of the construction cost, which is a typical value for a the level of design presented herein, particularly given the fact that a large percentage of the demolition work is means and methods driven, as opposed to detailed design.

The estimate of project costs includes a percentage allowance for construction contingencies to cover differences in actual and estimated quantities, unforeseeable difficulties at the site, changed site conditions, possible changes in plans, and other uncertainties during the construction period. The allowance is based on engineering judgment of the major pay items in the estimate, reliability of the data, adequacy of the estimated quantities, and general knowledge of the site conditions. KRRC used a value of ±20 percent of the construction cost for construction contingencies for the dam removal estimates, which is a typical value for this stage of project development.

KRRC applied the design and construction contingencies (total of 30%) discussed above as a percentage of the total construction cost, and added to the total estimate of project costs.

8.4.5 Monte Carlo Analysis

KRRC completed a Monte Carlo analysis to analyze uncertainties and risk, to be used as the basis for development of the MPL and MPH estimates.

The probabilistic range of costs for each estimate line item was determined with the use of '@Risk' Monte Carlo analysis software. The Monte Carlo analysis involves determining the impact and likelihood of occurrence of identified and quantified uncertainties and risks by running simulations to identify the range of possible outcomes for a number of scenarios - 10,000 scenarios in the case of this Project. A random sampling is performed in the simulation by using uncertain risk variable inputs to generate the range of outcomes with a confidence measure for each outcome.

Levels of probability are described from P1 to P100, where the number following the 'P' represents the percentage of most probable outcomes. For example, the P1 estimate amount will only cover the lowest 1% of the possible cost outcomes, whereas P100 will cover the maximum estimate amount determined from running the 10,000 scenarios. A P80 estimate covers the most likely final project cost in 80% of all scenarios, and is often used by the construction industry (Barreras 2011), including the USACE ("Per regulation and guidance, the P80 confidence level is the normal and accepted cost confidence level"), to calculate the amount of conservative risk contingency to carry on a project.

Due to the unique nature of this Project and theKRRC, KRRC selected a conservative P90 to represent the MPH for the Project. The P90 estimate would cover the most likely final project cost in 90% of all scenarios. A P10 was selected to represent the MPL.

8.4.6 Ongoing Due Diligence

General

KRRC is undertaking additional due diligence on construction costs, measures to lower construction costs, and measures to manage construction risk. KRRC will complete additional engineering, select a design-build contractor, negotiate a construction agreement with the Contractor, establish a guaranteed maximum price for the work to be performed, implement its insurance programs, and establish the requirements for all bid bonds, payment bonds, and the performance bond. Many risks considered in the Monte Carlo analysis that deal with design and regulatory compliance will be mitigated or better understood when this process is completed, likely lowering the MPH significantly.

Independent Board of Consultants (BOC)

The FERC approved the BOC for the Lower Klamath Project on May 22, 2018. Among other things, FERC's letter of approval included a plan and schedule to obtain BOC review of the estimate of project costs and MPH estimates for the Full Removal alternative, adequacy of available funds for facilities removal, adequacy of the proposed contingency reserve, and adequacy of the proposed insurance and bonding arrangements. The five-member BOC FERC-approved list includes Dan Hertel, PE (Engineering Solutions, LLC), James Borg, PE (D&H Concepts, LLC), Craig Findlay, PhD, PE, GE (Findlay Engineering, Inc.), Mary Louise Keefe, PhD (R2 Resource Consultants, Inc.), Ted Chant, PE (Chant Limited) and Robert Muncil, ARM (Cool Insurance Agency, Inc.). KRRC plans to convene the BOC on or before August 1, 2018.

The Definite Plan will be further informed by the review and recommendations of the BOC. KRRC will incorporate recommendations of the BOC into a revised Definite Plan and Appendix P will be updated accordingly.

8.5 Estimate Results Summary

Tables 8.5-1 and 8.5-2 below summarize the estimate of project costs, for both Full Removal and Partial Removal of the four dams.

Similar to previous project estimates, the results show probabilistic MPL and MPH costs based on the results of Monte Carlo simulations. The right-hand column indicates the estimated project costs, whereas the forecast range from MPL to MPH indicate the range of probabilistic outcomes. The MPL is P10 (likely final project cost in 10% of all scenarios) and the MPH is P90 (likely final project cost in 90% of all scenarios). Additional detail and cost breakdowns are provided in the full report in Appendix P.

Table 8.5-1 Results Summary - Full Removal

Cost Category	Forecast Range		Estimated Project Cost
	MPL	MPH	
Project Oversight			$29,581,000
Environmental Compliance & Permitting			$8,637,000
Engineering & Procurement			$15,632,000
Construction Management			$10,617,000
Construction	$202,108,000	$268,560,000	$227,980,000
Anticipated Mitigation Measures			$18,407,000
Monitoring & Reporting			$18,405,000
Design & Construction Contingency			$68,394,000
TOTAL	**$346,500,000**	**$507,100,000**	**$397,700,000**

Table 8.5-2 Results Summary - Partial Removal

Cost Category	Forecast Range		Estimated Project Cost
	MPL	MPH	
Project Oversight			$29,581,000
Environmental Compliance & Permitting			$8,637,000
Engineering & Procurement			$15,632,000
Construction Management			$10,617,000
Construction	$169,140,000	$229,250,000	$193,030,000
Anticipated Mitigation Measures			$18,407,000
Monitoring & Reporting			$18,405,000
Design & Construction Contingency			$57,909,000
TOTAL	**$313,500,000**	**$467,800,000**	**$352,200,000**

8.6 Construction Schedule

The estimate is based on the construction schedule and the construction plan described below. The schedule is predicated on the following:

- Construction of City of Yreka water supply improvements would be completed in 2020 (prior to drawdown) and may be under a separate contract from the PDB Contract for the dam removal work
- Construction of downstream flood control improvements would be completed in 2020 (prior to drawdown) and may be under a separate contract from the PDB Contract for the dam removal work

- Construction of the access road improvements would be completed in 2020 (prior to drawdown)
- An effective Date of Agreement (guaranteed maximum price) for the dam removal PDB Contractor on or before February 15, 2020
- Lineal and concurrent activities
- Equipment application and production
- The ability to drawdown J.C. Boyle, Copco No. 1 and Iron Gate reservoirs at the beginning of 2021
- Major earthworks and removal activities are assumed to be performed using two 10-hour shifts, six days per week
- In-stream construction window in Oregon is assumed to be from July 1 through September 30
- In-stream construction window in California is assumed to be from June 15 through October 15

The duration of many of the schedule activities are determined from the labor and equipment productivity associated with the estimate pay item sheets.

The access road, dam modification, water supply, and downstream flood control construction would be completed during an estimated 6- to 8-month period in 2020, since these activities require completion prior to drawdown and facility removal. Subsequent dam removal and associated construction would occur during approximately 8 months of work in 2021, with restoration related construction activities likely extending through 2022. Monitoring and reporting would extend for 5 years after construction completion. Figure 8.6-1 below shows a summary schedule for construction activities.

ID	Task Name	Duration	Start	Finish
1	**Supporting Construction**	**142 days**	**Wed 4/1/20**	**Thu 10/15/20**
2	Dry Creek Bridge	21 days	Wed 4/1/20	Wed 4/29/20
3	Fall Creek Bridge	66 days	Mon 4/20/20	Mon 7/20/20
6	Lakeview Bridge	65 days	Wed 4/22/20	Tue 7/21/20
7	Daggett Rd Bridge	98 days	Wed 4/22/20	Fri 9/4/20
8	Jenny Creek Bridge	108 days	Wed 4/22/20	Fri 9/18/20
11	Camp Creek Bridge	66 days	Thu 7/16/20	Thu 10/15/20
14	Scotch Creek Culvert	**29 days**	Fri 7/24/20	Wed 9/2/20
17	Recreation Areas	110 days	Wed 4/1/20	Tue 9/1/20
19	Flood Improvements	83 days	Wed 4/1/20	Sat 7/25/20
21	Yreka Water Supply	102 days	Thu 4/30/20	Sun 9/20/20
23	**Copco 1 Dam**	**355 days**	**Mon 6/15/20**	**Fri 10/22/21**
24	Dam Modifications	134 days	Mon 6/15/20	Thu 12/17/20
25	Dam Modifications	117 days	Wed 7/8/20	Thu 12/17/20
26	In-Water Dam Modifications	40 days	Mon 6/15/20	Fri 8/7/20
27	Drawdown	90 days	Tue 11/3/20	Mon 3/8/21
28	Dam Removal	253 days	Wed 11/4/20	Fri 10/22/21
29	Dam Demolition	137 days	Thu 4/15/21	Fri 10/22/21
30	Power House Demolition	116 days	Wed 11/4/20	Wed 4/14/21
31	Power Plant Demolition	24 days	Wed 11/4/20	Mon 12/7/20
32	Switch Yard Demolition	4 days	Wed 11/4/20	Mon 11/9/20
33	In-Water Dam Demolition	89 days	Tue 6/15/21	Fri 10/15/21
34	Transmission Line Demolition	34 days	Tue 6/15/21	Fri 7/30/21
35	**JC Boyle Dam**	**195 days**	**Fri 1/1/21**	**Thu 9/30/21**
36	Drawdown	22 days	Fri 1/1/21	Sun 1/31/21
37	Dam Removal	190 days	Fri 1/8/21	Thu 9/30/21
38	Dam Demolition	190 days	Fri 1/8/21	Thu 9/30/21
39	Dam Excavation	77 days	Wed 6/16/21	Thu 9/30/21
40	Forebay Demolition	164 days	Mon 1/18/21	Thu 9/2/21
41	Buildings Demolition	24 days	Wed 4/7/21	Mon 5/10/21
42	Penstock Demolition	151 days	Mon 1/18/21	Mon 8/16/21
43	Power House Demolition	159 days	Mon 1/18/21	Thu 8/26/21
44	In-Water Dam Demolition	20 days	Thu 7/1/21	Wed 7/28/21
45	Transmission Line Demolition	50 days	Mon 1/18/21	Fri 3/26/21
46	**Copco 2 Dam**	**120 days**	**Sat 5/1/21**	**Fri 10/15/21**
47	Dam Removal	120 days	Sat 5/1/21	Fri 10/15/21
48	Dam Demolition	107 days	Sat 5/1/21	Sat 9/25/21
49	Penstock Demolition	120 days	Mon 5/3/21	Fri 10/15/21
50	Power House Demolition	96 days	Mon 5/3/21	Mon 9/13/21
51	In-Water Dam Demolition	75 days	Tue 6/15/21	Sat 9/25/21
52	Power Plant Demolition	42 days	Mon 5/3/21	Tue 6/29/21
53	Transmission Line Demolition	32 days	Mon 5/3/21	Tue 6/15/21
54	**Iron Gate Dam**	**344 days**	**Mon 6/22/20**	**Thu 10/14/21**
55	Dam Modifications	56 days	Mon 6/22/20	Mon 9/7/20
56	Dam Modifications	56 days	Mon 6/22/20	Mon 9/7/20
57	In-Water Dam Modifications	23 days	Thu 8/6/20	Mon 9/7/20
58	Drawdown	43 days	Fri 1/1/21	Tue 3/2/21
59	Dam Removal	204 days	Mon 1/4/21	Thu 10/14/21
60	Fish Facility Demolition	111 days	Mon 1/4/21	Mon 6/7/21
61	Dam Demolition	95 days	Tue 6/1/21	Mon 10/11/21
62	Dam Excavation	82 days	Tue 6/1/21	Wed 9/22/21
63	Buildings Demolition	18 days	Tue 6/8/21	Thu 7/1/21
64	Penstock Demolition	88 days	Tue 6/15/21	Thu 10/14/21
65	Pipe Demolition	14 days	Fri 7/2/21	Wed 7/21/21
66	In-Water Dam Demolition	69 days	Wed 7/7/21	Mon 10/11/21
67	Power House Demolition	61 days	Tue 6/1/21	Tue 8/24/21
68	Power Plant Demolition	46 days	Tue 6/1/21	Tue 8/3/21
69	Transmission Line Demolition	5 days	Tue 6/1/21	Mon 6/7/21
70	**Restoration**	**347 days**	**Mon 2/1/21**	**Tue 5/31/22**
71	Fluvial sediment & habitat	89 days	Tue 6/15/21	Fri 10/15/21
72	Vegetation habitat	347 days	Mon 2/1/21	Tue 5/31/22
73	Aerial pioneer crop seeding	65 days	Mon 2/1/21	Fri 4/30/21
74	Salvage & plant existing riparian veg	108 days	Mon 2/1/21	Wed 6/30/21
75	Pole Cutting Installation 2021	86 days	Mon 2/1/21	Mon 5/31/21
76	Pole Cutting Installation 2022	86 days	Tue 2/1/22	Tue 5/31/22

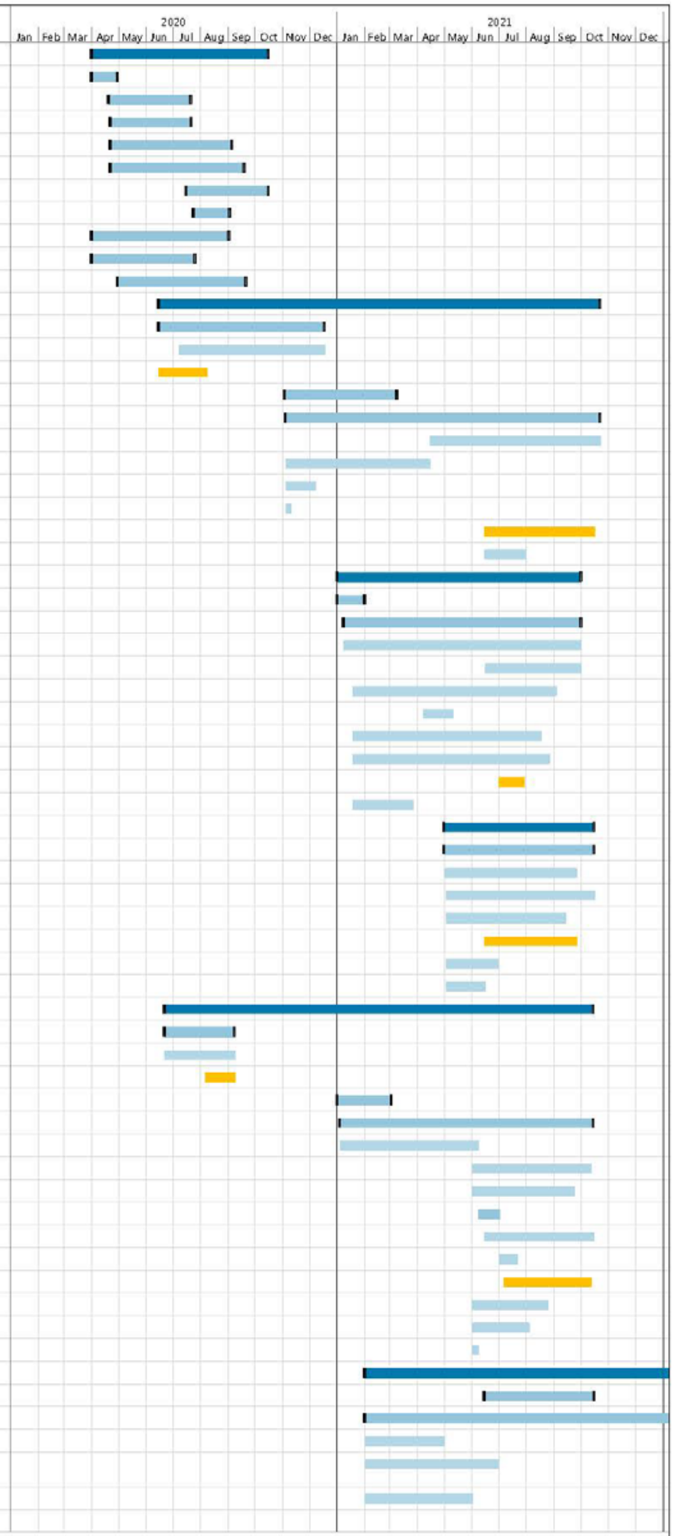

Figure 8.6-1 Summary Construction Schedule

Chapter 9: References

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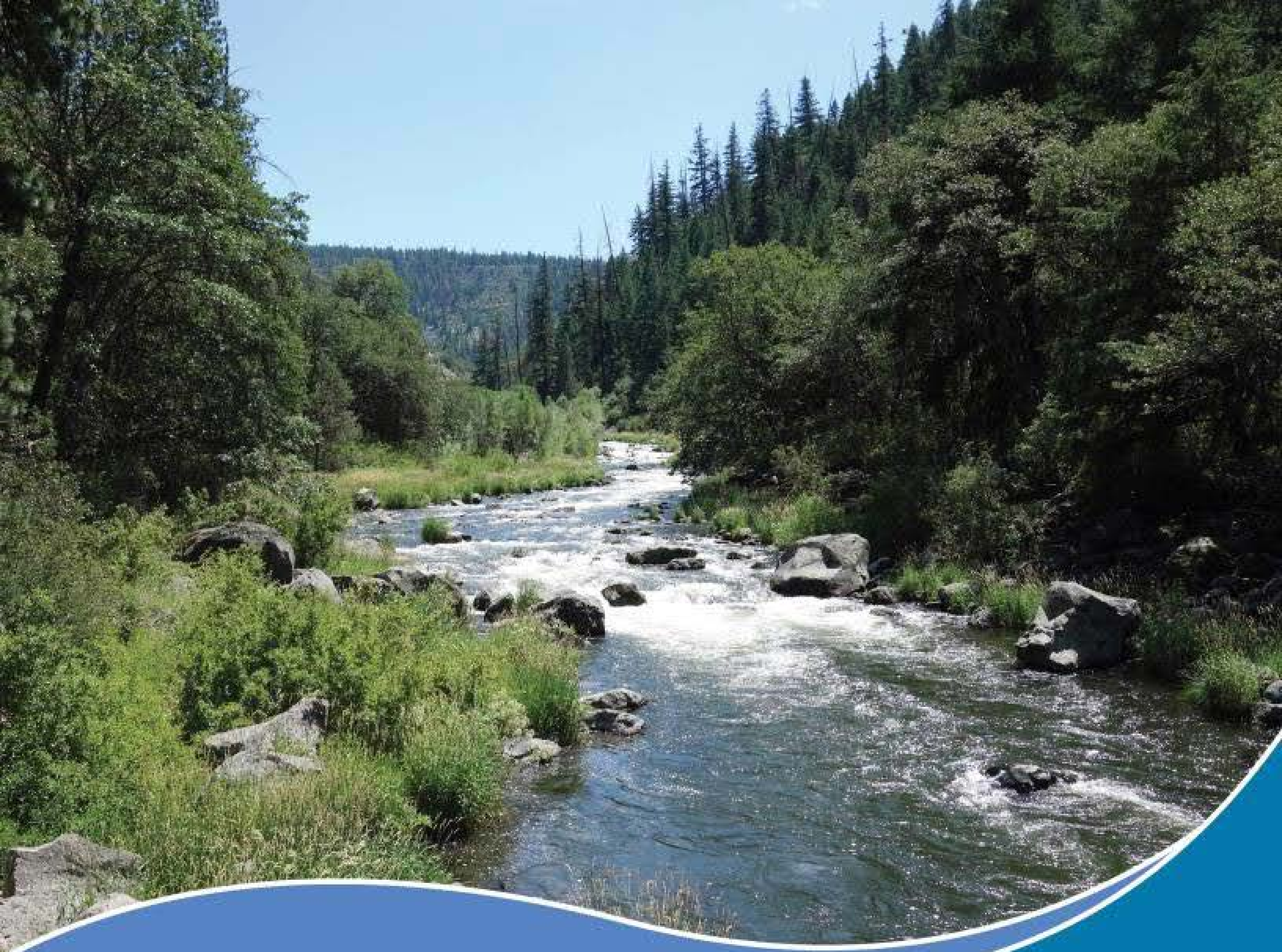

Definite Plan for the Lower Klamath Project

Appendix A – Risk Management Plan

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Prepared for:

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Acronyms and Abbreviations

BOC	Board of Consultants
CA	California
CEQA	California Environmental Quality Act
CMAR	Construction Manager at Risk
cfs	cubic feet per second
DB	Design-Builder
DSOD	California Division of Safety of Dams
DWR	Department of Water Resources
EAP	Emergency Action Plan
FERC	Federal Energy Regulatory Commission
ID	Identification
KRRC	Klamath River Renewal Corporation
NEPA	National Environmental Policy Act
PFMA	Potential Failure Modes Analysis
QA	Quality Assurance
QC	Quality Control

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Chapter 1: Plan Objectives and Background

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1. PLAN OBJECTIVES AND BACKGROUND

1.1 Plan Objectives

The implementation of any project comes with uncertainty and risk that can affect schedule, budget, and project performance. This is even more applicable to large, multi-disciplinary and high profile projects. Successful implementation includes planning to identify and manage those uncertainties and risks. Section 7.2 of the Klamath Hydroelectric Settlement Agreement (KHSA), as amended, sets forth the essential elements of a risk management plan to be included in and implemented as part of the Definite Plan. These elements include the following:

- Insurance, performance bond, or similar measures as required by Appendix L to the KHSA
- Accounting procedures that will result in the earliest practicable disclosure of any actual or foreseeable cost overrun
- Appropriate mechanisms to modify or suspend performance of any task subject to such cost overrun; and
- Measures to reduce risks of cost overruns, delays, or other impediments to dam removal

This plan addresses these requirements as follows:

- Section 2 identifies the insurance, bonds and other surety arrangements to be secured by the Klamath River Renewal Corporation (KRRC) in compliance with Appendix L to the KHSA
- Section 3 identifies KRRC's preferred progressive design-build project delivery method and plan for a competitive process for selecting its dam removal contractor, and negotiation of construction agreements
- Section 4 includes a design and construction risk register and measures to reduce risks of cost overruns, delays, or other impediments to dam removal

The objective of this Risk Management Plan is to provide a tool and processes to identify and quantify the design and construction risks that are particular to the Lower Klamath Project (Project), assign those risks to the appropriate party, develop design and construction risk management strategies to reduce or eliminate the risk, and to manage and re-evaluate the risks as we progress through the project lifecycle.

1.2 Project Background & Overview

The proposed Project is described in Sections 4 through 7 of the Definite Plan, and generally includes the decommissioning and full removal of four dam developments (Iron Gate, Copco No. 1 and No. 2, and J.C. Boyle) on the Klamath River approximately 200 miles from the Pacific Ocean in the states of Oregon and California by the KRRC. Figure 1.2-1 provides an overview of the Klamath River watershed and the locations of the four dams. The Project objectives are to restore free-flowing river conditions and volitional fish passage by the complete removal of dams, power generation facilities, water intake structures, canals, pipelines, and ancillary buildings. The Definite Plan also describes a partial removal alternative which is presented for purposes of environmental review. Under the partial removal alternative, the objectives of a free-flowing river conditions and volitional fish passage would be achieved, but portions of each dam would remain in place, along with ancillary buildings and structures such as powerhouses, foundations, tunnels, and pipes.

Prior to removal of the dams and hydropower facilities, the KRRC will drawdown the water surface elevation in each reservoir as low as possible to facilitate accumulated sediment evacuation and to create a dry work area for facility removal activities. In order to meet drawdown timing and duration, specific infrastructure modifications are required at Iron Gate and Copco No. 1 dams in advance of drawdown. In general, drawdown will begin on January 1 of the drawdown year, and will extend through March 15 of the same year.

After drawdown is accomplished, dam and hydropower facility removal will begin, and the KRRC will stabilize remaining reservoir sediments to the extent feasible. Full reservoir area restoration will begin after drawdown, and extend throughout the year, and possibly into the subsequent year. Vegetation establishment could extend several years.

Other key project components include measures to address aquatic and terrestrial resources, road and bridge improvements, relocation of the City of Yreka's pipeline across Iron Gate Reservoir and associated diversion facility improvements, flood improvements downstream, as well as demolition of various recreation facilities adjacent to the reservoirs.

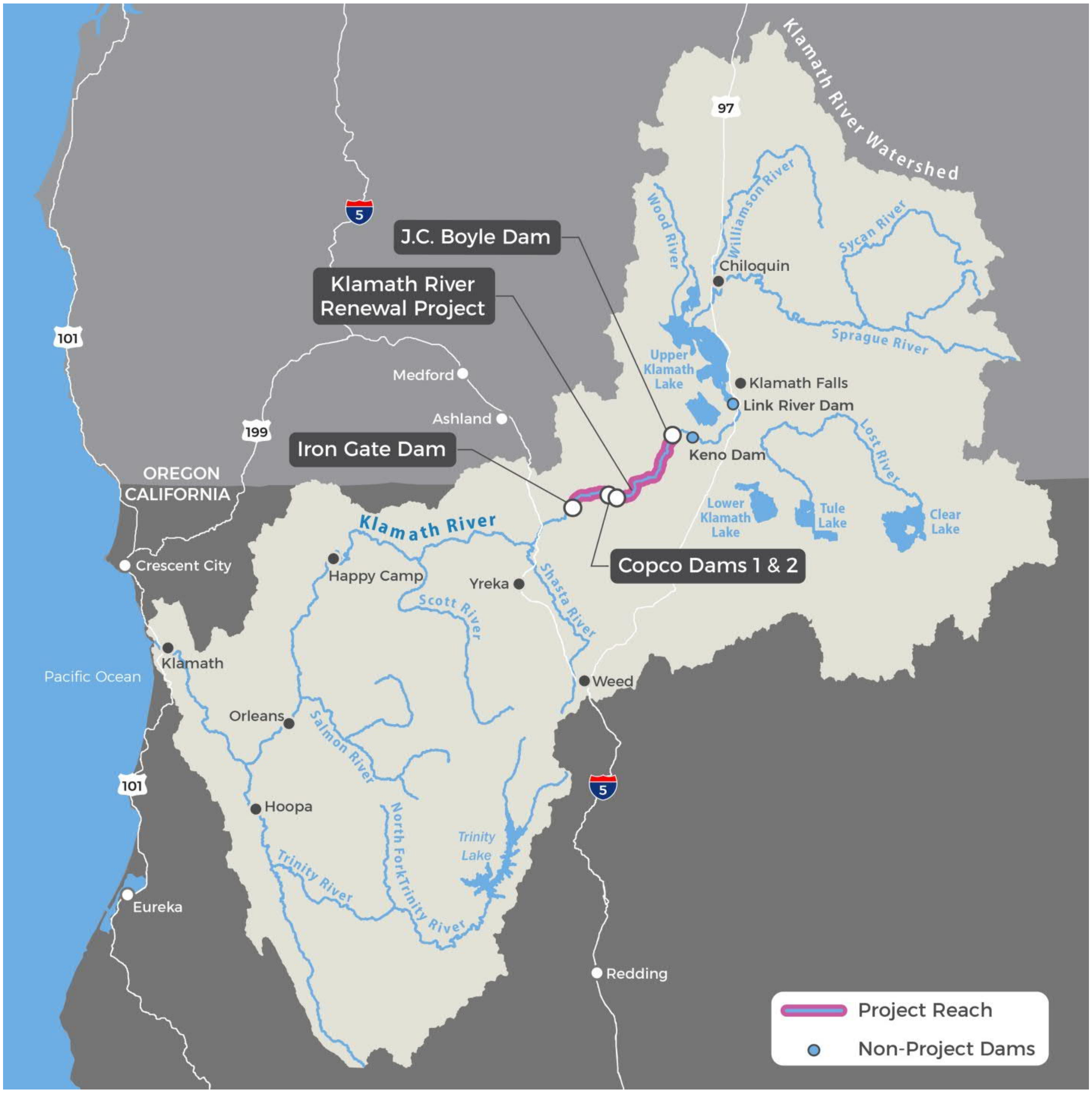

Figure 1.2-1 Klamath River Watershed and Facilities Locations

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Chapter 2: Insurance, Bonds and Other Surety Arrangements

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2. INSURANCE, BONDS AND OTHER SURETY ARRANGEMENTS

2.1 Overview

This section of the Risk Management Plan identifies the insurance, bonds and other surety arrangements that KRRC will maintain in fulfillment of its obligations under Appendix L of the KHSA and prudent business practices. KRRC developed this plan with specialized guidance and advice from Willis Towers Watson (Willis). Willis is a global firm that provides a wide range of insurance brokerage, reinsurance, and risk management consulting services1. Working with Willis as its insurance advisor, KRRC has established and will maintain a robust insurance program to minimize liability risks to the Project and to KRRC.

2.2 Insurance

2.2.1 Overview

KRRC will maintain two insurance programs, each of which will be designed to address different insurance needs and requirements over time. Prior to the commencement of dam removal activities, the insurance currently maintained by KRRC is best viewed as a corporate insurance program that is intended to address KRRC's general risks as a business entity (discussed below as the Corporate Insurance Program). The project-specific insurance needs and requirements in connection with the proposed Project cover a broader range of risks, and are directly responsive to the requirements of Appendix L to the KHSA (discussed below as the Project Insurance Program).

2.2.2 Timing

KRRC's Corporate Insurance Program is in place and is described below. KRRC's project-specific coverages will be established and implemented as part of the dam removal contractor procurement process. KRRC will incorporate these coverages in the RFP for KRRC's dam removal contractor and will be incorporated into the dam removal contract that is ultimately executed by KRRC and the dam removal contractor. KRRC has begun the process of introducing insurers to the Project, with an eye toward selecting the insurer or insurers that offer the best options for project coverage. This will be determined after the insurers have completed their review of the Project.

Once the scope, limits and providers of the project coverages have been finally determined, the actual insurance policies will be put in place in coordination with the beginning of the dam removal work to which

[1] Additional information regarding this firm may be found at https://www.willistowerswatson.com/en/about-us/overview

they relate, including certain preliminary site work. For example, insurance for design work will be in place at the time the dam removal contract becomes effective, as KRRC contemplates a design-build contract structure. Insurance for the actual removal activities may not be in place until removal work is ready to commence.

2.2.3 Corporate Insurance Program

KRRC intends its Corporate Insurance Program to address KRRC's general risks as a business entity and includes the following:

- $1,000,000 Commercial General Liability policy which is supplemented by a $5,000,000 Umbrella policy
- $10,000,000 Directors and Officers policy that protects the KRRC's board members
- Worker's Compensation and Employer's Liability policy with a $1,000,000 limit for the KRRC employee(s)
- Commercial Automobile policy with $1,000,000 in limits
- Commercial Property policy that covers the KRRC's scheduled property

KRRC's liability insurance policies name PacifiCorp, the State of Oregon, the State of California, and their respective officers, agents, employees, and members as additional insureds in accordance with the requirements of the Amended KHSA. Certificates of insurance evidencing that policies of insurance providing such provisions, coverages, and limits as set forth above are included as Appendix B.

2.2.4 Project Insurance Program

The Project Insurance Program will be an "owner controlled insurance program" or OCIP for purposes of securing certain project coverages. Under an OCIP, the owner establishes a Commercial General Liability and Umbrella insurance program in which contractors and subcontractors enroll for coverage, rather than requiring each contractor or subcontractor to procure insurance independently. The net result is a more comprehensive, seamless and efficient insurance program which precludes insurers from denying coverage based on a claim that a different insurer is responsible. By consolidating the risks into a single insurance program, this approach best removes cross-litigation costs caused by multi-party losses on a construction project. This is because the same policy essentially covers each contractor and subcontractor.

An OCIP also allows the project sponsor/owner to control and design the coverage it intends to procure and the cost of coverage. Specific decisions regarding which policies to purchase, when to purchase them, and what insurance limits to obtain are largely driven by the timing and structure of the dam removal. That said, KRRC sets forth below the current expectations regarding its project-specific insurance program.

While KRRC will base the final project-specific insurance requirements on KRRC's discussions with potential insurers and the development of the dam removal contractor RFP, KRRC expects to secure the following project-specific coverages:

- Commercial General Liability (CGL): KRRC will obtain primary Commercial General Liability coverage with limits of $2,000,000 per occurrence and $4,000,000 general aggregate. This policy will be dedicated to this Project. The policy will extend liability coverage to the dam removal contractor and all eligible subcontractors for their work at this Project. The policy will also respond to third-party damage from the construction activity after the Project. This tail coverage will last for ten years or to the statute of repose for the respective state of construction operations. This tail coverage will trigger once the Project has reached substantial completion.
- Umbrella Liability: The OCIP by an Umbrella Liability policy of $200,000,000 in limits will augment the liability coverage provided by KRRC's CGL policy. This policy will follow the terms and conditions of the underlying primary CGL. This Umbrella limit will cover all enrolled parties, which is an added value for smaller subcontractors that cannot afford such high limits.
- Worker's Compensation/Employer's Liability: KRRC will require that all contractors and subcontractors maintain at all times Worker's Compensation and Employer's Liability coverage. This coverage will be maintained in the amounts no less than the applicable statutory requirements for Worker's Compensation and $1,000,000 for Employer's Liability. Because this coverage is statutory, it is not efficient to include it in the OCIP, which each contractor and subcontractor will procure directly.
- Commercial Automobile Liability: KRRC will require that all contractors and subcontractors maintain auto liability insurance limits no less than $1,000,000 combined single limit per accident for bodily injury and property damage. This coverage will also be outside the OCIP and KRRC's contractors and subcontractors will procure it directly to cover all owned, leased and non-owned vehicles used in connection with the work.
- Builder's Risk/Inland Marine or Commercial Property Insurance: Builder's risk insurance is a type of insurance typically associated with vertical construction where an improvement is increasing in value and where the cost of restoration increases as the Project progresses, such as the construction of an office building. In procuring it for a dam removal project, a slightly unconventional analysis will apply to determining prudent limits of coverage. KRRC anticipates obtaining coverage for 100% of the replacement value of any salvaged material or property. KRRC will purchase builder's risk as a project-specific property coverage.
- Contractor's Pollution Liability (CPL): KRRC anticipates that coverage of up to $100,000,000 limits will be included as part of the project program. It will be a dedicated policy covering all contractors and subcontractors at the project site with no enrollment process.
- Fixed Site Pollution Liability: KRRC will acquire this coverage outside the OCIP and will go into effect when KRRC acquires title to the dam facilities and will be in an amount up to $100,000,000. It is the intent to underwrite this policy with the same insurers and in conjunction as the CPL policy to address any pre-existing environmental damages.

- Professional Liability/Errors and Omissions Insurance: This coverage will be required under the terms of KRRC's design contract procurement, whether on a stand- alone basis or as part of a design-build procurement. It will go into effect when KRRC retains the design professional. KRRC expects the coverage limits to be up to $25,000,000. In addition, KRRC will consider whether to purchase an Owner's Protective Professional Indemnity (OPPI) insurance policy as a back-stop to all the design professional's' liability available limits coverage. KRRC will make this decision based on the size, experience and financial strength of the selected design team and their respective insurance limits available to the Project. Coverage limits selected may be as high as 20-40% of the value of construction.

These policies name PacifiCorp, the State of Oregon, the State of California, and their respective officers, agents, employees, and members as additional insureds in accordance with the requirements of the KHSA. KRRC will provide certificates of insurance evidencing that policies of insurance providing such provisions, coverages, and limits as set forth above to PacifiCorp and the States before any contract for dam removal is effective and before dam removal work begins.

2.2.5 Independent Board of Consultants

The Board of Consultants (BOC) will review the forgoing insurance coverages. The BOC includes a member or members with expertise in insurance coverage and bonding for large and complex civil construction projects. KRRC will implement any further recommendations that the BOC may provide with respect to the foregoing insurance coverage.

2.2.6 Ongoing Evaluation

KRRC and Willis will review all policies of insurance on a not-less-than-annual basis to make sure that they are sufficient and cost effective relative to other insurance products and risk management tools as may subsequently become available.

2.3 Bonds

2.3.1 Requirements and Timing

Appendix L to the Amended KHSA addresses bonding requirements. Bond requirements include bid bonds, performance bonds (in an amount equivalent to original contract value) and payment bonds (in an amount equivalent to original contract value). These bonds will be secured in connection with awarding contracts to undertake decommissioning activities. One or more of KRRC's vendors and contractors will maintain these bonds (and/or parent company guaranty or standby letter of credit). KRRC will require that all bonds be obtained from financially sound surety companies.

2.3.2 Performance Bond

The performance bond securing the contractor's performance under the dam removal contract will be in the full amount of the dam removal contract. The contractor's surety company issuing the bond will determine the form of bond: however, AIA Form 312 is the predominant form in use at this time. To the extent alternate forms are used, they will be substantively similar.

2.3.3 Independent Board of Consultants

The BOC will review and approve its proposed bonding requirements. KRRC will implement any further recommendations that the BOC may provide with respect to bonding requirements. Because the performance bond backstops the dam removal contractor's performance, it cannot be issued until the dam removal contract is in place and will be issued at that time.

2.3.4 Ongoing Evaluation

As with insurance, KRRC and Willis will periodically review the amount and form of bonds (and/or parent company guaranty or standby letter of credit) to make sure that they are sufficient and cost effective relative to other products and risk management tools as may subsequently become available.

2.4 Specialty Corporate Indemnitor

2.4.1 Overview

Appendix L to the KHSA requires KRRC to identify and contract with a specialty corporate indemnitor (a Liability Transfer Corporation, or LTC) to protect the states of Oregon, California and PacifiCorp from potential liability that may be uninsurable or underinsured. KRRC will fulfill this requirement in consultation with the States and PacifiCorp and in connection with the design and implementation of the insurance program discussed above. KRRC will use this risk management tool to address certain risks not covered by KRRC's insurance Program. Parameters established by the KHSA to assess the sufficiency of a corporate indemnitor include:

- Appropriate capitalization (as agreed to by the States and PacifiCorp)
- Performance in projects of similar scope, magnitude, complexity and type
- Experience with federally regulated permitting processes
- Longevity in the industry

This requirement will be fulfilled in connection with the selection of the design-build contractor hired to implement the Definite Plan.

2.4.2 Structure and Timing

The LTC can be structured contractually, through third-party indemnities or potentially with additional special insurance products. The LTC may perform portions of the Project and will assume responsibility for various project risks, both during project execution and post-project (including the fulfillment of any long-term mitigation obligations established by the Definite Plan or regulatory approvals). The "gap" between the general responsibilities to be assumed by the general contractor and the program of required insurance has yet to be determined. Defining and filling this gap is an ongoing process, as KRRC seeks to better define construction costs, measures to lower construction costs, and measures to manage construction risk. KRRC expects to fulfill this requirement concurrently with the execution of the contract for dam removal.

2.4.3 Independent Board of Consultants

The BOC will review the potential and appropriate risks that may be transferred to a LTC. KRRC anticipates obtaining BOC guidance on this risk management tool concurrently with its efforts to identify a proposed contractor and negotiate a progressive design-build contract with a guaranteed maximum construction price. KRRC's final decision on how best to use this risk management tool is, however, subject to the approval of the states of Oregon, California and PacifiCorp, in consultation with the Federal Parties, whose approval may not be unreasonably withheld.

Chapter 3: Project Delivery Method

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3. PROJECT DELIVERY METHOD

3.1 Overview of Progressive Design-Build Delivery Method

KRRC is pursuing a competitive process for selecting its dam removal contractor, or design-builder. KRRC contemplates structuring the dam removal contract as a progressive design-build contract under which, after selection, the designated design-builder will then spend six to nine months studying the project area and designing its removal program before the final guaranteed maximum price is locked in. KRRC expects this design process to begin in the first quarter of 2019. When KRRC finalizes the cost of the dam removal work under the contract through the negotiation of a guaranteed maximum price, the circumstances that most often lead to cost overruns for which the owner remains responsible - unknown site conditions – while not eliminated will have been significantly narrowed even beyond where it is today. As a result, final pricing will be determined prior to KRRC's acceptance of the project license.

The progressive design-build contract KRRC expects to enter into will provide that one overall contractor will complete both design and deconstruction on an integrated basis and will assure that, absent contractually defined uncontrollable circumstances, the work will be performed with minimal cost overruns. Thus, any project costs incurred within the defined work scope that are in excess of the guaranteed price will be the responsibility of the project contractor, not KRRC.

In addition to committing to a guaranteed maximum price, the project contractor will agree to complete the Project and perform the work to specified technical standards by a guaranteed completion date. Proposers will be required to include detailed proposals on their proposed means and methods of dam removal, consistent with regulatory requirements. Means and methods that offer greater promise of lessening potential liability or lowering costs can be scored higher in determining the proposal offering the best value. Daily liquidated damages will be payable to KRRC for unexcused delays, and KRRC will not be responsible for any cost overruns except those caused by predetermined risks that are outside the project contractor's ability to reasonably manage and control. A qualified construction-management entity will oversee the performance of the dam decommissioning and removal work under the project agreement.

This integrated project-delivery approach will be particularly useful for the Project because it will mitigate several elements of project-completion risk, in addition to the general price risk inherent in all construction projects. Integrated project delivery involves a self-selected team of highly qualified firms whose business interests are aligned, thus decreasing the risk of disputes among team members. By addressing multiple aspects of the work in a single contract, integrated project delivery also has the key advantage of creating one point of accountability for the Project, allowing KRRC to bring a claim against a single entity for any flawed work. Furthermore, considering that dam removal is a specialized area, integrated project delivery gives the prequalified entity the opportunity to make an innovative and cost-effective proposal to execute the work. Additional benefits of integrated project delivery include accelerated project delivery and improved project quality.

3.2 Risk Transfer

Risks transferred to the project contractor under the project agreement will include the risk of unexcused delays; unexpected work that the project contractor needs to perform to carry out the basic work scope; unavailability of materials; non-compliance with the decommissioning plan, applicable law and governmental approvals; intellectual property infringement; and the risk of exacerbating any existing hazardous substances or other pollution conditions. These risks are regarded in the industry as within the control of the project contractor team and are generally assumed contractually by the contractor without adding a risk premium to the contract price. KRRC will retain the risk of any delays caused by (i) uncontrollable circumstances (such as changes in law, force majeure, the discovery of cultural relics, and dam conditions unknown at the time the contract is entered into); (ii) any work scope changes directed by KRRC; and (iii) the inaccuracy of any information provided by KRRC to the project contractor that formed the basis of the decommissioning plan and that could not reasonably be verified by the project contractor.

3.3 Retained Risk; Project Contingency

If accurate information is supplied to the project contractor, no scope changes are requested by KRRC after contract execution, and no uncontrollable circumstances occur, the project contractor will be obligated to complete the Project for the guaranteed maximum price (which is based on competitively bid elements of the construction work) established at contract signing. On the other hand, if any of the risks retained by KRRC occur, KRRC as the project owner will bear the costs. Accordingly, the project budget will include an appropriate contingency reserve for any such risks, and KRRC will use insurance and other mechanisms to manage these risks.

Section 2.6 of Appendix P of the Definite Plan discusses contingency reserves, based on updated construction costs and are summarized here. A design contingency was set at 10% of the construction cost, which is a typical value for a level of design presented in the Definite Plan. In addition, KRRC used a value of 20% of the construction cost for construction contingencies for the dam removal estimates, which is a typical value for this stage of project development. KRRC applied the design and construction contingencies (total of 30%) as a percentage of construction cost and added to the overall estimate of project costs. Based upon current project cost estimates, KRRC applied design and construction contingencies of approximately $58 million and $68 million to the partial removal and full removal alternative estimates of project cost, respectively.

3.4 Contractor Selection Process

KRRC will choose the project contractor using a two-stage qualifications-based-selection (QBS) process. The first stage will involve a request for qualifications (RFQ), and the second stage will involve a request for proposals (RFP). QBS standards during the RFQ will include:

- Past performance of similar projects in scope, magnitude (complexity and size, such as but not limited to performance of work at multiple locations at the same time), and type (waterway work; environmentally regulated, etc.)
- Sufficient financial strength, including basic financial metrics such as corporate net worth and profitability
- Experience with federally regulated permitting processes
- Longevity in industry.

KRRC will invite three or four pre-qualified firms to make project submittals on a competitive proposal basis in response to a RFP issued by KRRC. KRRC will set forth the requirements for making project proposals in the RFP and will base them on the terms of the Definite Plan. KRRC will select the proposer submitting the best value proposal (best overall price and technical merit) to perform the work and enter into a comprehensive project agreement with KRRC. The states of California and Oregon and PacifiCorp will have the opportunity to review and comment on the selection process and resulting project agreement to assure that their interests are protected and that the project work will be properly carried out. KRRC may divide the work into two or three segments, contracted separately, as determined by KRRC to be in its best interests.

3.5 Performance Security; Indemnities

Section 2.3 addresses performance security and indemnities. The project contractor will furnish a conventional performance bond from a financially sound surety company, further assuring KRRC that the contractor will perform the project agreement as required. As an alternative, or in addition to a performance bond, KRRC may also ask the project contractor to provide a parent company guaranty or to furnish a standby letter of credit securing performance of the project agreement. KRRC will have the right to call upon any such guaranty or to draw on any such letter of credit if a project contractor fails to perform and use the proceeds to pay any non-performance damages it is owed under the project agreement. The project contractor will also indemnify KRRC for any loss or expense incurred by third parties resulting from an unexcused breach of the contract or any negligence or willful misconduct by the contractor. Each party, as is conventional in contracts of this nature, will waive the right to make a claim for punitive or consequential damages.

3.6 Construction Management

A qualified construction-management entity will provide oversight of the project contractor, including detailed design review and full construction-management services throughout the duration of the project agreement. The construction manager will participate in the contractor's design development meetings and will review all final design documents developed by the contractor. KRRC anticipates detailed reviews at the 60%, 90% and 100% completion levels, as well as review of final Construction Documents (plans, specifications, design report and cost estimate). The construction manager will be involved in recurring activities such as progress meetings, pay estimates, weekly progress reporting, and schedule updates. These recurring activities are the basic machinery for transferring information, making decisions, and identifying potential risks during construction. The construction manager will meet weekly with the contractor to review the current status of completed work onsite. The contractor will prepare and KRRC will review and approve a written safety plan that the selected contractor would be required to follow, thus providing a uniform approach toward project safety.

3.7 Independent Board of Consultants

The BOC will review project documents as well as dam removal schedules, plans and specifications, staging sequence, and supporting engineering studies. KRRC will incorporate any recommendations with respect to the proposed project delivery method into its project documents, contractor selection process, and project management procedures.

Chapter 4: Design & Construction Risk Register

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4. DESIGN & CONSTRUCTION RISK REGISTER

4.1 Overview

This Section identifies construction risks (in the form of a risk register) and estimates their likelihood and consequences of occurrence, ranking those risks to determine which pose the greatest risk to the Project, and developing risk management strategies for the highest ranking risks. The risk register will be a living document prepared with the participation of the full project team (KRRC, consultants, stakeholders, etc.) eventually including the Design-Builder (DB) or Contractor. This draft plan is based on the Project as it has been described and developed in the Federal Energy Regulatory Commission (FERC) Definite Plan for Decommissioning (KRRC 2018) (Definite Plan).

The plan will be updated periodically by the full project team to add newly identified risks, and adjust risks that have been previously identified either upward or downward.

The risk register identifies design and construction risks as they are recognized throughout the duration of the Project. KRRC has assigned each identified risk its own unique Risk identification (ID) number and categorized into one of seven risk categories, which are described in further detail in Section 4.2. Risk ID numbers are not necessarily sequential, since they were derived from an initial broader list that may not have all moved forward. The register also includes specific information and data associated with each risk as follows:

- A description of the risk
- The root cause(s) of the risk
- The risk's relationship to the four phases of the Project
- The primary impact aspect of the risk
- The likelihood (probability) that the risk will occur
- A rating of the impact or consequence if the risk event occurred
- A risk score (rating) by combining the likelihood and related consequence
- A summary of risk management measures
- The assigned owner of the risk

As the risk register is further developed and implemented, responsible parties from the Owner and DB will be assigned to further define and implement risk management measures identified for each risk. As risks are avoided or mitigated, or as new relevant information is obtained, risk category, score and rating will be updated to reflect the latest information.

Since the risk register will evolve and KRRC will update it throughout the life of the Project, ongoing assessment and reporting will be necessary. Reporting and other continuing risk management activities are discussed in Section 4.8.

4.2 Risk Category

KRRC has categorized each risk into one of the following general categories:

1. Environmental – These are design and construction risks primarily related to environmental aspects of the Project. Environmental aspects and associated risks could involve existing or future biological, cultural or other environmental conditions/species, potential construction related effects such as air quality or noise, or potential downstream environmental effects.
2. Permitting – Risks that are primarily related to environmental compliance and permitting. This includes process-related considerations, requirements associated with compliance and acquisition of all necessary regulatory permits.
3. Design – These are risks primarily related to development of the project design and subsequent performance of associated Project features. Risks could involve performance failures as a result of incorrect assumptions or calculations, incomplete or inaccurate drawings and specifications, etc.
4. Procurement and Construction - Risks primarily related to the procurement of a DB or Contractor, and with actual construction of the Project including labor, equipment, material, existing conditions, subsurface conditions, site safety, etc. Procurement related risks could involve the procurement process and/or contract negotiation. Construction related risks could involve DB quality of work or production, as well as health and safety.
5. Operations and Maintenance - Risks primarily related to post-construction project performance and maintenance. The project team anticipates minimal long-term operations and maintenance requirements.
6. External - These are risks primarily related to events or conditions outside of the control of the Project, such as unforeseen site conditions, forces of nature (e.g. floods and wildfires), etc.
7. Organizational - These are risks primarily related to the project organization, governance and associated constraints such as financing/funding, access agreements, funding agreements, transfer agreements, etc.

4.3 Phases

Each identified risk will exist during particular phases of the Project. The Project phases include the following:

1. Planning: The period until KRRC selects a DB for implementation. Activities during the Planning phase include data collection, preliminary field investigations, preliminary design, permitting and regulatory consultation and application development, contract work packaging to define the

intended scopes of work to most efficiently achieve the project schedule and other project objectives, selection of the appropriate project delivery method for each contract work package, and procurement activities for selecting a DB for each work package. Such procurement activities will involve, depending on delivery method, development and preparation of the Requests for Qualifications and Proposals for a DB, evaluation of proposals, and negotiation of the associated contracts.

2. Design: Design is the period during which the detailed and final design of the Project is performed. Activities during this phase include field investigations for final design, final design, permitting activities, and regulatory review and approval of the final design documents.
3. Construction: The period during which construction activities to implement the final design actually take place. Activities during the Construction Phase include mobilization, preparation of the site, pre-reservoir drawdown construction activities, other early construction activities, dam and appurtenances demolition activities, followed by site restoration.
4. Post-Construction: The period following dam removal and site restoration.

The risk register shows each risk in relation to the four phases (see Figure 4.3-1 for example). Phases during which the risk could be realized are indicated by red, and earlier phases during which risk mitigation can be developed and implemented are indicated by yellow.

Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase
19	Proc & Const	Construction	General changed field condition (geotechnical, existing utilities, hazardous materials, and biological resources) leads to redesign, project delays and/or cost overruns	Field condition differs from documented findings	M	M	A	
20	External	Construction	Wetter-than-expected weather during construction increases costs and causes delays	Climate change; Hydrology	M	M	A	

Note: M = period when management strategies are developed; A = period when risk may be actualized

Figure 4.3-1 Risk Register Phases Designation Example

4.4 Primary Aspect of Risk

For additional classification and subsequent data processing, KRRC categorized each identified risk as one of four primary risk aspects as follows:

1. Time: The consequence of the risk is greatest with respect to the project schedule.

2. Cost: The consequence of the risk is greatest with respect to the project budget.
3. Safety: The consequence of the risk is greatest with respect to the safety of workers and the public.
4. Environmental Impact: The consequence of the risk is greatest with respect to the environment.

Any risk will include more than one of the four aspects. The categorization by aspect is a tool to help assess the risk in these four different areas.

4.5 Risk Score and Rating

The risk score and rating is a function of the probability of the risk occurring and the consequence if the risk were to occur. Probability of occurrence is broken into five different categories to provide sufficient ranges of likelihood, as listed below:

- Probability Score of 5: Risk has a 60% or greater probability of occurrence, meaning it is very likely to occur
- Probability Score of 4: Risk has a 40 to 59% probability of occurrence, meaning it is likely to occur
- Probability Score of 3: Risk has a 20 to 39% probability of occurrence, meaning it is less likely to occur
- Probability Score of 2: Risk has a 10 to 19% probability of occurrence, meaning it is unlikely to occur
- Probability Score of 1: Risk has a less than 10% probability of occurrence, meaning it is very unlikely to occur

Consequence of the risk occurring is also broken into five different categories to provide sufficient ranges for the consequences of impact. Since impacts for various risks can apply to one or more aspects or categories, it can be difficult to quantify all risks using the same metric (e.g. cost increase in $, etc.). For that reason, engineering and management judgment is involved when assigning consequence of impact scores. A high level of coordination and collaboration among key project decision makers is necessary for assigning consequence of impact scores. Table 4.5-1 provides some general guidance on consequence of impact scores under aspect categories identified in Section 4.4.

The risk score is calculated by multiplying the probability of risk by the consequence of impact, and then categorizing or rating the risk as low, moderate, or high as shown on the risk score matrix in Table 4.5-2. As shown in the risk score matrix, any risk that has a consequence of impact score of 5 is categorized as a very high risk.

Table 4.5-1 Consequence of Impact Definition for Various Aspects

	CONSEQUENCE OF IMPACT				
PRIMARY ASPECT	Very Low (1)	Low (2)	Moderate (3)	High (4)	Very High (5)
Time	No or little impact to schedule	Schedule delay of less than 3 months	Schedule delay of 3 to <6 months	Schedule delay of 6 to 12 months	Schedule delay of more than 12 months
Cost	<$1M	$1M-$5M	$5M-$10M	$10M-$30M	$30M-50M
Safety	No or little impact to public safety	Number of individuals exposed to minor safety risk less than 5	Number of individuals exposed to minor safety risk greater than 5	Number of individuals exposed to serious safety risk less than 5	Number of individuals exposed to serious safety risk more than 5, or any life threatening risk (1 or more)
Environmental Impact	No significant impact to any environmental resource	Short-term impact that is insignificant	Short-term impact that is significant. Long-term impact that is insignificant.	Long-term significant impact to non-listed species	Long-term significant impact to fisheries or listed species

Table 4.5-2 Risk Score and Ranking Matrix

Probability of Occurrence	5 (60-100%)	5	10	15	20	25
	4 (40-59%)	4	8	12	16	20
	3 (20-39%)	3	6	9	12	15
	2 (10-19%)	2	4	6	8	10
	1 (1-9%)	1	2	3	4	5
		1	2	3	4	5
		Consequence of Impact				

4.6 Risk Status

As the Project develops and is implemented, the status of identified risks will be assigned using the following codes:

1. Open: risks that continue to pose a threat for the Project. These are risks that may or may not have occurred that will not expire until some future date
2. Managed: risks which have had risk management measures implemented such that the likelihood of occurrence or consequences of occurrence has been reduced to a level that the Project can accept in the event the risk occurs
3. Expired: risks that may, or may not, have occurred but no longer pose a threat to the Project. When a risk expires, the probability becomes zero thereby making the risk score zero

4.7 Risk Strategy

During development and implementation of the Project, KRRC will assign the risk strategy to identified risks using the following codes:

1. Manage: Risk management seeks to reduce the likelihood of the risk occurring and/or the consequence of the risk, should it occur.
2. Avoid: Avoidance of the risk eliminates the likelihood of the risk occurring and/or the consequence of the risk, should it occur.
3. Transfer: Transference of the risk makes the risk either partially or completely another party's responsibility.
4. Accept: Acceptance recognizes that the risk cannot be fully managed, avoided, or transferred.
5. Shared: Shared risk means that the liability associated with the risk can be partially transferred (as described above), but certain aspects of the risk remain with the KRRC and will need to be managed, avoided or accepted.

4.8 Continuing Risk Management

As mentioned above, KRRC will update the risk register throughout the life of the Project, involving ongoing assessment and reporting. The project team will manage and track the risk register through all phases of the Project.

Once KRRC selects a DB, they will be required to develop their own risk register, which will focus solely on the design and construction phases of the Project.

4.8.1 Risk Workshops

Subsequent to the initial identification of risks, KRRC will conduct a series of risk workshops at strategic points throughout the Project duration. The goal of these risk workshops will be to further update and refine risks, conduct evaluations and explore mitigation opportunities, while engaging new partners in the Project and the risk management process. Possible times for subsequent risk workshops may include:

- After the CEQA Draft Environmental Impact Report public review period ends
- After the Board of Consultants 2018 review of the Definite Plan is complete
- Upon engagement of Progressive Design-Builder for design work
- After key permits are issued (e.g. FERC Surrender order)
- Prior to first commencement of significant construction activities
- Midpoint of construction, or prior to significant phase(s) of construction

4.8.2 Monitoring and Control

During each risk management meeting, the attendees will review status, risk score and risk management opportunities for all risks active in the current project phase. Output of the risk management meeting shall be an updated risk register for distribution.

Responsibilities for meeting facilitation and reporting are as follows:

Phase	Responsible	Draft to PM	Final Version
Planning	Owner's Project Manager	-	✓
Design	DB/CMAR Project Manager	✓	-
	Owner's Project Manager	-	✓
Construction	DB/CMAR Project Manager	✓	-
	Owner's Project Manager	-	✓

Project monthly progress reports will include a list of open risks, the status of associated risk management actions, and any changes to action completion dates. A narrative will explain any significant exceptions to risk management action completion dates. KRRC will report any new risks.

KRRC will not delete expired risks (i.e. those that have occurred but no longer pose a threat to the Project) – these will remain on the risk register as closed items, or they will be transferred to a register of expired risks for record purposes.

Planning & Design Phases

At a minimum, KRRC will complete quarterly updates throughout the planning phase, with more frequent updates likely required during the detailed design and construction phases.

Construction Phase

KRRC will hold routine risk management meetings at least once every two months. The owners assigned to risks in the current project phase will attend these meetings.

4.8.3 Closing Risk Registers and Lessons Learned

Closing risk registers involves documenting all managed risks and final impacts on the overall Project. Impacts include, but are not limited to, impacts on project costs and schedule. KRRC will similarly document monitored but unmitigated risks. This information will be available for use on future projects, and can be used to adjust severity and probability indices, better define risk tolerance levels and improve risk management efforts.

The PM will prepare a Lessons Learned Report when the risk register is closed. The primary focus will be to identify activities which were highly effective, effective, partially effective, or not effective, and to recommend ways to improve overall effectiveness for risk management activities.

4.9 Risk Register

The current risk register is included as Appendix A. Each risk is categorized by project phase, and the root cause of each such risk is identified. The risk register identifies the primary aspects of each such risk, as well as probability, impact and weight, and provides an overall ranking for each risk. The risk register identifies a strategy for managing each risk, and risk management measures, where appropriate. Finally, the risk register identifies the risk owner and the status of each risk. As noted above, the risk register will evolve and be updated throughout the life of the Project, involving ongoing assessment and reporting.

Chapter 5: References

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5. REFERENCES

KRRC 2018. Definite Plan for the Lower Klamath Project, Klamath River Renewal Corporation. June 2018.

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Attachment A Risk Register

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Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase	Primary Aspect of Risk	Probability (P)	Impact (I)	Risk Weight (P x I)	Overall Rating	Strategy	Risk Management Measure	Risk Owner	Risk Status
11	Proc & Const	Planning	Bid process or result (if traditional DB) or RFP selection (if progressive DB) is protested	DB(s) not selected protest bid	A				Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Manage	Develop fair bid evaluation process that is clearly defined in RFP; Consider bid preparation stipend: Clearly define bid protest process in RFP.	Owner	Open
12	Proc & Const	Planning	Procurement process fails to result in a contract	Negotiation of contract terms or price fails	A				Time	1 Very Unlikely (1-9%)	3 Moderate	3	Low	Manage	Use prequalification process that values similar experience in reaching cost agreements; Develop fair bid evaluation process that is clearly defined in RFP.	Owner	Open
16	Organizational	Design	Engineer's estimate lower than GMP for PDB or low bids for traditional DBB on smaller work packages	Project perceived as risky; Lack of competition	M	A			Cost	3 Less Likely (20-39%)	4 High	12	Med	Manage	Robust Engineer's estimate to include Monte Carlo analyses; Independent review of Engineer's estimate, Include adequate contingency for project risk; Utilize project delivery method that provides Contractor's progress cost estimates to control budget (PDB or CMAR). Close coordination and transparency on costs and associated assumptions during progress cost estimated prepared by DB or CMAR; Provide contract exit strategy that Owner can terminate for convenience and implement alternate delivery approaches.	Owner	Open
17	Proc & Const	Design	DB Designer/Contractor dispute leads to schedule delays and cost increases	Designer does not have sufficient budget or 'skin in the game'.	M	A	A		Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Manage	Consider contractual measures to maximize design/contractor collaboration such as require Designer to be a partner rather than a subcontractor and provisions that oblige Contractor to continue work even when dispute arises.	PDB	Open
18	Proc & Const	Design	Failure to agree to GMP during detailed design (if PDB or CMAR delivery method)	Disconnect between DB and Owner		A			Time	2 Unlikely (10-19%)	4 High	8	Med	Share	Robust Engineer's estimate to include Monte Carlo analyses; Independent review of Engineer's estimate, Include adequate contingency for project risk; Utilize project delivery method that provides Contractor's progress cost estimates to control budget (PDB or CMAR). Close coordination and transparency on costs and associated assumptions during progress cost estimated prepared by DB or CMAR; Provide contract exit strategy that Owner can terminate for convenience and implement alternate delivery approaches.	Owner / PDB	Open
19	Proc & Const	Construction	General changed field condition (geotechnical, existing utilities, hazardous materials, and biological resources) leads to redesign, project delays and/or cost overruns	Field condition differs from documented findings	M	M	A		Time	3 Less Likely (20-39%)	3 Moderate	9	Med	Manage	Comprehensive field investigation and documentation.	Owner	Open
20	External	Construction	Wetter-than-expected weather during construction increases costs and causes delays	Climate change; Hydrology	M	M	A		Time	2 Unlikely (10-19%)	4 High	8	Med	Accept	Consider defining anticipated rain days in contract as a number greater than average; Contract requirement for contractor plan for wetter-than-expected weather.	Owner / Force Majeure	Open
21	External	Construction	Flows higher than expected during instream construction window leads to schedule delays	Unanticipated river flows	M	M	A		Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Accept	Rigorous flow analyses during planning/design; Set performance requirement in contract (define return period of flow that contractor required to be prepared for).	Owner / Force Majeure	Open
22	External	Construction	Fire in watershed increases erosion and sediment	Lightning; Accidental; Arson; Combined with storm		M	A	A	Cost	2 Unlikely (10-19%)	3 Moderate	6	Med	Accept	Fire Management Plan has been developed and Contractor will be required to prepare their own Fire Management Plan.	Owner / Force Majeure	Open
23	External	Construction	Fire in watershed during construction causes construction delays	Lightning; Accidental; Arson; combined with storm		M	A		Time	3 Less Likely (20-39%)	4 High	12	Med	Accept	Develop and implement emergency response plan for fire management.	Owner / Force Majeure	Open
24	External	Construction	Earthquake damages temporary construction	Earthquake occurs near project	M	M	A		Cost	1 Very Unlikely (1-9%)	2 Low	2	Low	Accept	Consider specifying a contract defined design earthquake for temporary construction.	Owner	Open
25	Design	Construction	Design errors or omissions lead to Project delays or cost overruns	Design error.		M	A		Cost	3 Less Likely (20-39%)	2 Low	6	Med	Transfer	Comprehensive design review; proactive QA/QC.	Owner's Eng	Open
26	Proc & Const	Construction	Construction errors (quality control)	EOR fails to properly inspect or direct work in the field; QC failures	M		A		Cost	3 Less Likely (20-39%)	3 Moderate	9	Med	Transfer	Clear contract requirements; Owner review and enforcement of Contractor QA/QC Plan and rigorous Owner audit and spot testing to confirm results	PDB	Open
27	Proc & Const	Construction	DB unable to obtain construction permits (e.g. County encroachment permits) in time for construction	Poor planning, insufficient communication, difficulty negotiating requirements		M	A		Time	2 Unlikely (10-19%)	4 High	8	Med	Share	Owner coordination with Contractor for proactive communication with Counties; Contingency planning for delayed start during first year of construction	PDB	Open
29	External	Construction	Quantity overruns on earthwork, concrete demolition, etc.	Existing as-built data, exploratory data not adequate or accurate	M	M	A		Time	3 Less Likely (20-39%)	2 Low	6	Med	Accept	Obtain new topographic and bathymetric data for use by Designer and Contractor; Rigorous QA by Owner on design calculations and assumptions related to earthwork volumes	Owner	Open

Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase	Primary Aspect of Risk	Probability (P)	Impact (I)	Risk Weight (P x I)	Overall Rating	Strategy	Risk Management Measure	Risk Owner	Risk Status
31	Proc & Const	Construction	Public safety at construction site	Public safety measures insufficient to keep out public	M		A		Public Safety	1 Very Unlikely (1-9%)	5 Very High	5	High	Share	Development of appropriate health and safety qualifications, experience and other requirements during the procurement process, as well as active overview and enforcement of the Contractor's health and safety and site security plans. No public access to work areas.	Owner's Eng / PDB	Open
32	Design	Construction	Copco lake reservoir rim or local slope failure along access roads	Slope instability, inadequate access road condition assessment prior to construction. Design analyses unable to be made for all geologic conditions and slope geometries; insufficient data		M	A		Time	2 Unlikely (10-19%)	4 High	8	Med	Share	Comprehensive field investigation and design review; Develop plan to address slope failures along Copco Road if they were to occur during reservoir drawdown.	Owner / PDB	Open
33	Design	Construction	Failure of temporary cofferdams result in demolition delays	Conservative design of cofferdams; unanticipated foundation conditions		M	A		Time	2 Unlikely (10-19%)	2 Low	4	Low	Transfer	Comprehensive field investigation, review of original construction, and design review	PDB	Open
34	Design	Construction	Dam or similar structure fails during drawdown	Failure mode not investigated or analyzed properly		M	A		Public Safety	1 Very Unlikely (1-9%)	5 Very High	5	High	Transfer	Rigorous detailed design analysis surrounding dam safety during drawdown; Completion of the FERC Potential Failure Modes Analysis process; Close coordination with the FERC regional office and state dam safety authorities; Implement FERC Emergency Action Plan, as appropriate.	PDB	Open
35	Env	Construction	Release of hazardous material (other than from construction equipment) to river during construction	Contractor activities result in unanticipated release of hazardous material into river	M	M	A		Envir Impact	1 Very Unlikely (1-9%)	5 Very High	5	High	Transfer	Completion of the Phase 1 hazardous material assessments and follow-up evaluations, appropriate health and safety qualifications, experience and other requirements during the procurement process, implementation of BMPs to avoid or contain the release of hazardous material, as well as active overview and enforcement of the Contractor's Hazardous Material Management Plan.	PDB	Open
36	Design	Construction	Reservoir sediment more difficult to access than anticipated, causing construction delays (restoration)	Lack of material properties understanding	M	M	A		Cost	2 Unlikely (10-19%)	2 Low	4	Low	Share	Comprehensive investigation and testing during planning and detailed design phase (with DB or Contractor input).	Owner / PDB	Open
37	Env	Construction	Special-status species presence delays construction	Unanticipated species found onsite cause stop work	M	M	A		Envir Impact	2 Unlikely (10-19%)	4 High	8	Med	Manage	Pre-construction surveys; Design planning; Require work areas to be cleared prior to nesting season; Proactive surveys for nesting activity during nesting season; Proactive nesting mitigation measures during nesting season.	Owner / PDB	Open
38	Env	Construction	Bald and Golden Eagle present within restriction buffer that delays construction	Did not identify birds prior to construction	M	M	A		Time	2 Unlikely (10-19%)	4 High	8	Med	Transfer	Additional surveys to identify nest locations in the years leading up to construction; Implementation of the avoidance and minimization measures identified in the Definite Plan; Effective transfer of risk through Contract terms to Design-Builder.	PDB	Open
39	Env	Construction	Loss of significant freshwater mussels in 1st year of demolition	Suspended sediment and bedload movement.			A		Envir Impact	3 Less Likely (20-39%)	3 Moderate	9	Med	Manage	Obtain latest research on relocation techniques and bring in industry experts during detailed design; Implement risk management measures.	Owner / Force Majeure	Open
40	Permit	Construction	Construction mitigation permit requirements not satisfied	Limited environmental mitigation measures available do not meet time and budget constraints		M	A		Envir Impact	3 Less Likely (20-39%)	3 Moderate	9	Med	Transfer	Coordination between Designer, Contractor, and permitting agencies; Satisfy permit requirements.	Owner / PDB	Open
41	Env	Construction	Unanticipated non-burial related cultural resources (foundations, barns, etc.) discovered during reservoir drawdown or construction (beyond current allowance)	Non-burial cultural resource not disclosed or already known about	M		A		Cost	2 Unlikely (10-19%)	2 Low	4	Low	Manage	Identification of existing cultural resources to the extent feasible; Ongoing coordination with Native American groups and local historical societies; Development of treatment measures that would implemented following drawdown or during construction	Owner / Force Majeure	Open
42	Env	Construction	Known cultural resource damaged during construction	Mitigation measures fail to protect resource	M		A		Cost	2 Unlikely (10-19%)	3 Moderate	6	Med	Manage	Identification of existing cultural resources to the extent feasible; Ongoing coordination with tribes and local historical societies to assess potential damage and identify measures.	PDB	Open
43	Env	Construction	Unanticipated human burial sites, human remains, or funerary items discovered within reservoir areas during reservoir drawdown - requiring cessation of construction activities for a long duration.	Burial site not disclosed or already known about	M		A		Time	2 Unlikely (10-19%)	4 High	8	Med	Manage	Identification of existing cultural resources to the extent feasible; Ongoing coordination with Native American groups and local historical societies; Development of an Inadvertent Discovery Plan, Monitoring Plan, and NAGPRA Plan of Action, and rapid response plan to address the possibility of burial sites becoming exposed during drawdown.	Owner / Force Majeure	Open

Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase	Primary Aspect of Risk	Probability (P)	Impact (I)	Risk Weight (P x I)	Overall Rating	Strategy	Risk Management Measure	Risk Owner	Risk Status
44	Env	Construction	Unanticipated human burial site discovered during other construction activities - requiring cessation of construction activities for a short time (beyond current allowance)	Burial site not disclosed or already known about	M	M	A		Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Manage	Identification of existing cultural resources to the extent feasible; Ongoing coordination with Native American groups and local historical societies; Development of an Inadvertent Discovery Plan, Monitoring Plan, and NAGPRA Plan of Action to address the possibility of burial sites being discovered during construction.	Owner / Force Majeure	Open
45	Proc & Const	Construction	Reservoir drawdown impacts water quality more severely than anticipated causing project regulatory shutdown	Permit conditions and/or inadequate modeling of water quality; duration of drawdown extends past March due to extreme weather	M	M	A		Envir Impact	2 Unlikely (10-19%)	4 High	8	Med	Accept	Perform comprehensive water quality studies prior to construction; Implement risk management measures needed to comply with water quality requirements.	Owner's Eng / PDB	Open
46	Design	Construction	Reservoir drawdown and subsequent operation results in greater than anticipated erosion at bridges or along channel creating passage barrier	Local hydrodynamics result in greater than modeled erosion or scour	M	M	A	A	Cost	2 Unlikely (10-19%)	2 Low	4	Low	Accept	Comprehensive design review; Design additional scour protection for bridges if determined to be needed; Develop monitoring and mitigation plan for during and post reservoir drawdown.	Owner's Eng	Open
47	Proc & Const	Construction	Reservoir dewatering and subsequent operations have greater than anticipated effects on diversion intakes for irrigation/livestock	Greater than predicted suspended sediment and bedload movement	M	M	A	A	Cost	3 Less Likely (20-39%)	2 Low	6	Med	Share	Comprehensive field investigation and design review; Develop plan for monitoring/mitigating intakes during reservoir drawdown.	Owner / PDB	Open
48	Design	Construction	Reservoir dewatering and subsequent operation has greater than anticipated effects on groundwater wells	Difficult to investigate and analyze groundwater relationships		M	A	A	Cost	2 Unlikely (10-19%)	2 Low	4	Low	Share	Comprehensive field investigation and design review; Implement Groundwater Well Management Plan for evaluating changes in groundwater post-reservoir drawdown and proactively mitigate impacted wells.	Owner / PDB	Open
49	Env	Construction	Reservoir dewatering and subsequent operations have greater than anticipated effect on downstream channel aggradation/flooding	Evacuated coarse sediment is greater than anticipated leading to increased channel aggradation and associated flooding		M	A	A	Cost	3 Less Likely (20-39%)	3 Moderate	9	Med	Accept	Rigorous assessment on transport and flooding during detailed design; Monitoring post-drawdown; Raise awareness that active channel management program needed; Implement measures to manage channel aggradation and flood risk.	Owner	Open
50	External	Construction	Public safety risk in downstream channel during reservoir drawdown	Outreach and public safety measures insufficient to keep out public creating potential risk to public safety during drawdown (increased flows)	M	M	A		Public Safety	1 Very Unlikely (1-9%)	5 Very High	5	High	Manage	Comprehensive education and outreach plan; Detailed review and QA of safety program; Development of a Reservoir Dewatering Awareness Plan that will include procedures for notifying public of the schedule and anticipated flows for reservoir drawdown.	Owner / PDB	Open
51	Design	Construction	Slope failure blocks river or diversion intake	Upstream shell material less pervious than assumed in design; error in rapid-drawdown slope stability analyses; design analyses unable to be made for all geologic conditions and slope geometries; insufficient data	M	M	A		Envir Impact	2 Unlikely (10-19%)	5 Very High	10	High	Share	Comprehensive field investigation and design review; Develop slope monitoring plan for implementation during drawdown; Stockpile riprap for repairs of slope if local failures occur.	Owner / PDB	Open
52	Proc & Const	Construction	Copco No. 1 and/or Iron Gate Dam large gate procurements delay gate installation resulting in delay of reservoir drawdown	Design error; scheduling error; manufacturer requires additional information; construction error		M	A		Time	2 Unlikely (10-19%)	4 High	8	Med	Manage	Early detailed design; Early involvement of the Contractor to initiate gate procurement activities including input from the gate fabricator; Contractual milestones with liquidated damages; Early Contractor input including planning underwater work to modify/demo the existing Iron Gate Dam gate structure.	PDB	Open
53	Proc & Const	Construction	Copco. No.1 and Iron Gate Dam tunnel modifications are more difficult to construct causing schedule and cost overruns	Changed site condition or design omission	M	M	A		Time	3 Less Likely (20-39%)	2 Low	6	Med	Share	Comprehensive field investigation and design review; Early Contractor input as well as transparent Contractor progress cost estimates based on proven means and methods.	PDB	Open
54	Proc & Const	Construction	Copco No. 1 or Iron Gate Dam diversion gate malfunctions during drawdown resulting in delay of reservoir drawdown	Design or Construction error		M	A		Time	1 Very Unlikely (1-9%)	5 Very High	5	High	Transfer	Proactive QA/QC during design; Include backup systems for operating the gates in the design and construction including special inspections and testing of the gates prior to drawdown.	PDB	Open
55	External	Construction	Copco No. 1 and/or Iron Gate Dam diversion tunnel intake blocked by debris during drawdown reducing flow capacity	Debris within reservoir blocks intake		M	A		Envir Impact	2 Unlikely (10-19%)	3 Moderate	6	Med	Share	Maximizing the size of the intakes to match the size of the gates; Design debris grating for intake with ability to clear debris from grating.	Owner / PDB	Open
58	Proc & Const	Construction	Copco No. 1 concrete demolition production not adequate to meet project schedule	Inadequate equipment, staff, environmental issues, unfavorable weather			A		Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Transfer	Contract requirements including milestones; Flexibility for 24-hr work 7 days per week; Obtain concrete cores for strength testing to inform DB assumptions regarding drilling and blasting; Early Contractor involvement to avoid shortages of labor and equipment.	PDB	Open
59	Proc & Const	Construction	Copco No. 2 cannot continue to generate power after January 2020	Insufficient water available in Klamath River or water quality too poor		M	A		Cost	2 Unlikely (10-19%)	3 Moderate	6	Med	Accept	Confirm allowable water quality for operation; Evaluate Klamath River flows for potential for too little water to better understand probability of occurrence.	Owner	Open

Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase	Primary Aspect of Risk	Probability (P)	Impact (I)	Risk Weight (P x I)	Overall Rating	Strategy	Risk Management Measure	Risk Owner	Risk Status
60	Proc & Const	Construction	Iron Gate Dam 16.5-ft x 18-ft diversion gate cannot be installed due to as-built drawings of gate guides not matching existing conditions	Unable to survey gate slot until demo complete		M	A		Time	2 Unlikely (10-19%)	3 Moderate	6	Med	Share	Early gate fabrication and installation with sufficient float to allow time for gate modifications, if needed.	PDB	Open
63	Design	Construction	Iron Gate Dam embankment experiences slope failure of upstream shell during reservoir drawdown	Upstream shell material less pervious than assumed in design; error in rapid-drawdown slope stability analyses	M	M	A		Public Safety	1 Very Unlikely (1-9%)	4 High	4	Med	Share	Comprehensive field investigation and design review; Develop slope monitoring plan for implementation during drawdown; Stockpile riprap for repairs of slope if local failures occur.	Owner / PDB	Open
64	Proc & Const	Construction	Iron Gate Dam excavation production less than required to complete excavation by required date	Inadequate planning, equipment, staff, or unforeseen environmental issues, unfavorable weather			A		Public Safety	2 Unlikely (10-19%)	5 Very High	10	High	Transfer	Contractual milestones; Flexibility for 24-hr work 7 days per week; Higher cofferdams for planned breach; Early Contractor involvement to avoid shortages of labor and; Development and implementation by the Contractor of an effective FERC Emergency Action Plan (EAP).	PDB	Open
65	External	Construction	Iron Gate Dam or J.C. Boyle dam overtopped during excavation by storm water flows in excess of 100-year event resulting in dam failure	Climate change; increased variability in precipitation patterns	M	M	A		Public Safety	1 Very Unlikely (1-9%)	5 Very High	5	High	Accept	Require that the dam height during excavation not be less than needed to safely pass a 150-year event through the diversion tunnel; Completion of the FERC Potential Failure Modes Analysis process; Implement EAP, if necessary; Close coordination with the FERC regional office and state dam safety authorities.	Owner / Force Majeure	Open
66	Env	Construction	Iron Gate Hatchery shutdown due to inadequate water supply	New water supply or treatment facilities do not provide suitable supply for hatchery operations, resulting in lowered production	M	M	A	A	Envir Impact	3 Less Likely (20-39%)	3 Moderate	9	Med	Manage	Rigorous design of replacement supply; Pilot treatment technology; Proactive QA/QC during construction.	Owner	Open
68	Environmental	Post-Construction	Greater than anticipated effect on downstream biological resources	Effect of suspended sediment causes greater than anticipated impact to given species	M		A	A	Envir Impact	3 Less Likely (20-39%)	5 Very High	15	High	Manage	Develop appropriate aquatic resource measures through coordination with the regulatory agencies; Implement risk management measures to address effect on downstream resources.	Owner	Open
69	Environmental	Post-Construction	Limited recovery of fish species of concern	Fish recovery does not meet agency expectations	M	M	M	A	Envir Impact	2 Unlikely (10-19%)	2 Low	4	Low	Manage	Aquatic Resource (AR) measures included in Project.	Owner	Open
70	Environmental	Post-Construction	Bald and Golden Eagle net loss within 5 years of construction completion	Mitigation and rehabilitation measures provided insufficient protection				A	Envir Impact	3 Less Likely (20-39%)	4 High	12	Med	Accept	Proactively monitor species before and during construction; Implement additional risk management measures.	Owner	Open
71	Environmental	Post-Construction	Bat roosts do not meet success criteria requiring additional mitigation	Predictive model of bat roost effectiveness is incorrect	M	M	M	A	Envir Impact	2 Unlikely (10-19%)	1 Very Low	2	Low	Manage	Agency input into performance requirements in DB contract and design; Proactive QA/QC during construction.	Owner	Open
72	Environmental	Post-Construction	Habitat restoration goals not satisfied in field	Constructed project component does not meet agency expectations	M	M	M	A	Envir Impact	2 Unlikely (10-19%)	3 Moderate	6	Med	Transfer	Agency input into performance requirements in DB contract and design; Proactive QA/QC during construction.	PDB	Open
73	External	Post-Construction	Large seismic event up to design Maximum Credible Earthquake (MCE) occurs after project completion that results in blockage of Klamath River	Large seismic event causes catastrophic landslide or slope failure		M		A	Public Safety	1 Very Unlikely (1-9%)	2 Low	2	Low	Transfer	Develop clear design requirements for PDB contract; Work with dam safety authorities to set reasonable design criteria and associated durations.	Owner / Force Majeure	Open
78	Operational & Maintenance	Post-Construction	Unanticipated maintenance or repair required during regulatory monitoring and reporting period (e.g. plant establishment, tributary passage blockage, etc.)	Agency success criteria not met during post-construction period	M	M	M	A	Cost	3 Less Likely (20-39%)	3 Moderate	9	Med	Share	Development of management plans to clearly identify success criteria; Develop maintenance triggers and overall approval process; Comply with management plans.	Owner / PDB	Open
80	Proc & Const	Construction	J.C. Boyle Dam excavation production less than required to complete excavation by required date	Inadequate planning, equipment, staff, or unforeseen environmental issues, unfavorable weather			A		Public Safety	2 Unlikely (10-19%)	3 Moderate	6	Med	Share	Contractual requirements including milestones; Flexibility for 24-hr work 7 days per week; Higher cofferdams for planned breach; Early Contractor involvement to avoid shortages of labor and equipment.	PDB	Open
82	Env	Construction	Hydraulic oil or other hazardous material from construction equipment release to river during construction	Contractor mechanical equipment failure result in unanticipated release of hazardous material into river	M		A		Envir Impact	4 Likely (40-59%)	3 Moderate	12	Med	Transfer	Contractor required to develop a Spill Prevention, Control, Countermeasure (SPCC) Plan and active overview and enforcement of the SPCC Plan.	PDB	Open
87	Proc & Const	Construction	Plant pathogens reduce plants available for restoration work	Pathogens introduced at nurseries	M	M	A	A	Cost	3 Less Likely (20-39%)	2 Low	6	Med	Share	Contract requirements for nurseries and for care of plants; Quality Control/Quality Assurance.	PDB	Open
89	External	Construction	Reservoir ice impedes sediment flushing during reservoir drawdown	Ice on one or more reservoirs during drawdown might impede sediment erosion			A		Envir Impact	3 Less Likely (20-39%)	4 High	12	Med	Accept	None.	Owner / Force Majeure	Open
90	External	Construction	River channel locates in unexpected location during reservoir drawdown	Channel relocates on historic terrace rather than original channel			A		Cost	1 Very Unlikely (1-9%)	3 Moderate	3	Low	Accept	Contractor to develop a mitigation plan during design to move river into original channel.	Owner / Force Majeure	Open
91	External	Construction	Unknown fish passage barriers are found during drawdown	Unknown pre-existing barriers exposed during drawdown	M	M	A	A	Cost	4 Likely (40-59%)	1 Very Low	4	Med	Accept	Review of historic documents for evidence of barriers; Require Contractor to develop contingency plan to evaluate for barriers following reservoir drawdown and actions to remove barriers during dam removal.	Owner / Force Majeure	Open

Risk ID	Risk Category	Phase	Risk Description	Root Cause(s)	Planning Phase	Design Phase	Construction Phase	Post-Construction Phase	Primary Aspect of Risk	Probability (P)	Impact (I)	Risk Weight (P x I)	Overall Rating	Strategy	Risk Management Measure	Risk Owner	Risk Status
93	Permit	Planning	Western Pond Turtle becomes Federally listed during permitting process	Project effect on listed species	A	A	A		Time	4 Likely (40-59%)	3 Moderate	12	Med	Manage	Proactive coordination with appropriate regulatory agencies on likely requirements and associated field work; Address contingency in consultations.	Owner / Force Majeure	Open
95	Env	Construction	Unanticipated human burial site discovered between Iron Gate Dam and Humbug Creek during reservoir drawdown and post construction (beyond current allowance)	Burial site not disclosed or already known about exposed due to erosion of channel banks during elevated flows during drawdown.	M		A	A	Cost	3 Less Likely (20-39%)	2 Low	6	Med	Manage	Identification of existing cultural resources to the extent feasible; Ongoing coordination with Native American groups and local historical societies; Development of an Inadvertent Discovery Plan, Monitoring Plan, and NAGPRA Plan of Action, and rapid response plan to address the possibility of burial sites becoming exposed.	Owner / Force Majeure	Open
96	Env	Post-Construction	Weeds outcompete native plants and site restoration goals are not met	Proliferation of weeds	M	M	M	A	Cost	2 Unlikely (10-19%)	2 Low	4	Low	Share	Contract warranty period; Post-construction maintenance requirements in contract.	Owner / PDB	Open
97	Environmental	Construction	Northern spotted owl, bald eagle or golden eagle nests during construction period, requiring restrictions on construction timing and activity.	Bird creates new nest during construction.	M	M	A		Time	2 Unlikely (10-19%)	1 Very Low	2	Low	Accept	Monthly monitoring during breeding season.	Owner	Open
103	External	Planning	Differing Site Condition claim during Yreka Water Supply Pipeline Crossing Construction.	Adequate geotechnical subsurface information is not readily available. Unanticipated subsoil conditions are encountered or claimed to have been encountered during construction.	M	M	A		Cost	2 Unlikely (10-19%)	3 Moderate	6	Med	Manage	Conduct an adequate and thorough geotechnical exploration program in conformance with standard practice and describe subsoil conditions in terms of a geotechnical baseline report (GBR) and a geotechnical data report (GDR).	Owner	Open

Appendix B Figures – CONTAINS CEII – REDACTED

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Appendix C Figures – Other

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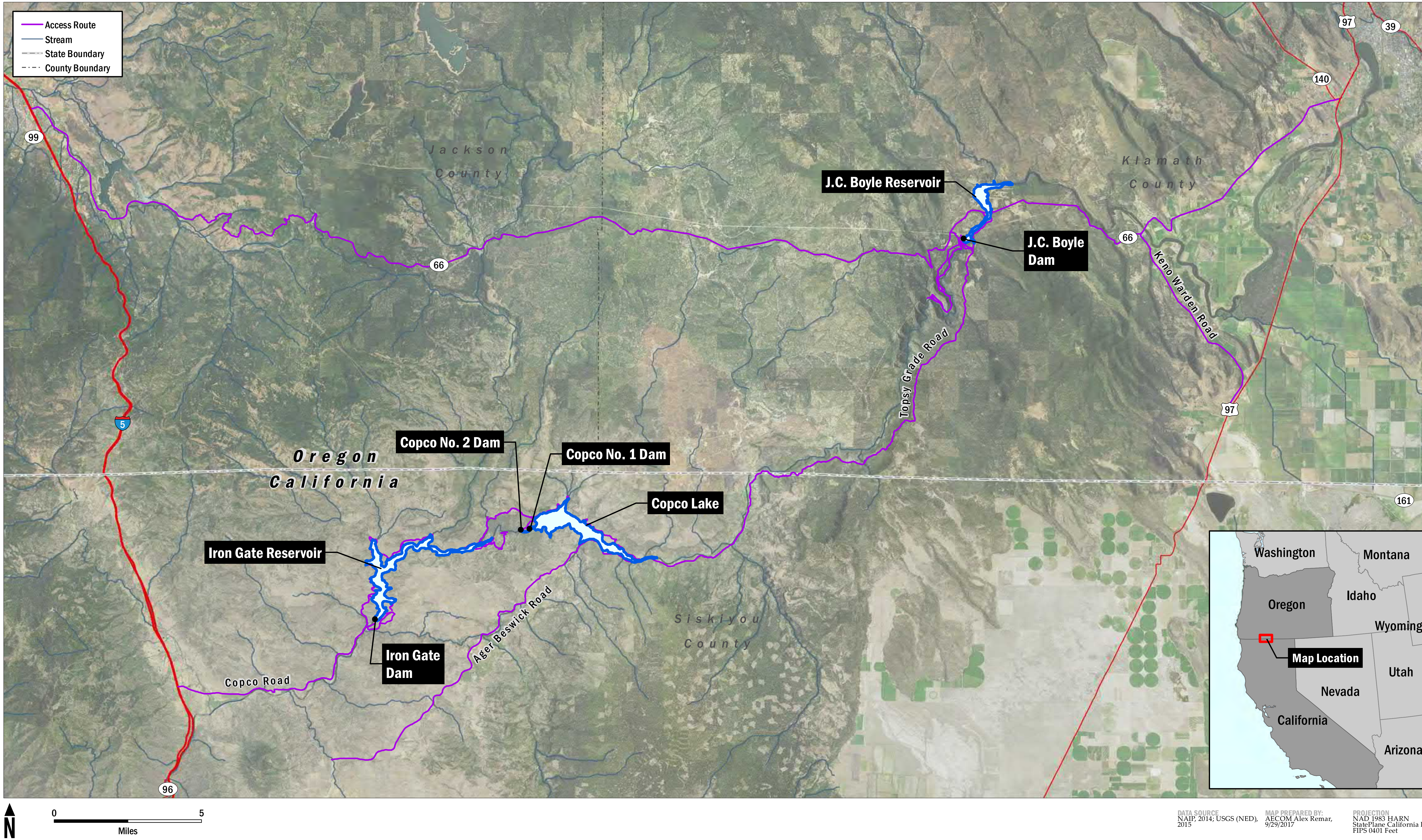
AECOM Oakland CA 9/29/2017 USER latha.chandrasekaran PATH L:\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\CEQA_Report\Figure_1_2-2_ProjectVicinityAndAccess.mxd



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 9/29/2017

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM

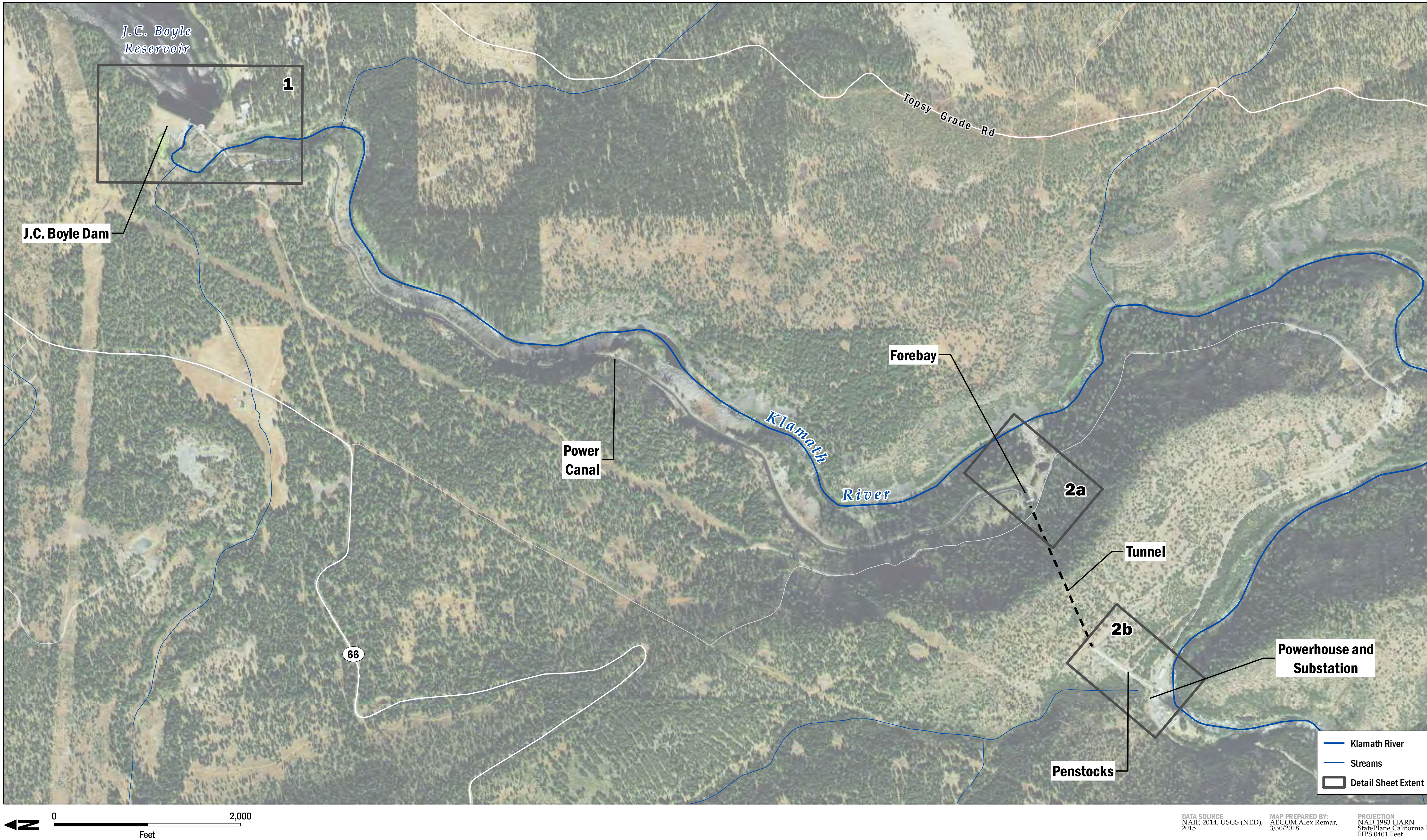
Klamath River Renewal Corporation

Klamath River Renewal Project

FIGURE 1.2-2

Project Vicinity and Access

AECOM Oakland CA 3/30/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_2_1-1__JCB_ExistingFeatures_Overview.mxd



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 3/30/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

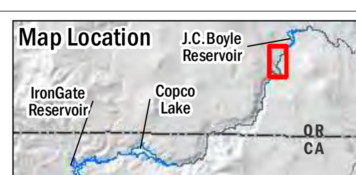


FIGURE 2.1-1

J.C. Boyle Dam Existing Features Overview Sheet

0 150
Feet

DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 9/29/2017

PROJECTION
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Klamath River Renewal Corporation
Klamath River Renewal Project

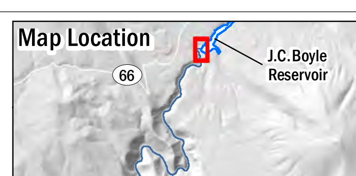
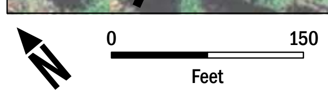


FIGURE 2.1-1
J.C. Boyle Dam Existing Features
Sheet 1 of 2

AECOM Oakland CA 9/29/2017 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\CEQA_Report\Figure_2_1-1__JCB_ExistingFeatures_Sheet2.mxd

2A - FOREBAY AND SPILLWAY

2B - PENSTOCKS AND POWERHOUSE



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 9/29/2017

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

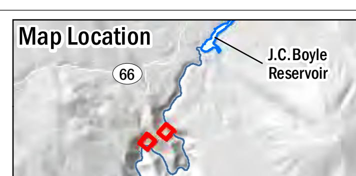
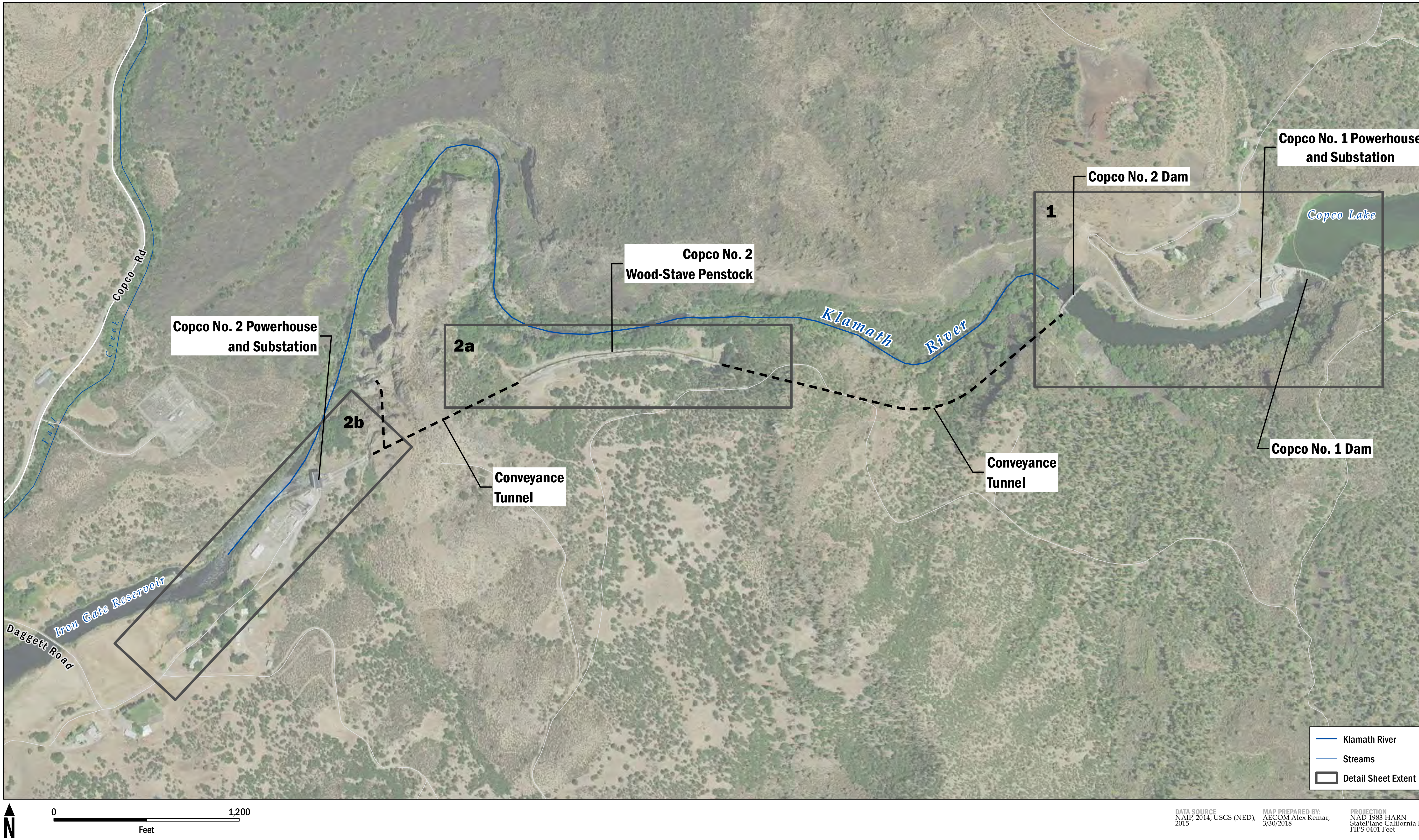
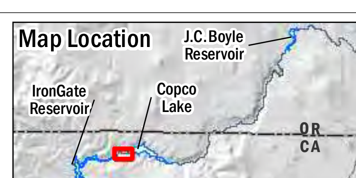


FIGURE 2.1-1

J.C. Boyle Dam Existing Features
Sheet 2 of 2

AECOM Oakland CA 3/30/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_2_2-1__Copco_ExistingFeatures_Overview.mxd





DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 3/30/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 2.2-1

Copco No. 1 and Copco No. 2 Dams Existing Features Overview Sheet

AECOM

Klamath River Renewal Corporation

Klamath River Renewal Project

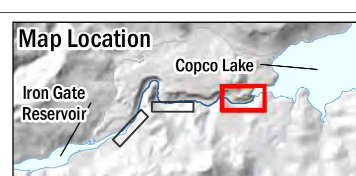


FIGURE 2.2-1

Copco No. 1 and Copco No. 2 Dams Existing Features

Sheet 1 of 2

AECOM Oakland CA 3/30/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_2_2-1__Copco_ExistingFeatures_Sheet2.mxd

2A - COPCO NO. 2 WOOD-STAVE PENSTOCK

2B - COPCO NO. 2 POWERHOUSE

N
0 300
Feet

DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 3/30/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

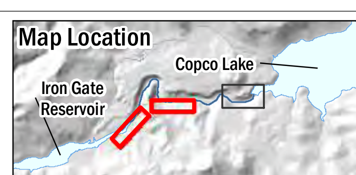
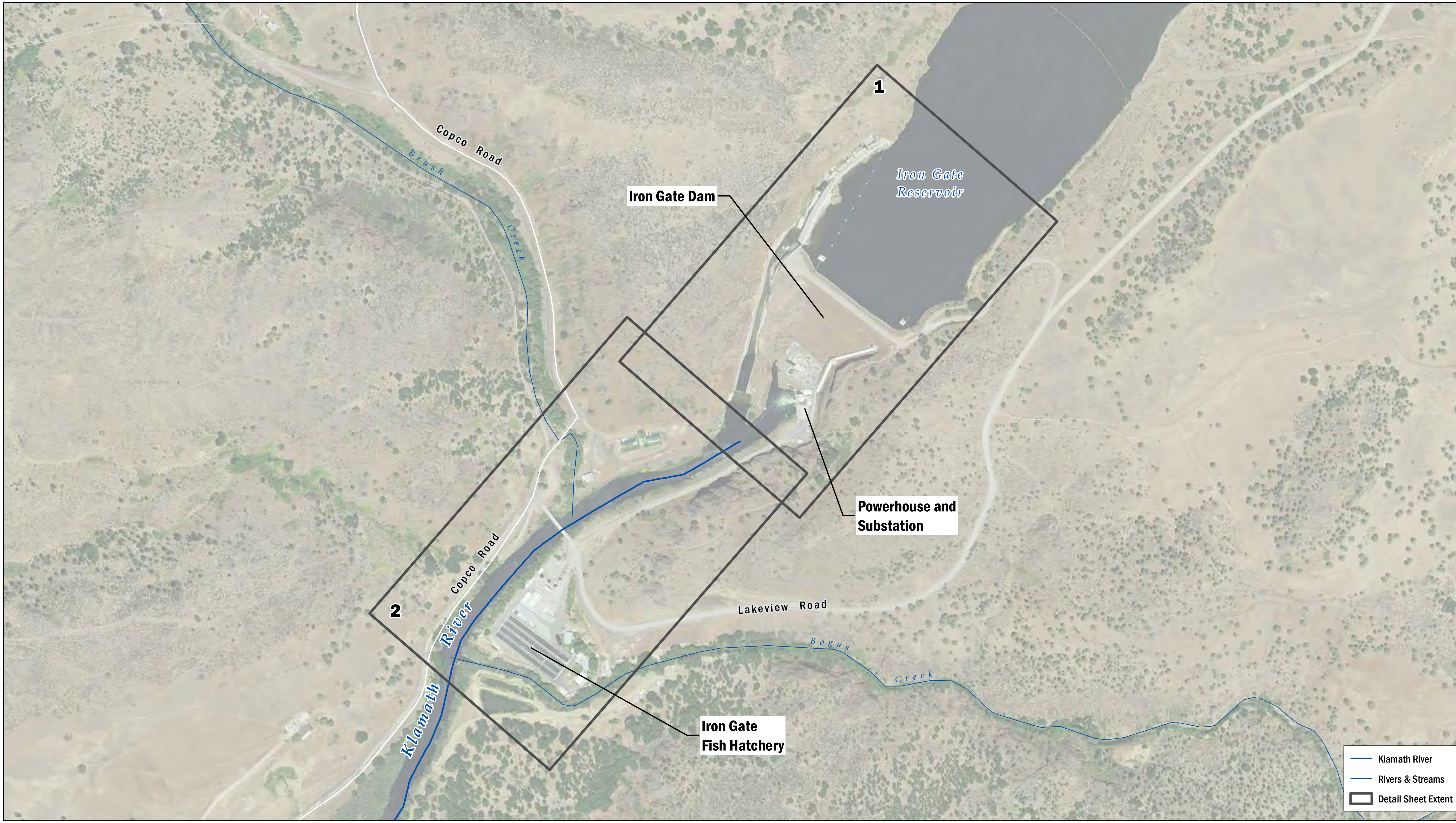


FIGURE 2.2-1

Copco No. 1 and Copco No. 2 Dams Existing Features
Sheet 2 of 2

AECOM Oakland CA 3/30/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_2_4-1__IG_ExistingFeatures_Overview.mxd



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Feet

DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 3/30/2018

PROJECTION
NAD 1983 HARN
StatePlane California I
FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

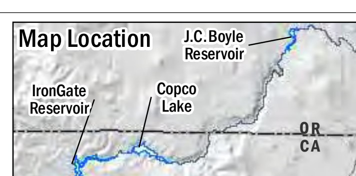
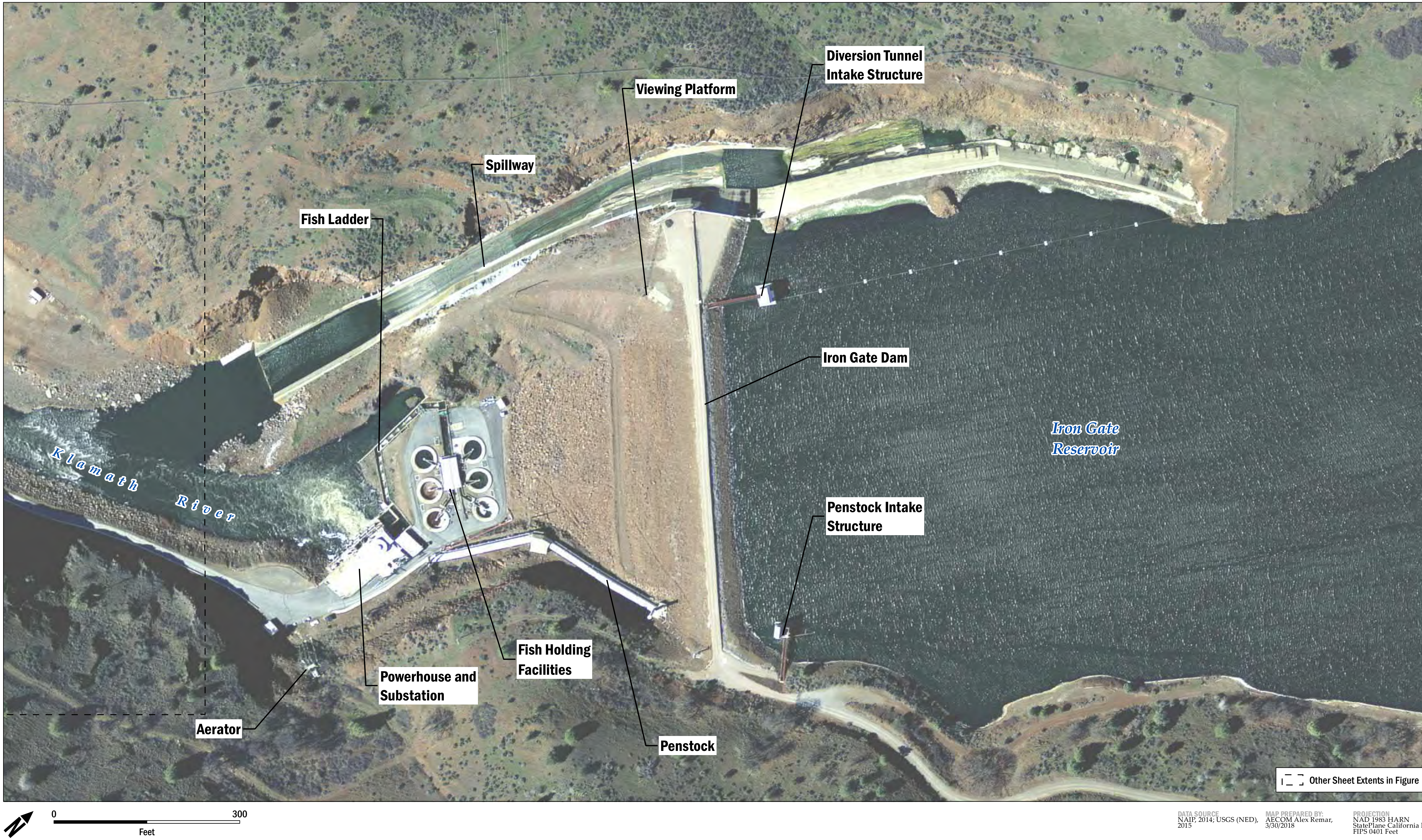


FIGURE 2.4-1

Iron Gate Dam Existing Features
Overview Sheet

AECOM Oakland CA 3/30/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_2_4-1__IG_ExistingFeatures_Sheet1.mxd



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 3/30/2018

PROJECTION
NAD 1983 HARN
StatePlane California I
FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

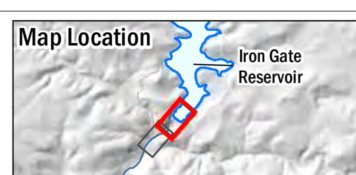


FIGURE 2.4-1

Iron Gate Dam Existing Features
Sheet 1 of 2

AECOM Oakland CA 9/29/2017 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\CEQA_Report\Figure_2_4-1__IG_ExistingFeatures_Sheet2.mxd

DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 9/29/2017

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

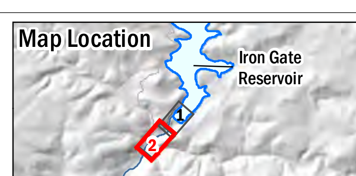
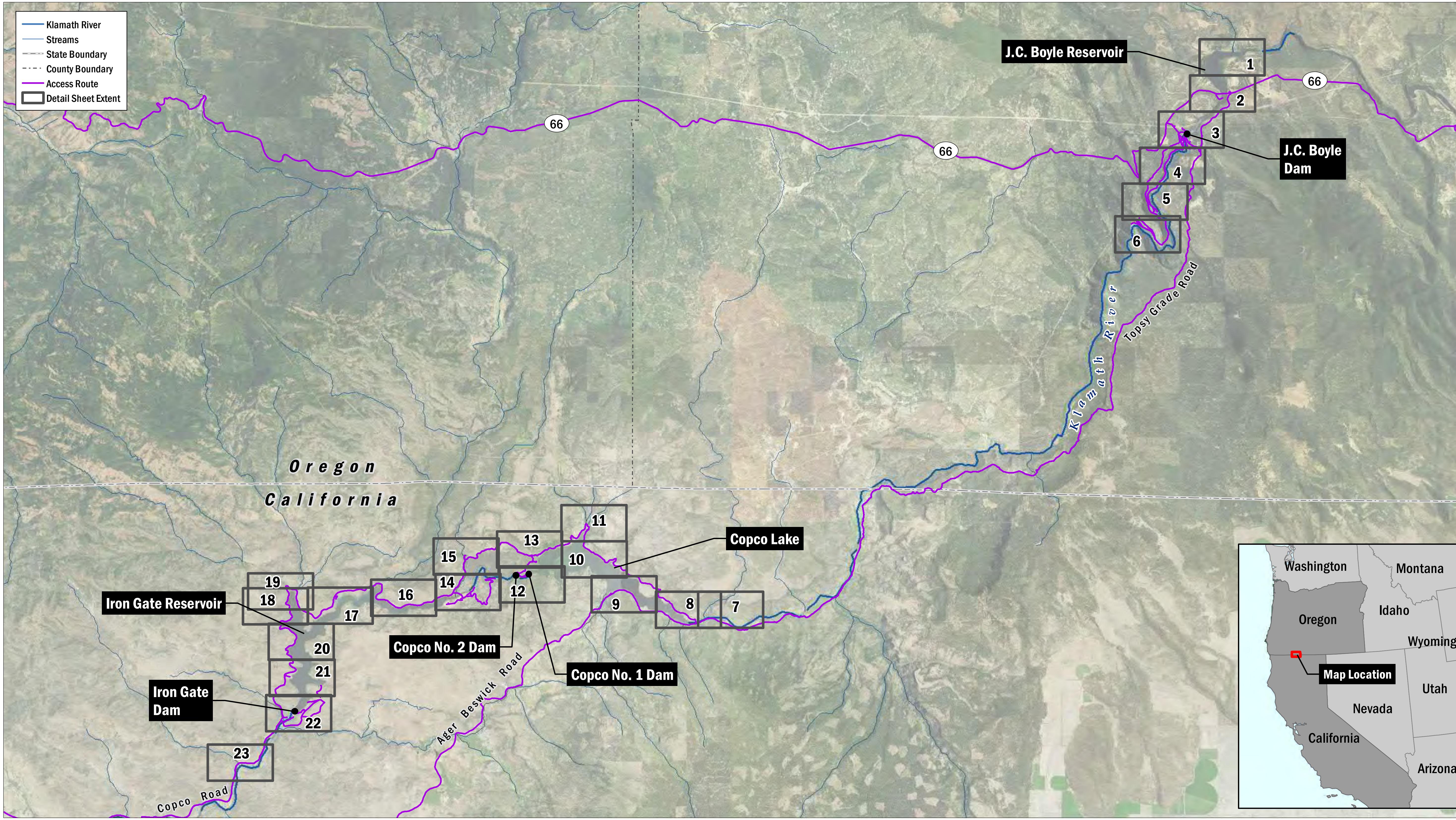


FIGURE 2.4-1

Iron Gate Dam Existing Features
Sheet 2 of 2

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Overview.mxd



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0 5

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DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM

Klamath River Renewal Corporation

Klamath River Renewal Project

FIGURE 5.1-1

Project Limits of Work and Access Overview Sheet

DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
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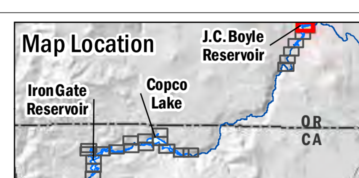
PROJECTION
NAD 1983 HARN
StatePlane California I
FIPS 0401 Feet

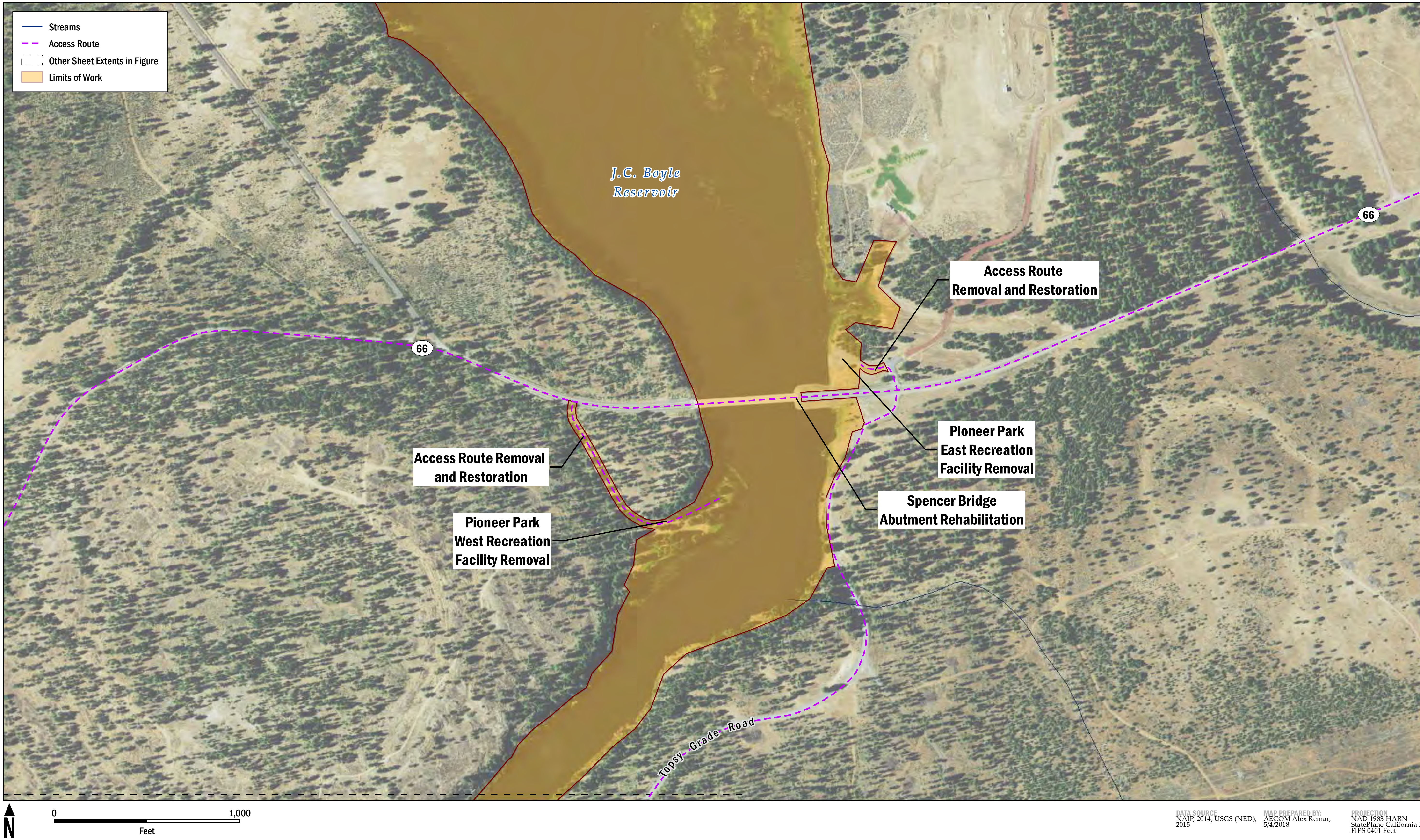
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 1 of 23

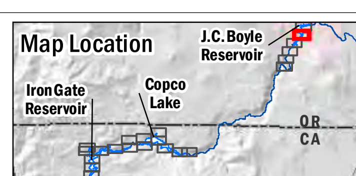


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

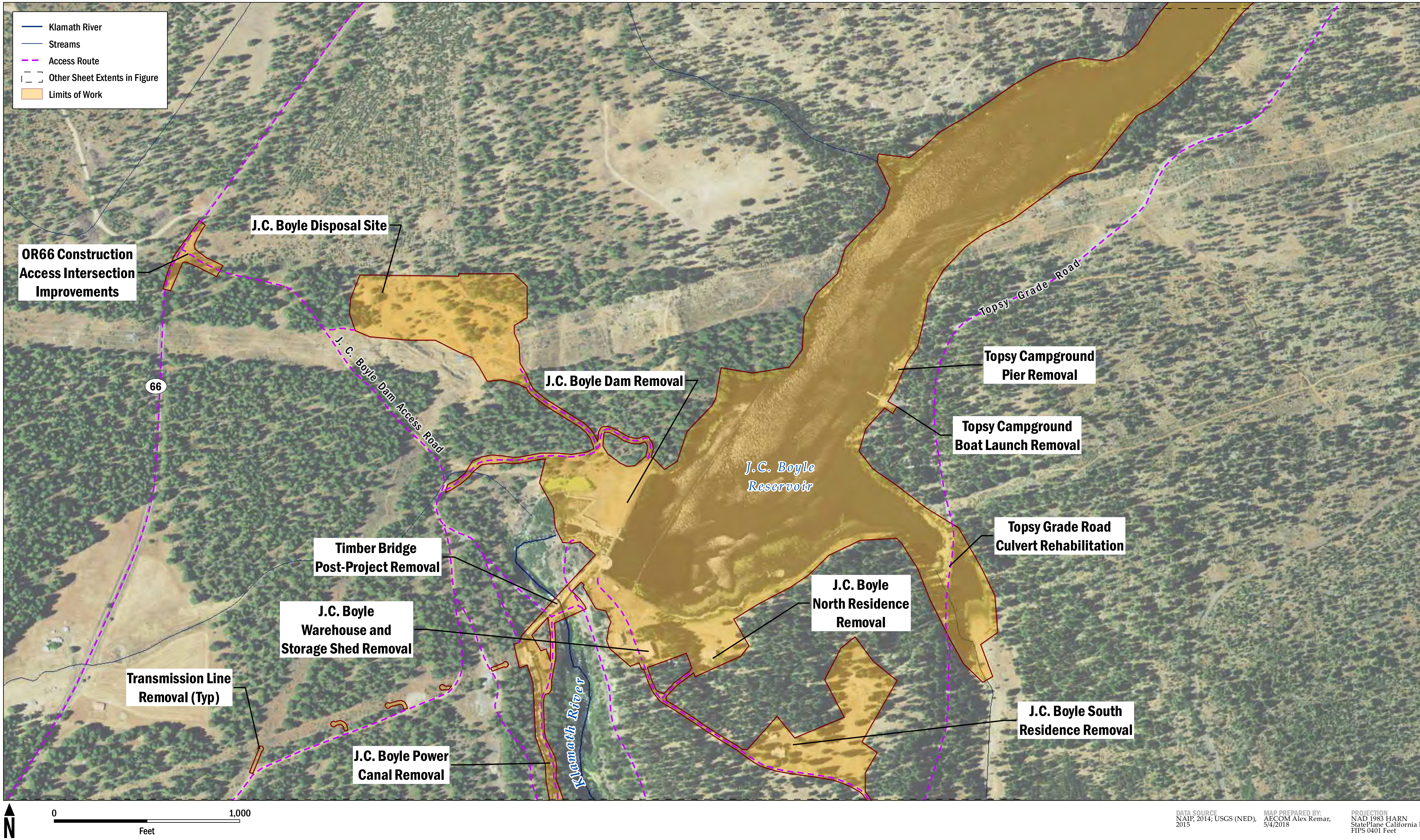
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 2 of 23

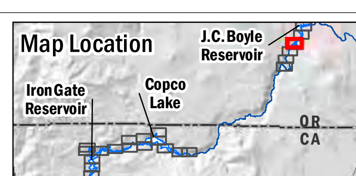


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

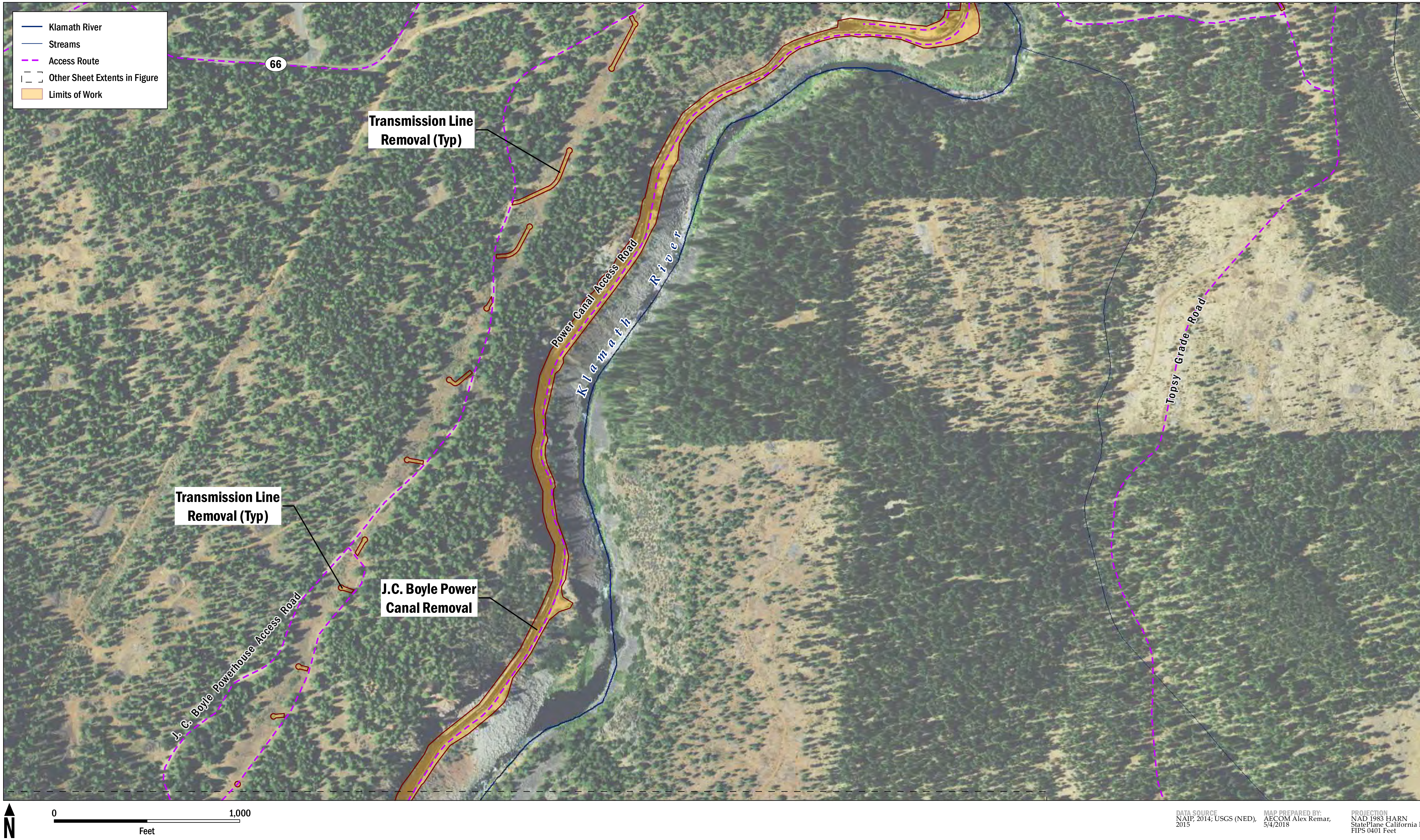
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 3 of 23

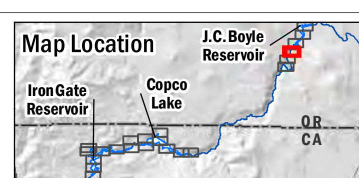


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



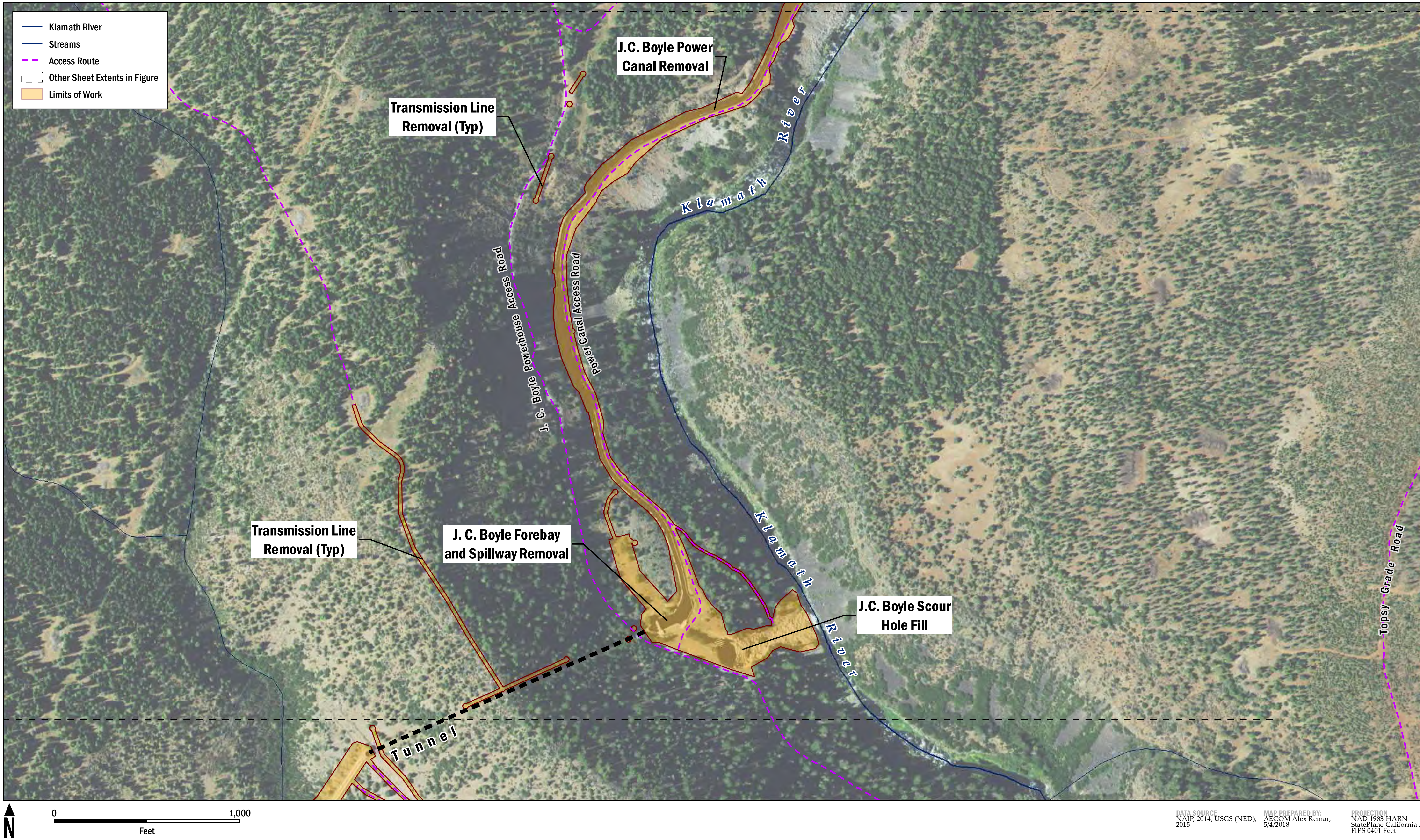
Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access

Sheet 4 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

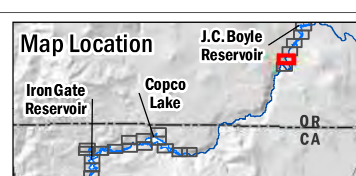


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN
StatePlane California I
FIPS 0401 Feet

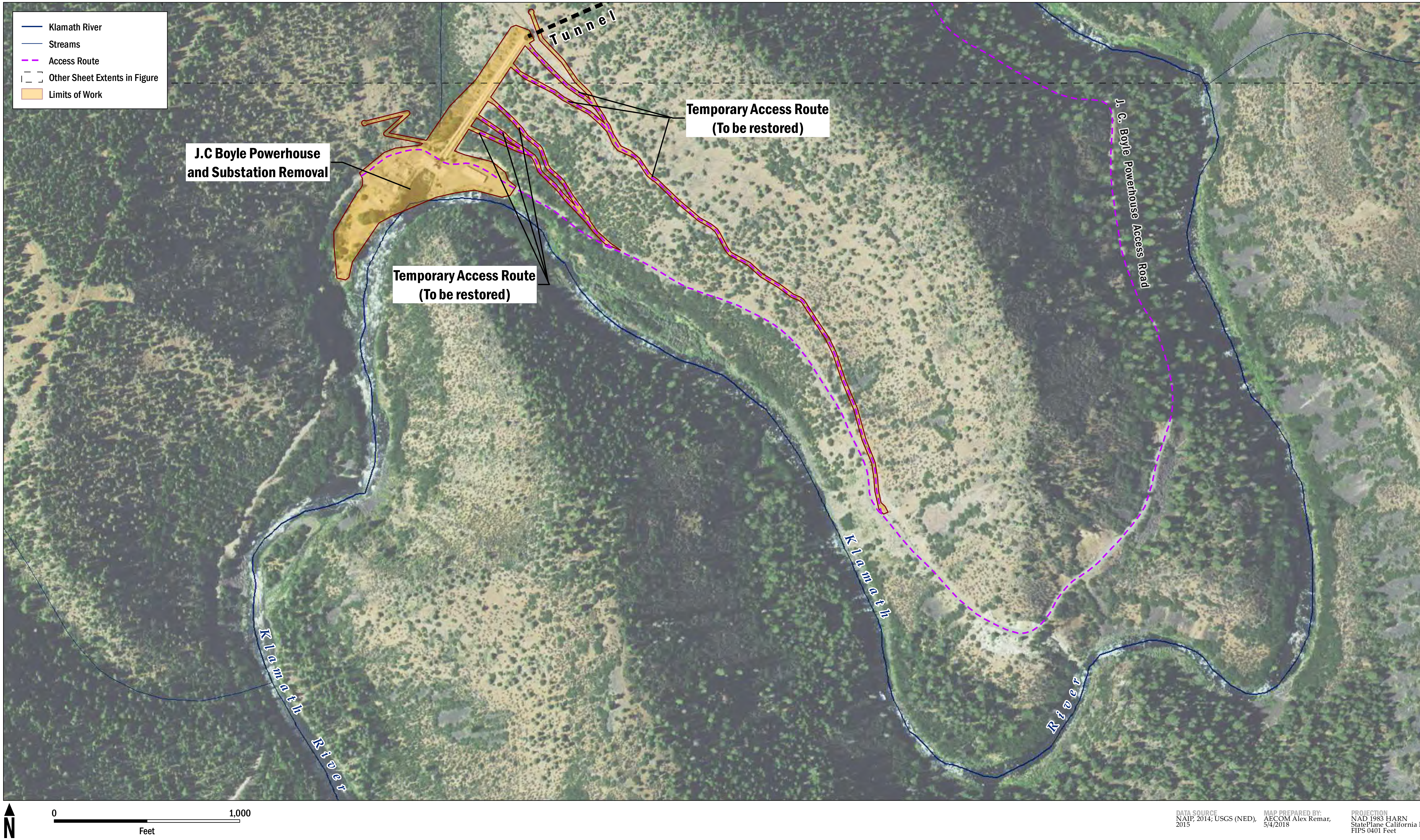
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 5 of 23

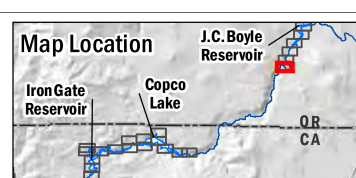


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access

Sheet 6 of 23

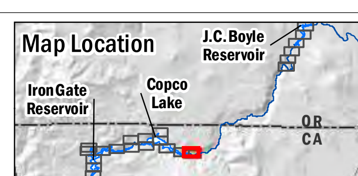
AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN
StatePlane California I
FIPS 0401 Feet

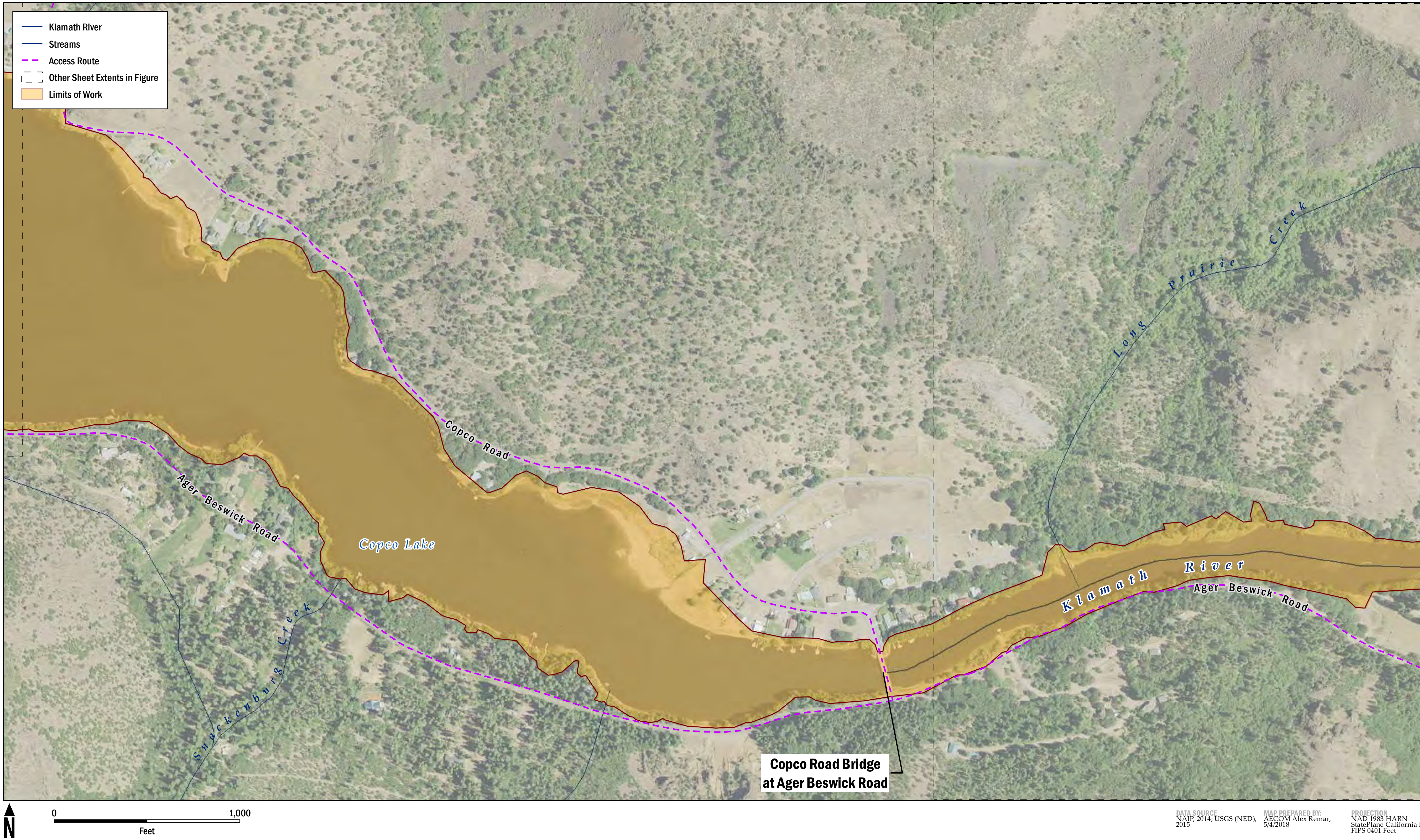
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1
Project Limits of Work and Access
Sheet 7 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

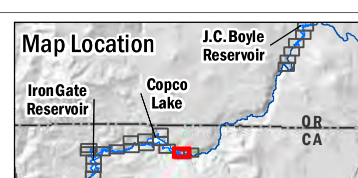


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

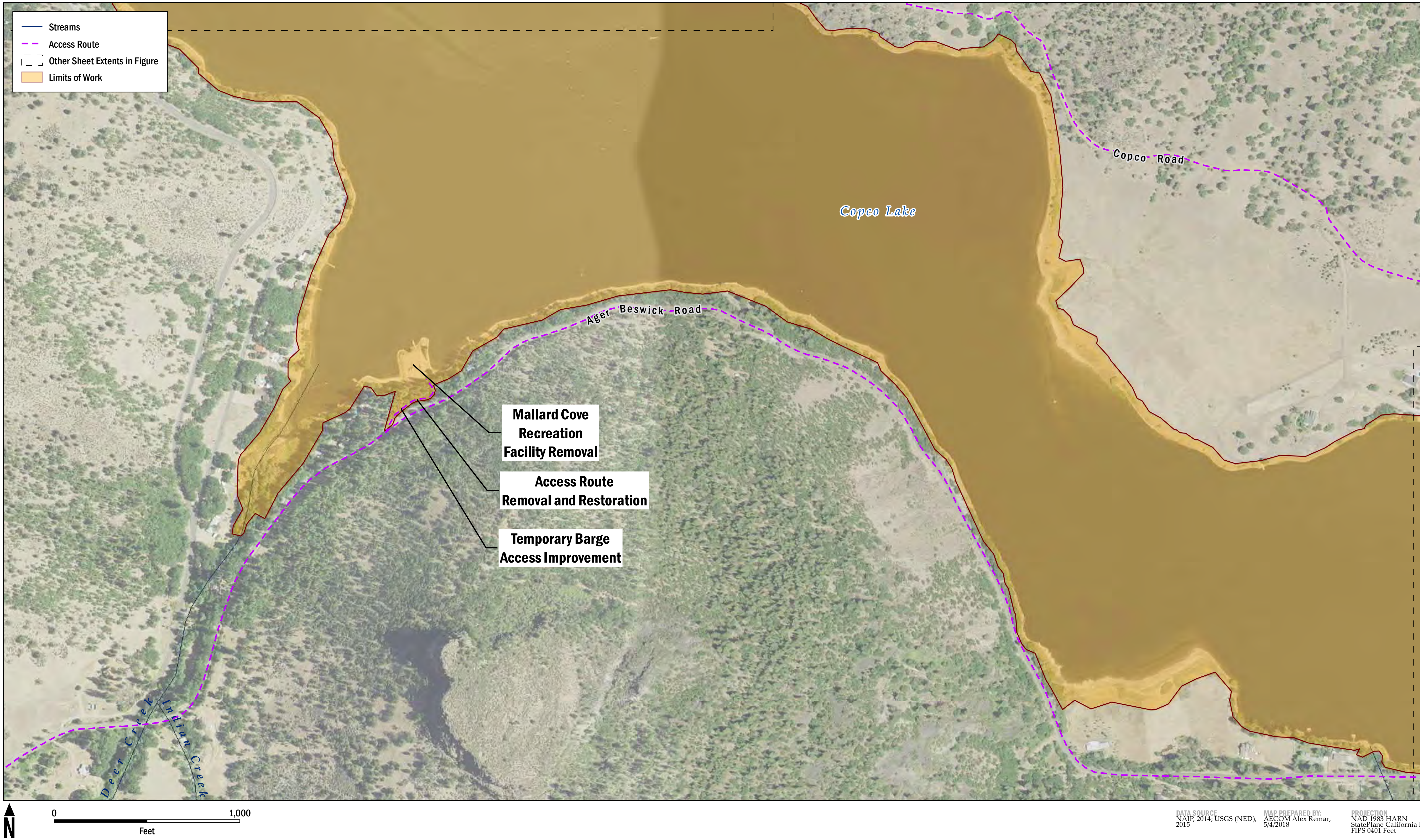


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 8 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

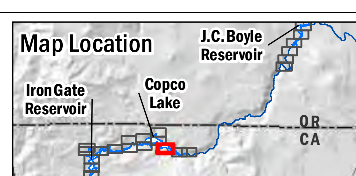


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN
StatePlane California I
FIPS 0401 Feet

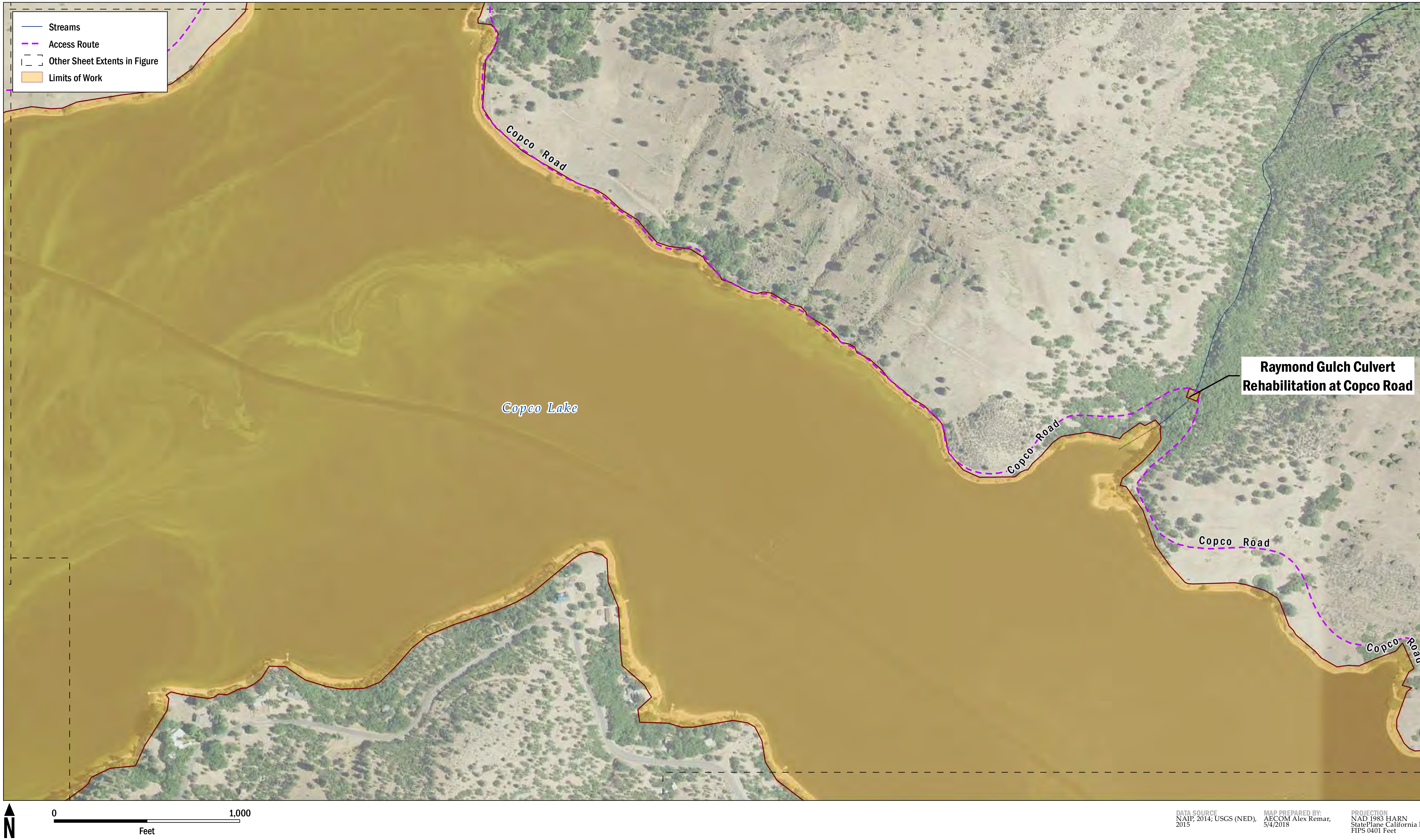
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1
Project Limits of Work and Access
Sheet 9 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

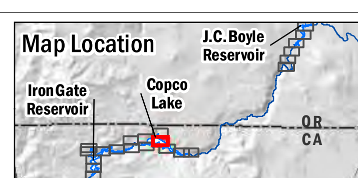


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

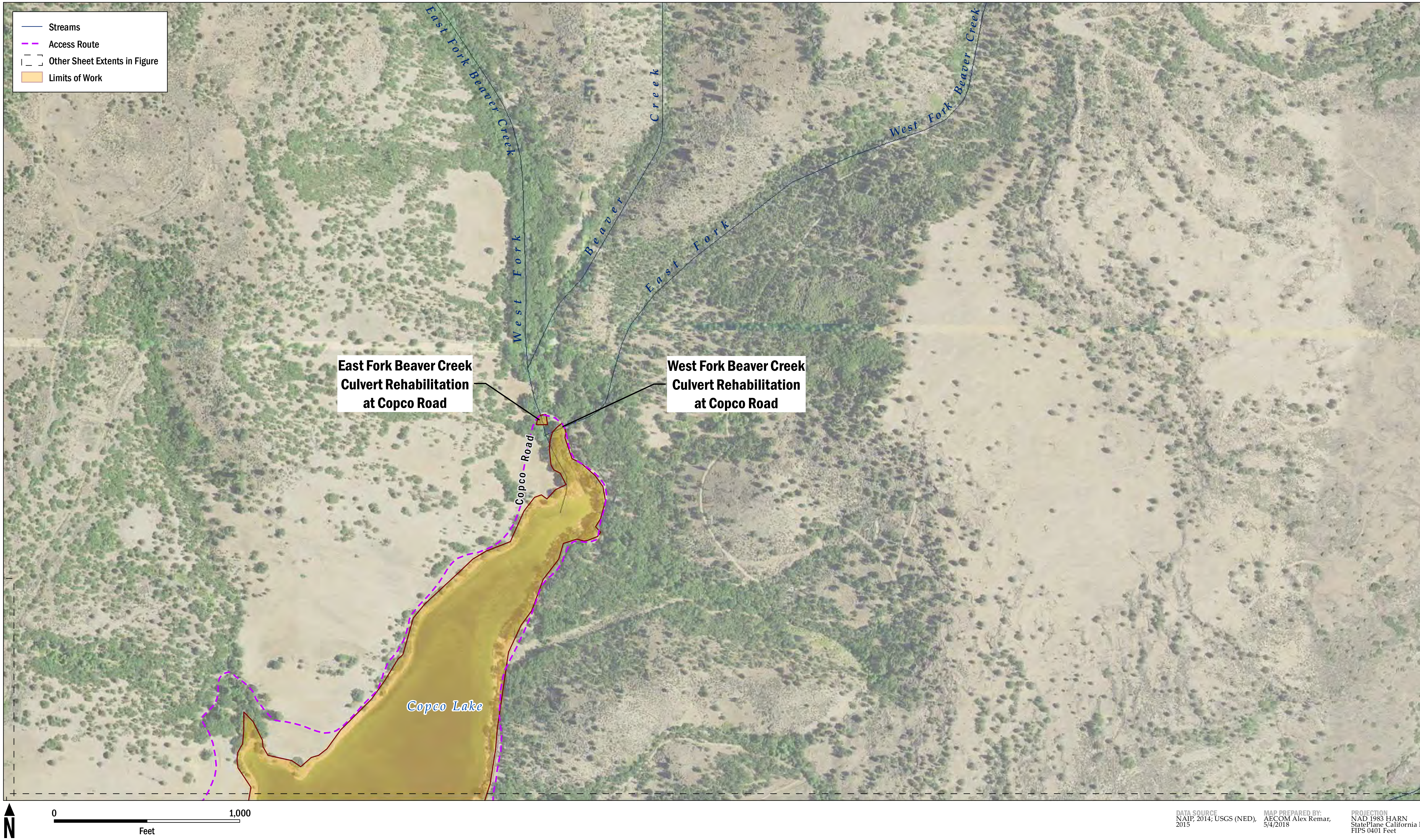


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access

Sheet 10 of 23

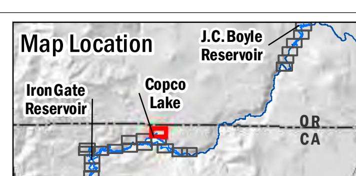


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

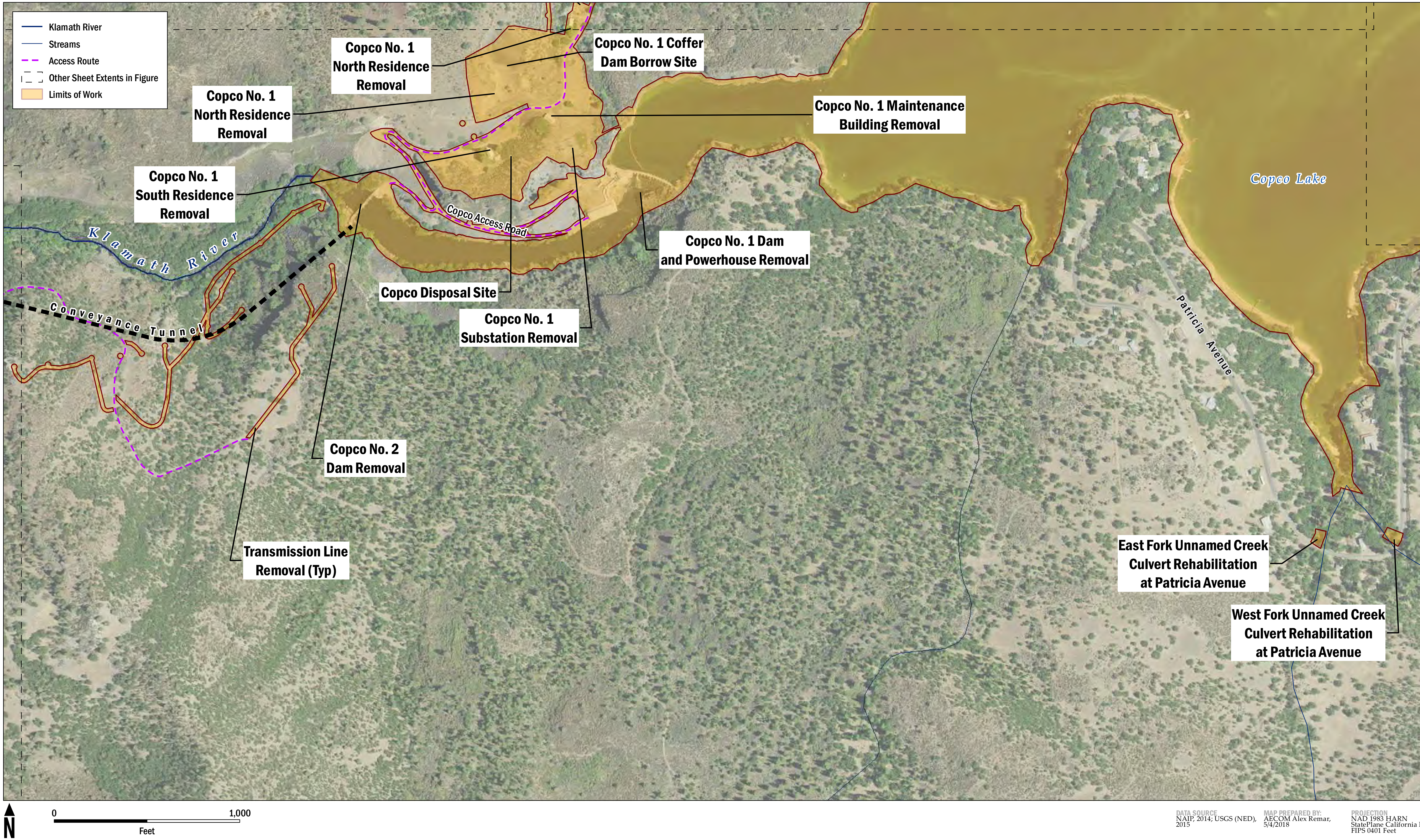
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 11 of 23

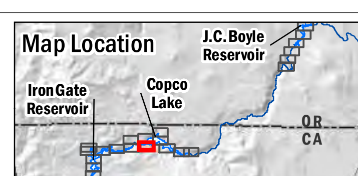


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

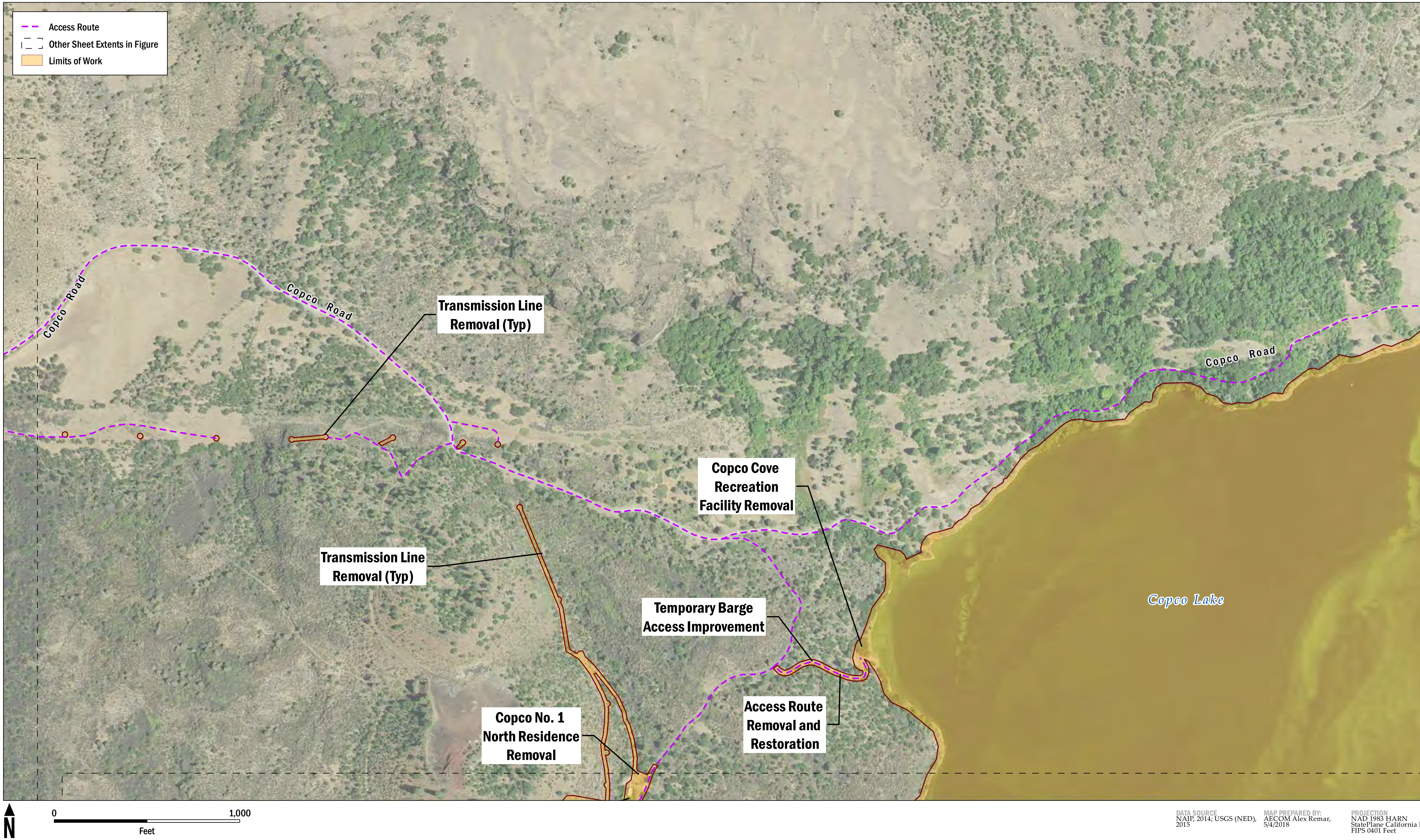


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 12 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

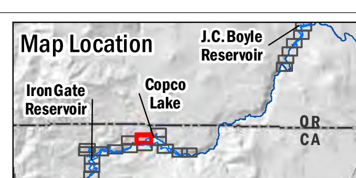


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN
StatePlane California I
FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

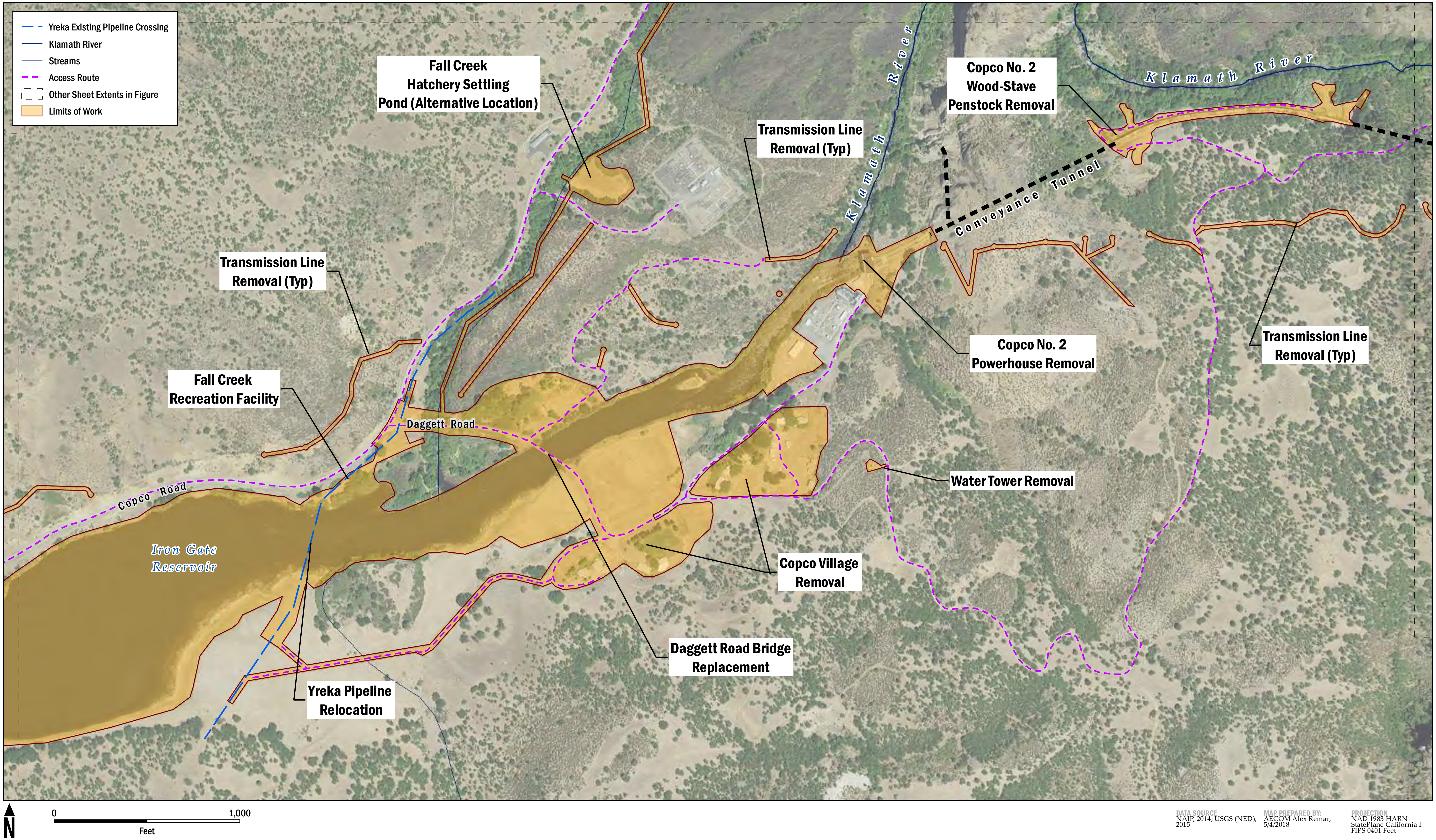


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access

Sheet 13 of 23

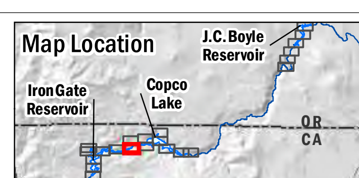


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

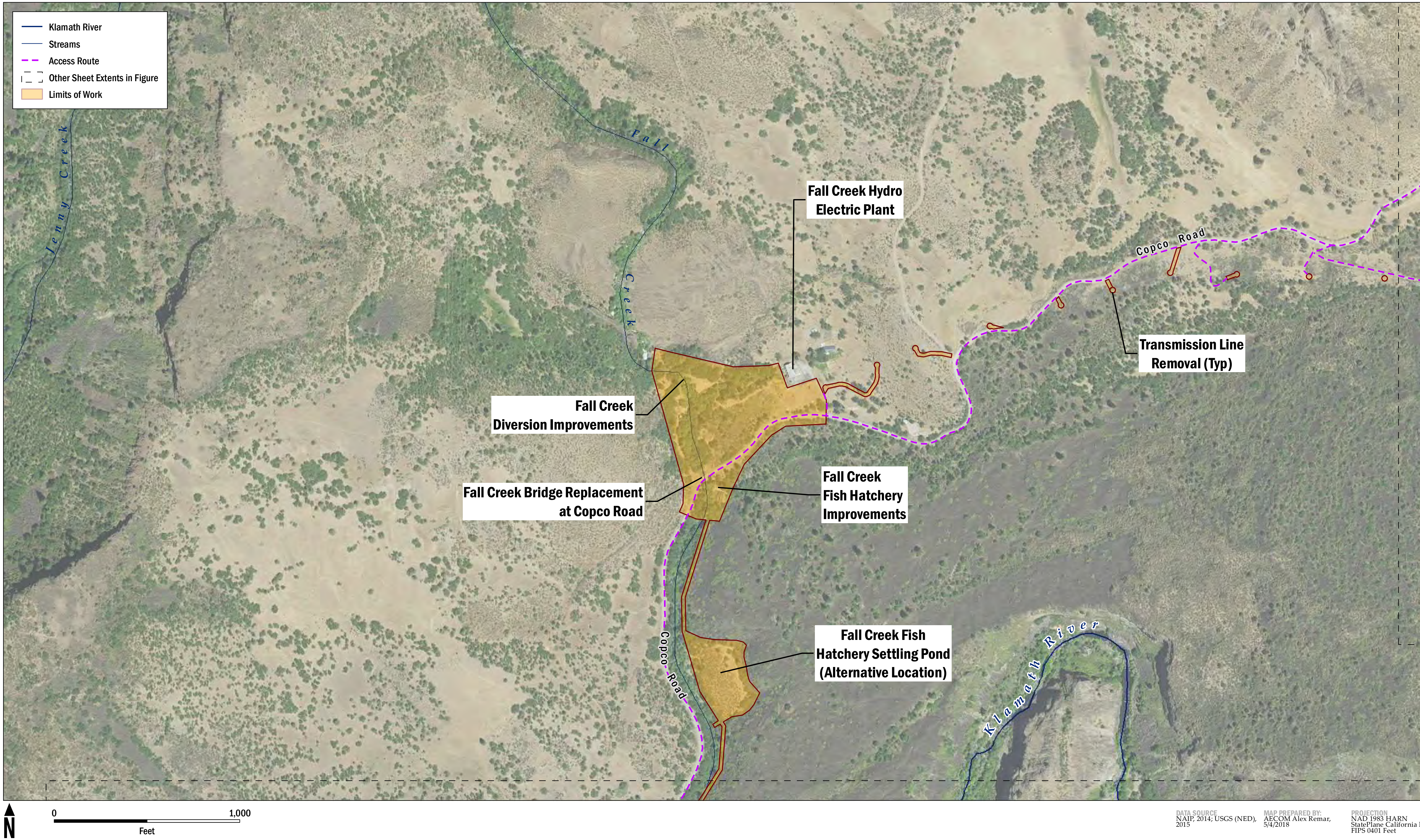


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 14 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

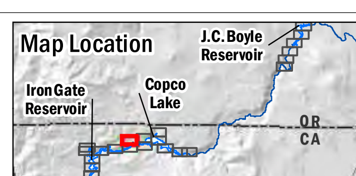


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

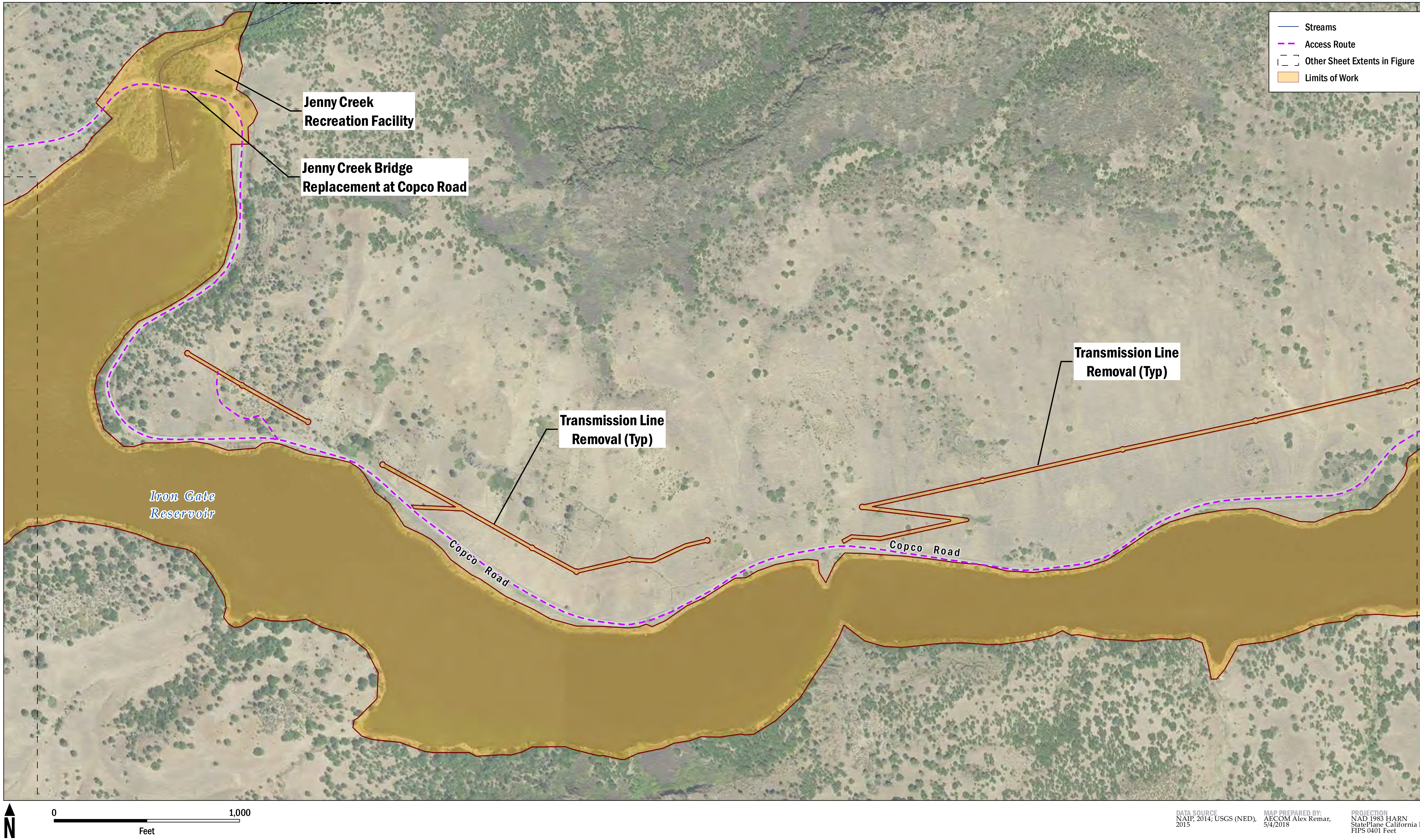


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 15 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_1-1_ProjectLimitsOfWorkAndAccess_Sheets.mxd

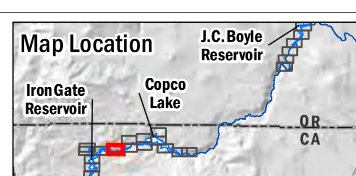


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

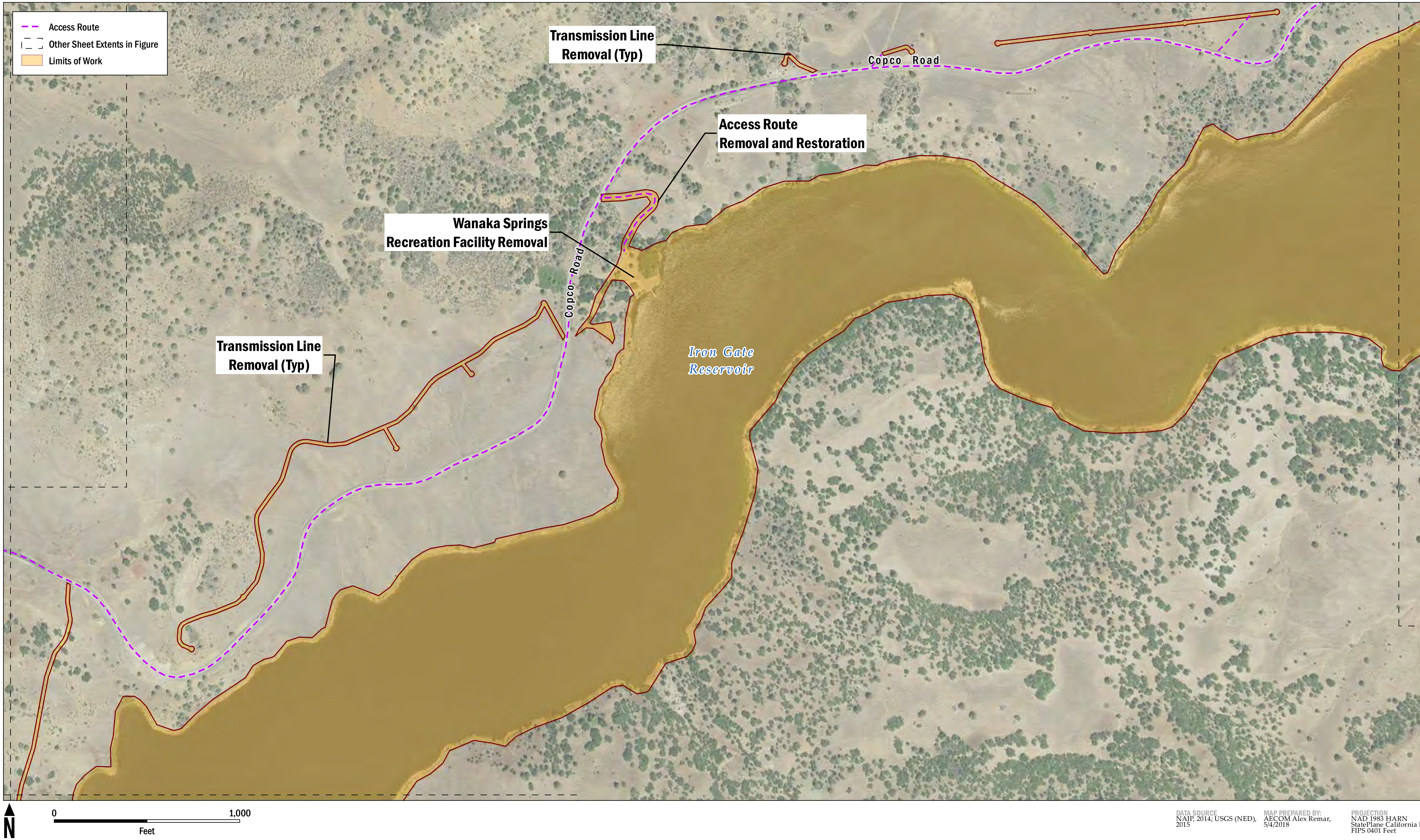


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access

Sheet 16 of 23

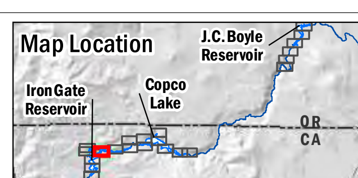


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

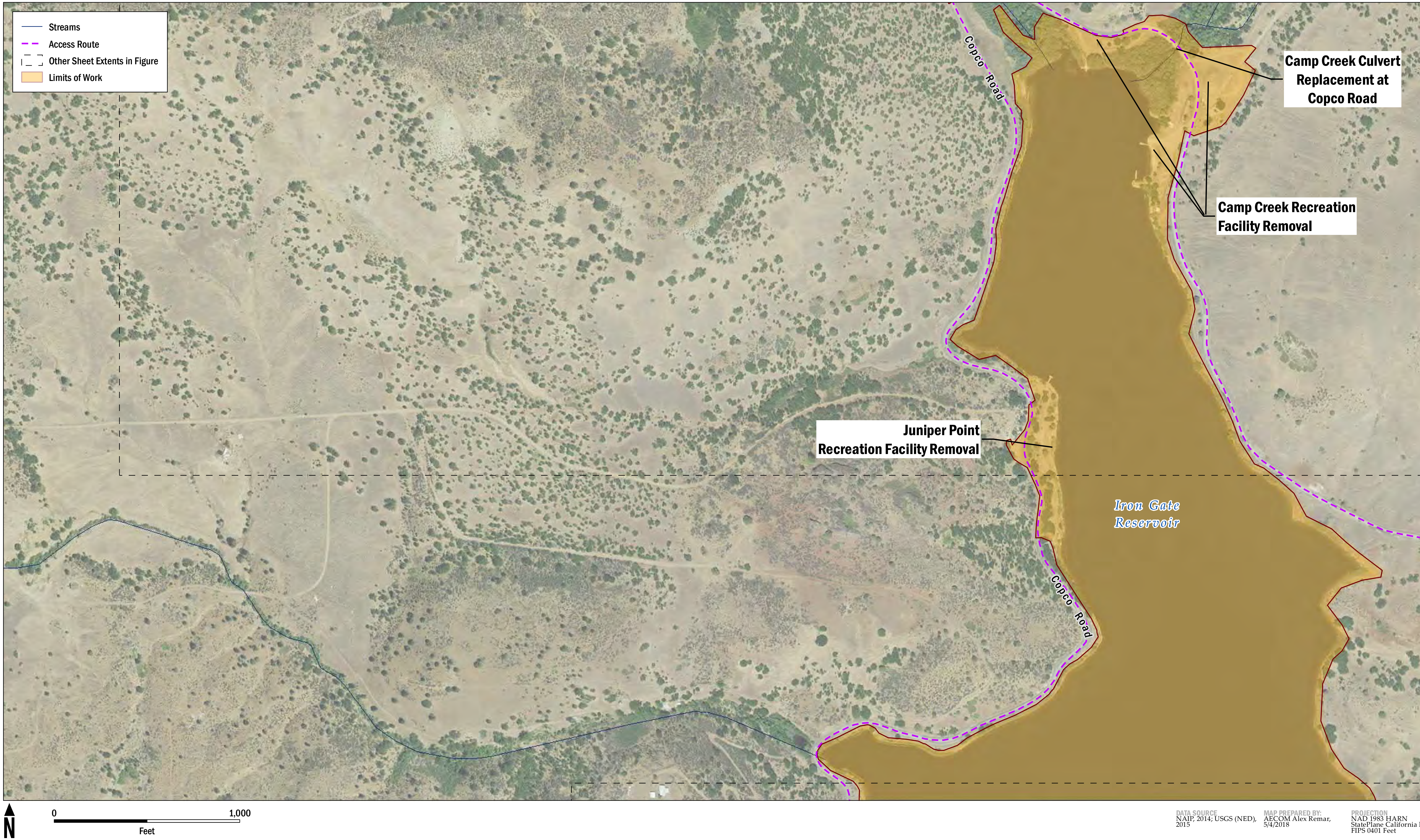
PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1
Project Limits of Work and Access
Sheet 17 of 23

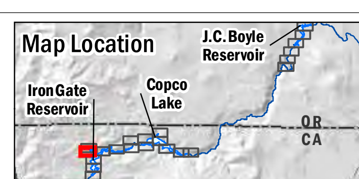


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN
StatePlane California I
FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

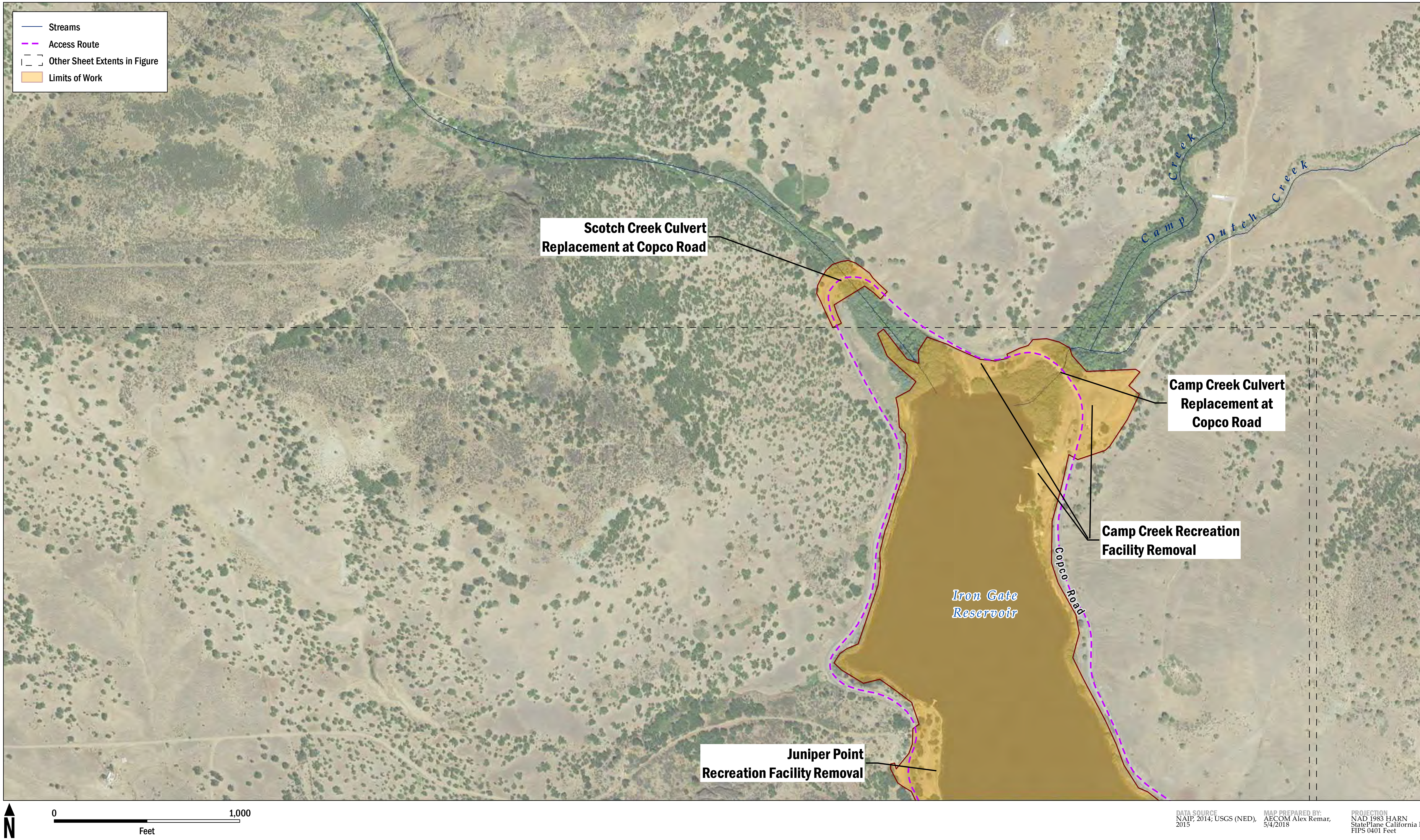


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access

Sheet 18 of 23

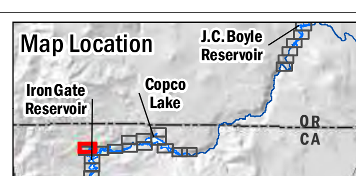


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN
StatePlane California I
FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

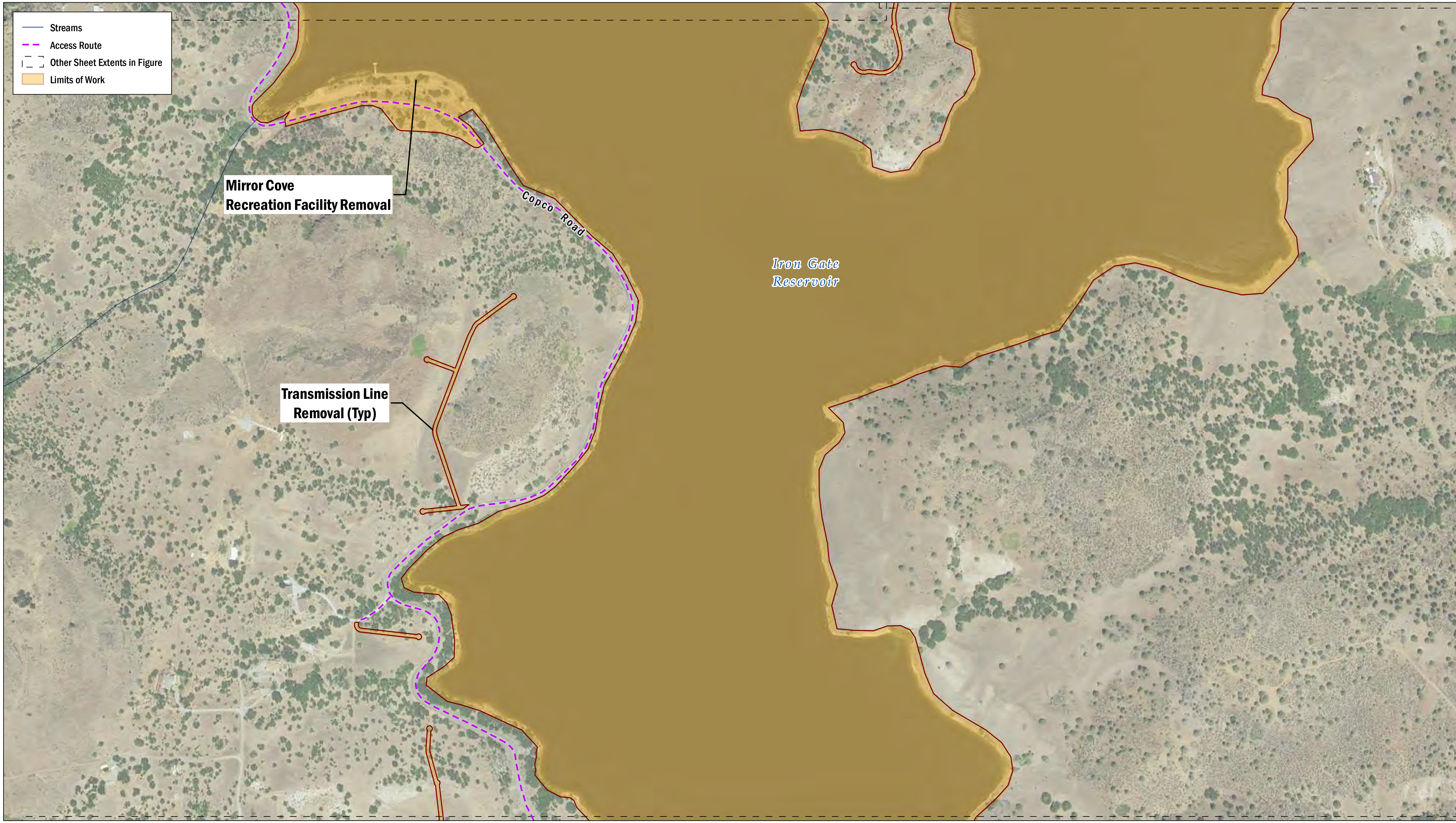


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access

Sheet 19 of 23



N
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Feet

DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
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PROJECTION
NAD 1983 HARN
StatePlane California I
FIPS 0401 Feet

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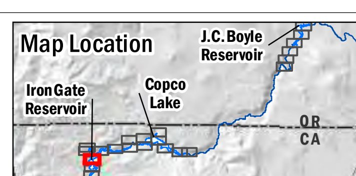
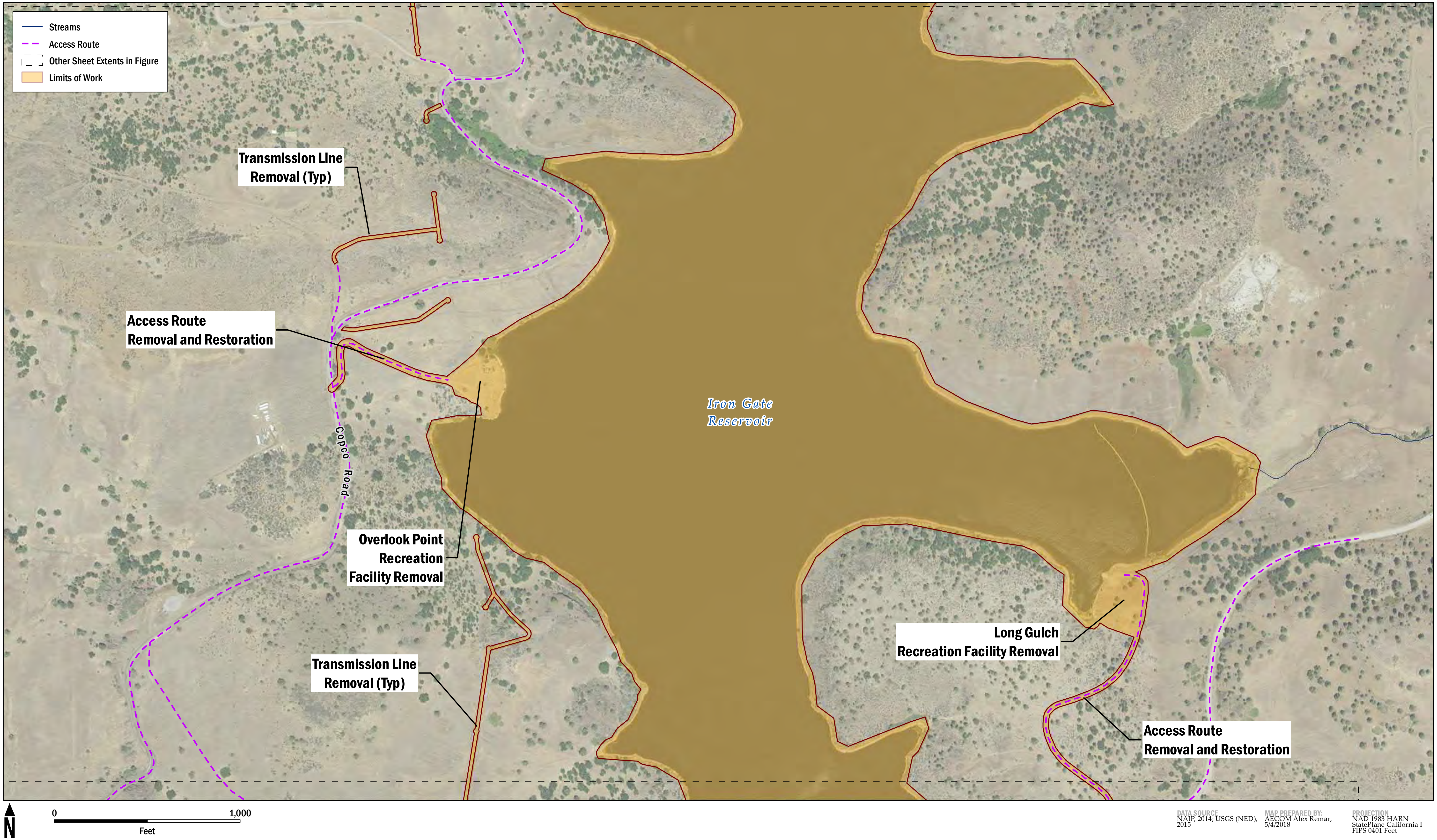
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1
Project Limits of Work and Access
Sheet 20 of 23



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
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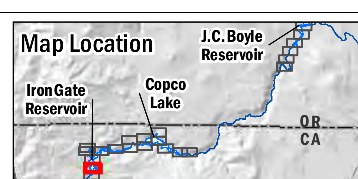
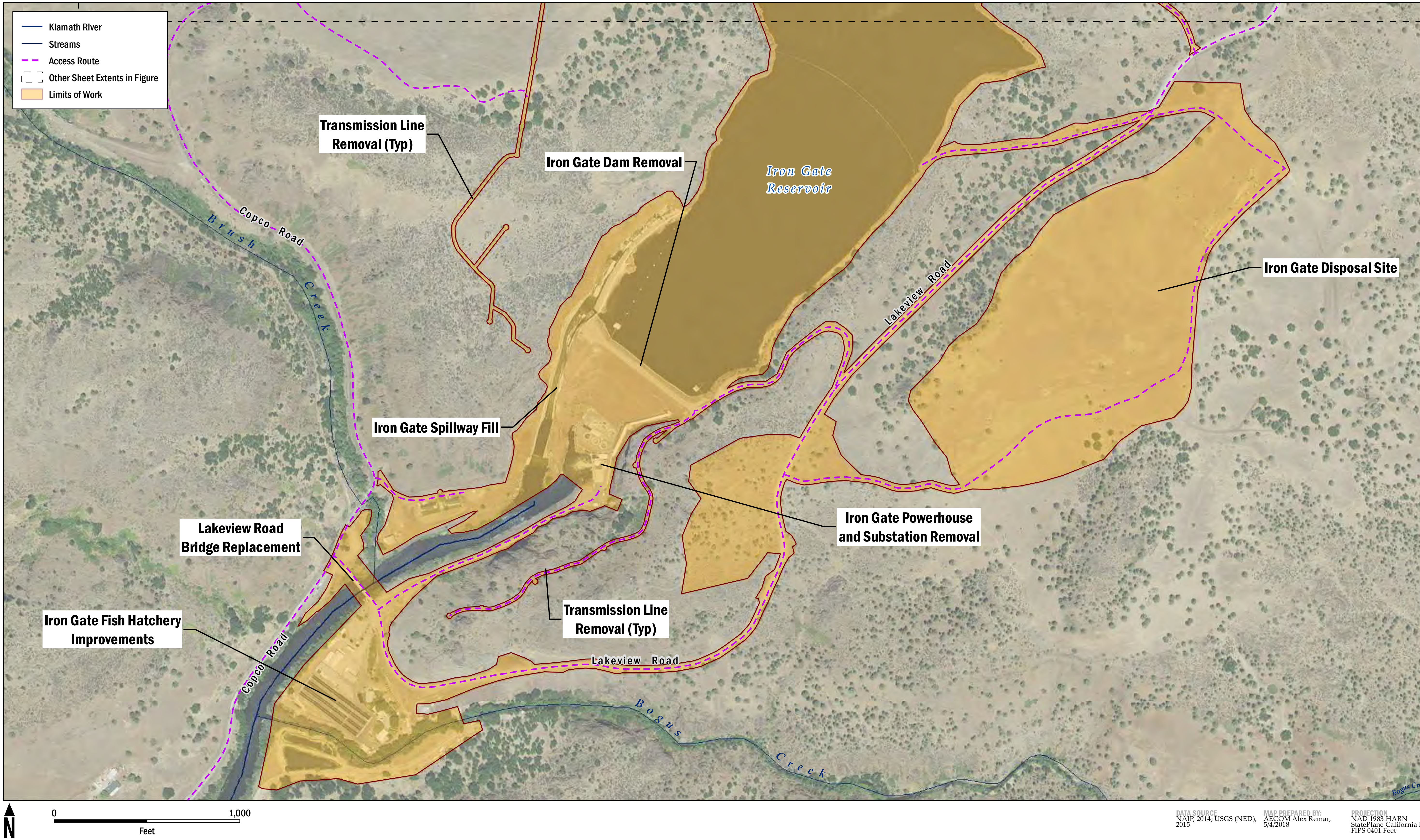
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 21 of 23



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
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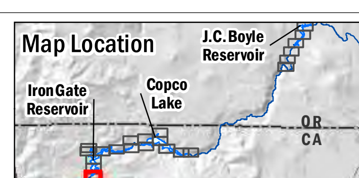
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access
Sheet 22 of 23

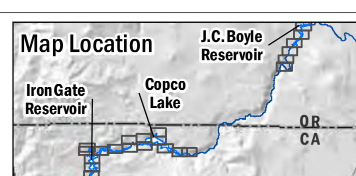
N
0 1,000
Feet

DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN
StatePlane California I
FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



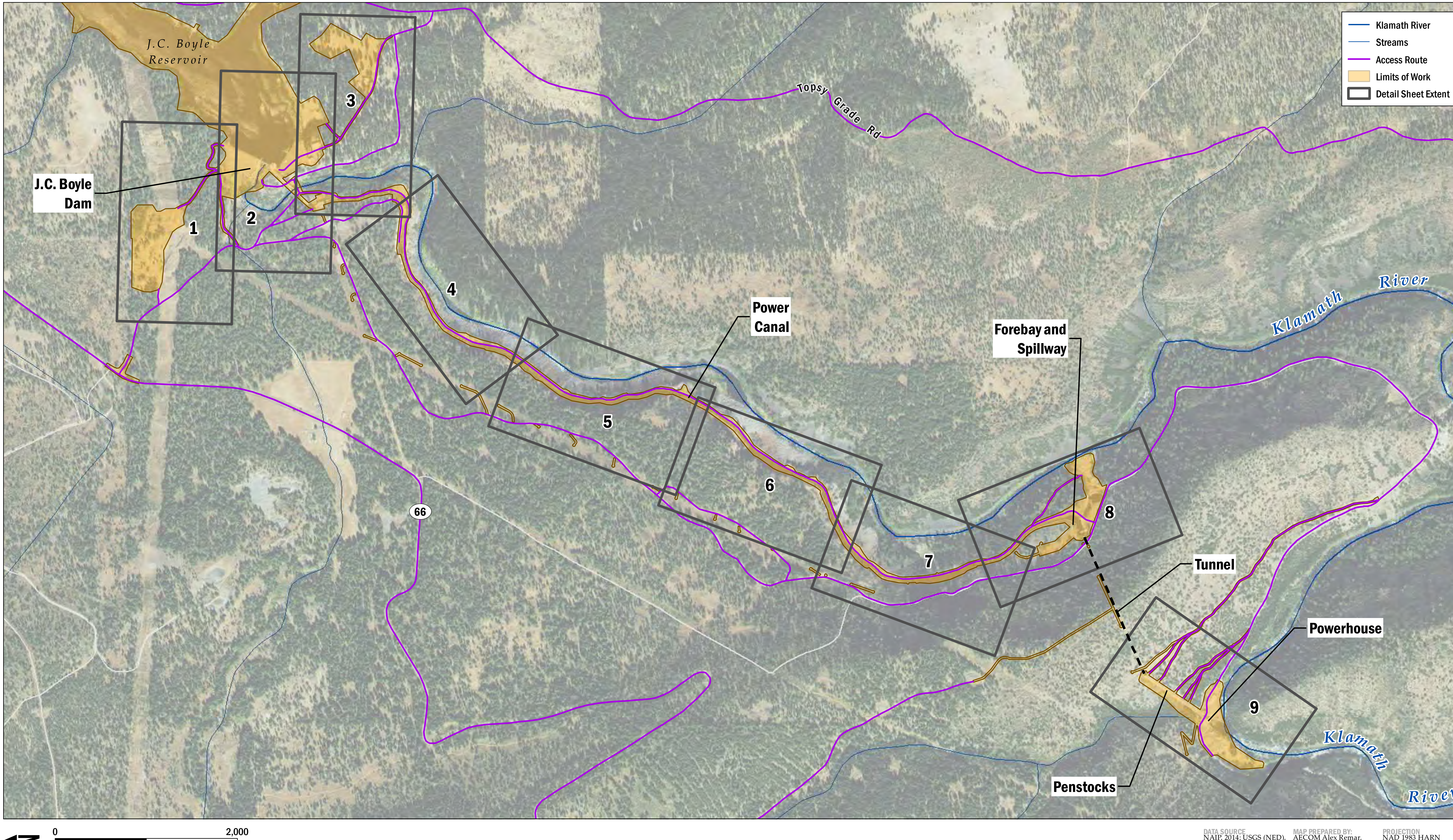
Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.1-1

Project Limits of Work and Access

Sheet 23 of 23

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_2-1_JCB_RemovalFeatureAndLimits_Overview.mxd



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

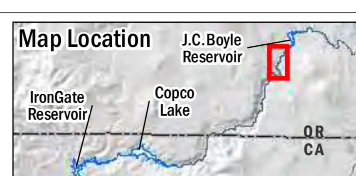
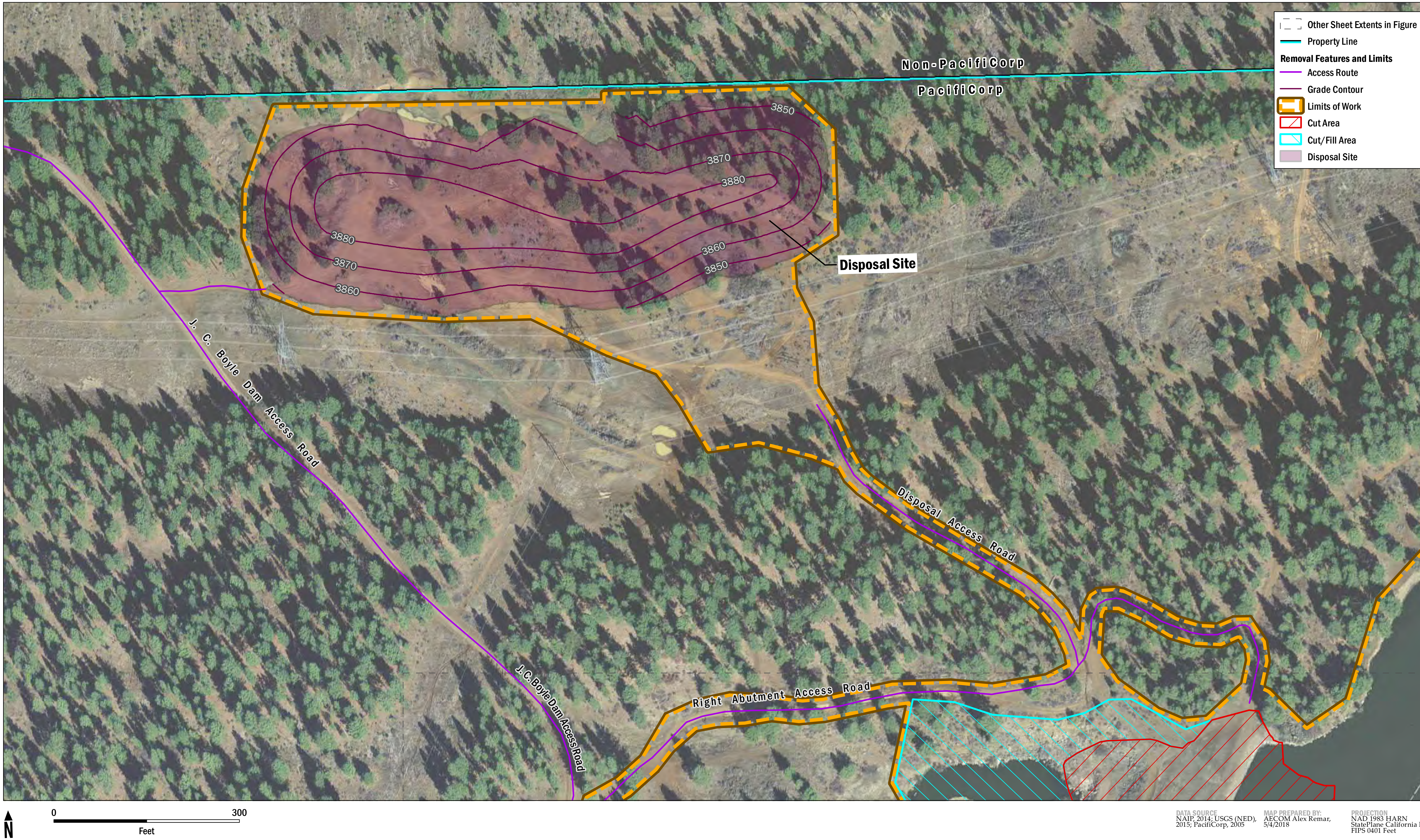


FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits
Overview Sheet



DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits

Sheet 1 of 9

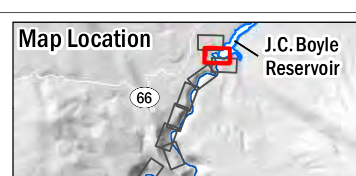
AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_2-1_JCB_RemovalFeatureAndLimits_Sheets.mxd

DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

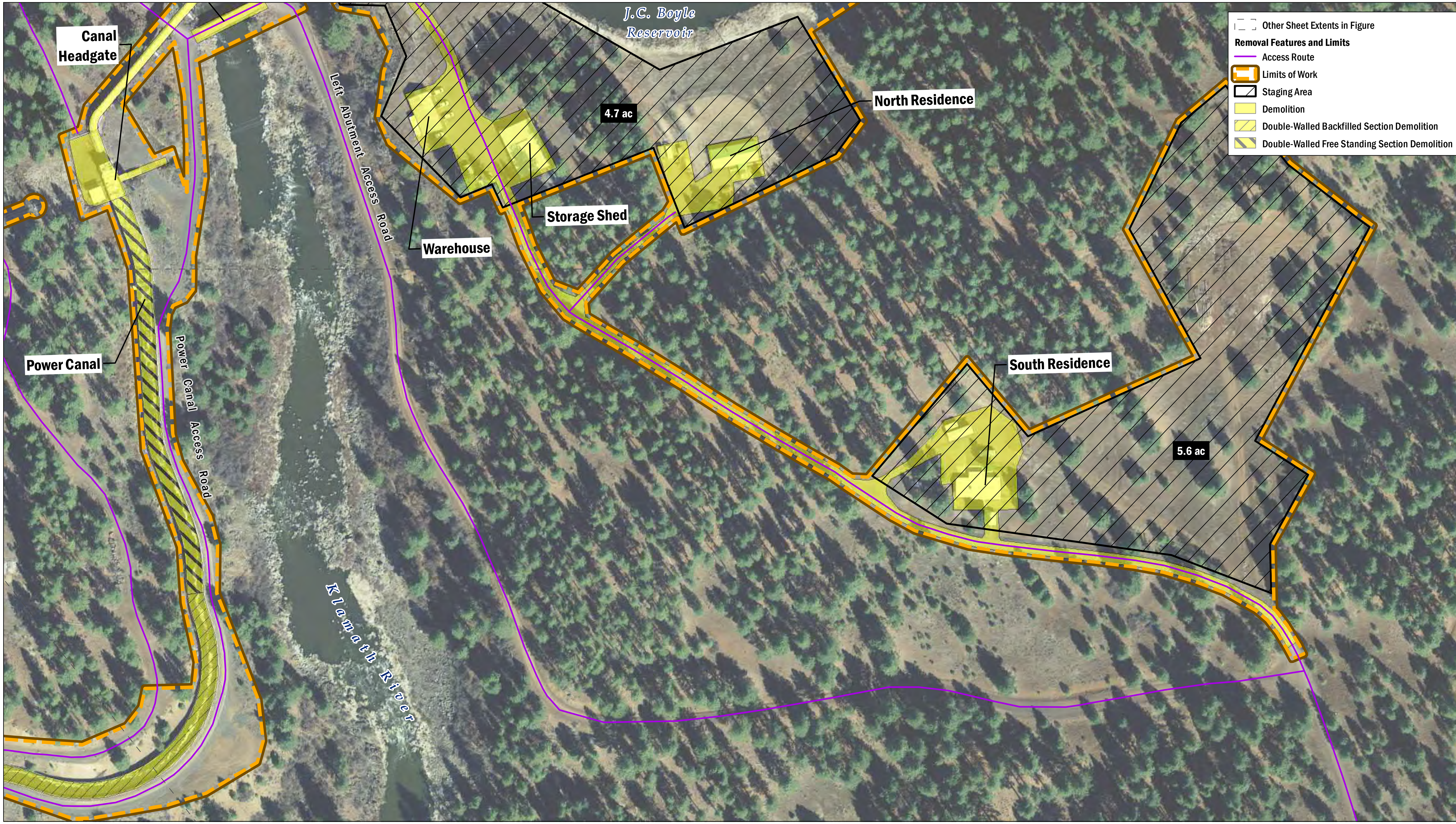
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits
Sheet 2 of 9



DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

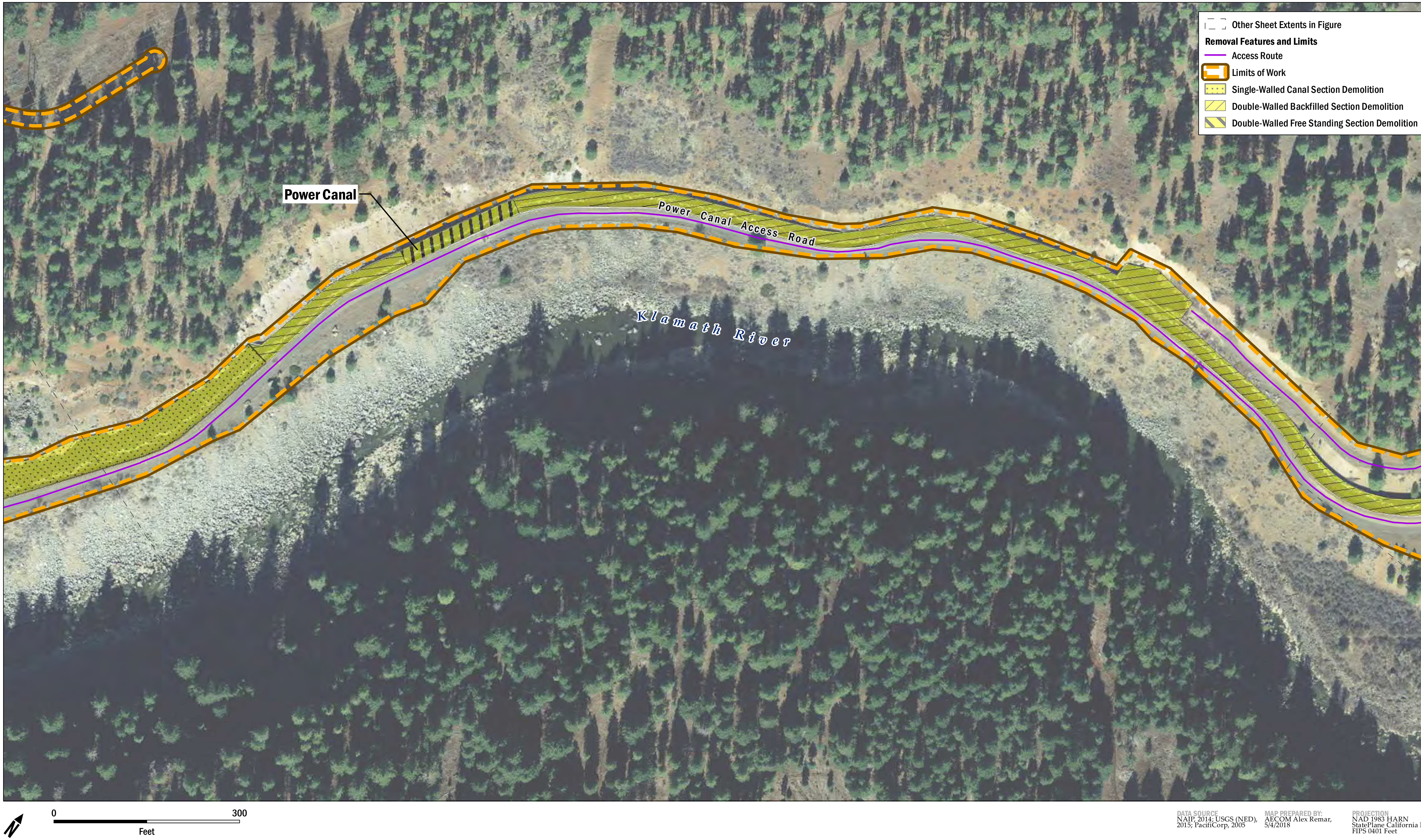
Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits

Sheet 3 of 9

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_2-1_JCB_RemovalFeatureAndLimits_Sheets.mxd

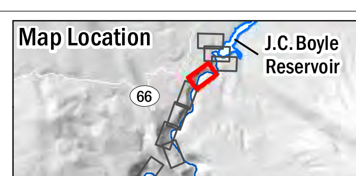


DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



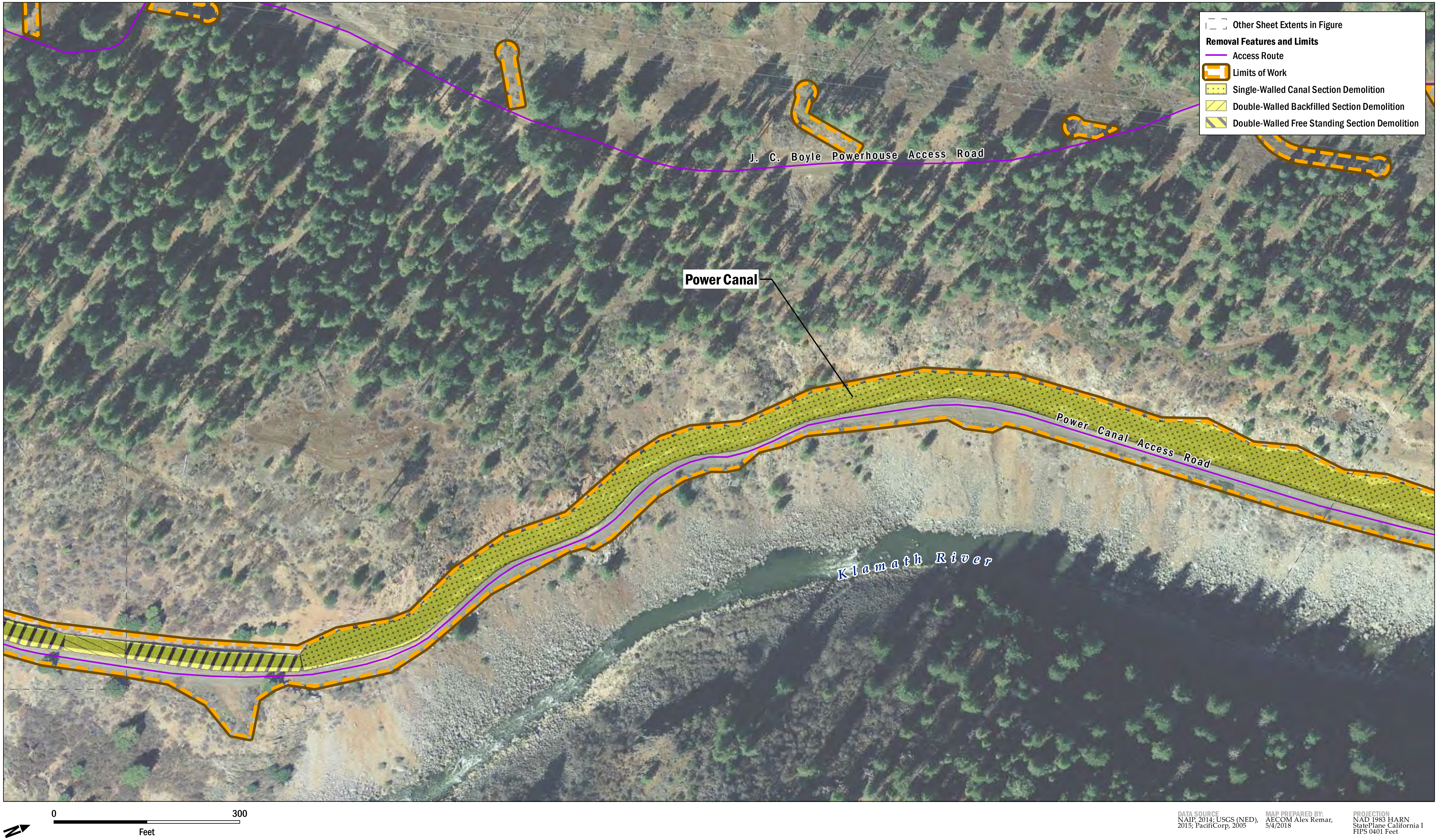
Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits

Sheet 4 of 9

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_2-1_JCB_RemovalFeatureAndLimits_Sheets.mxd



DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
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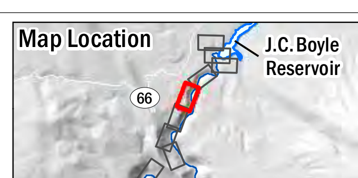
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits
Sheet 5 of 9

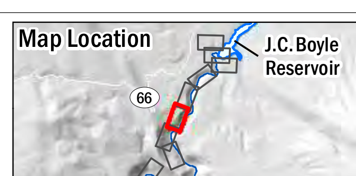
AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_2-1_JCB_RemovalFeatureAndLimits_Sheets.mxd

DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits

Sheet 6 of 9

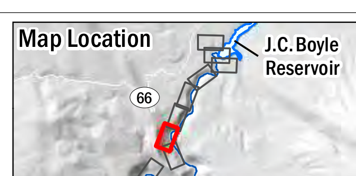
AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_2-1_JCB_RemovalFeatureAndLimits_Sheets.mxd

DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

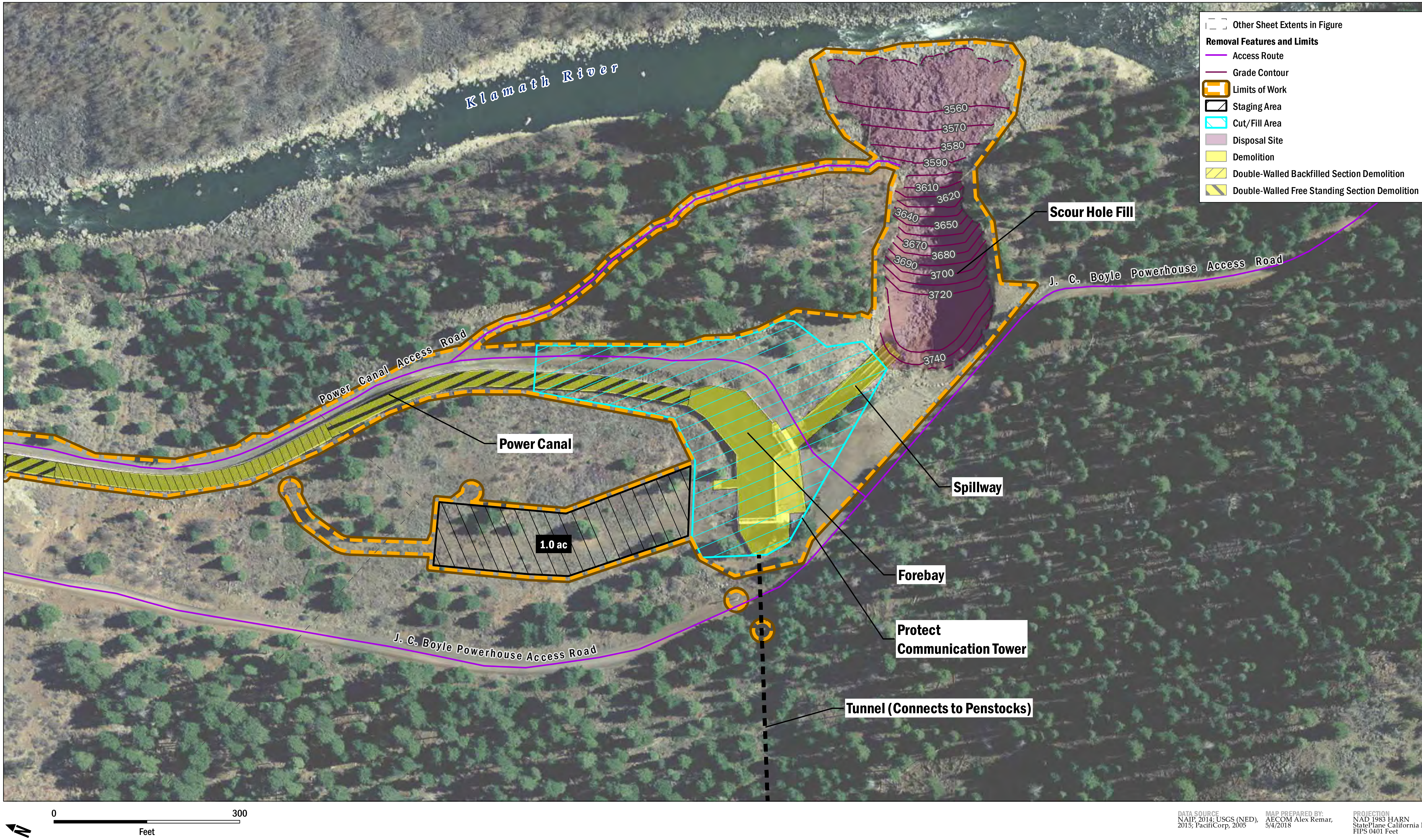


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits

Sheet 7 of 9



DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

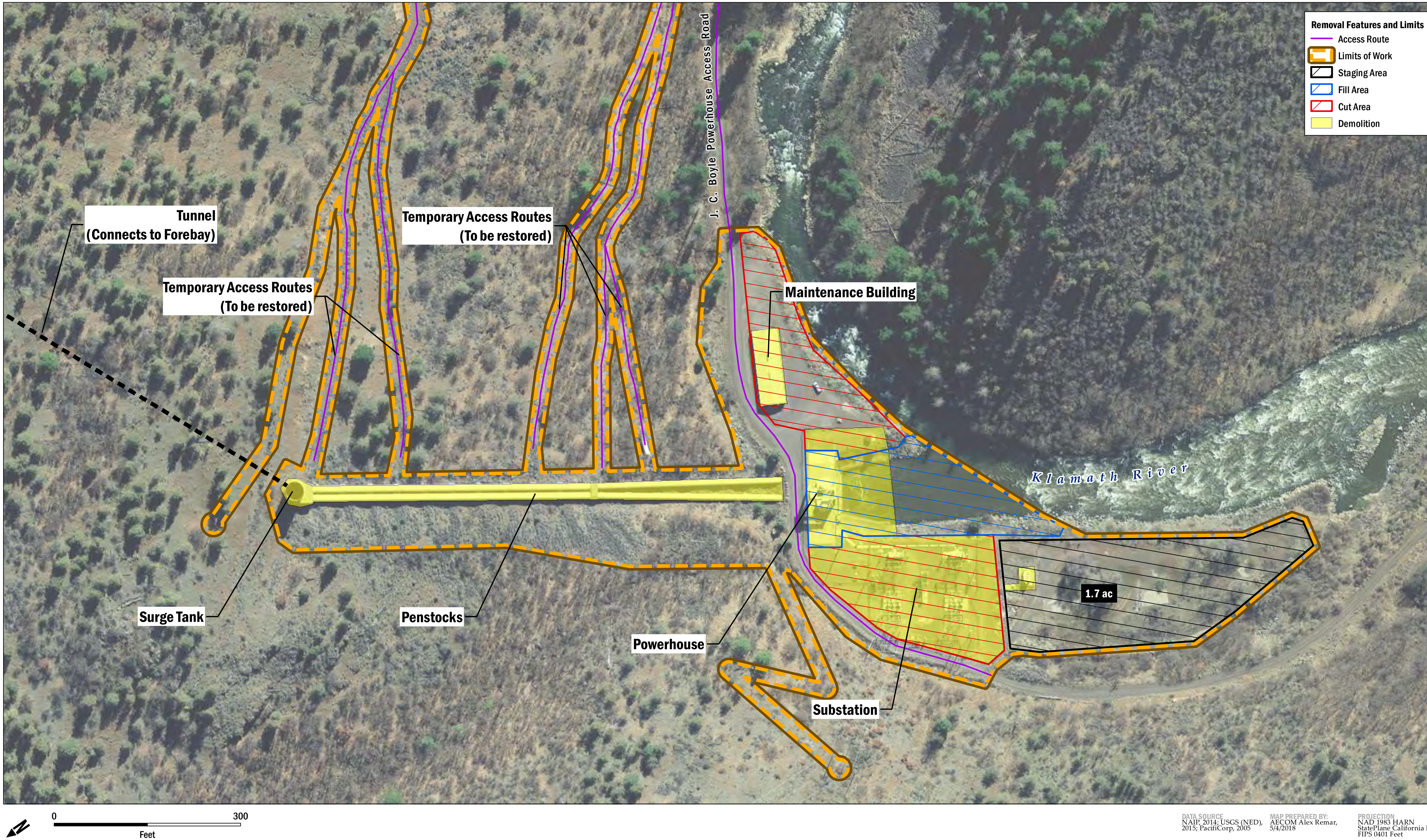
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

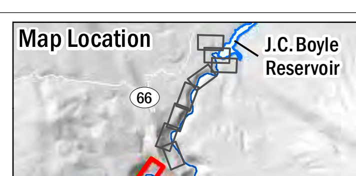
FIGURE 5.2-1

J.C. Boyle Dam Removal Features and Limits

Sheet 8 of 9

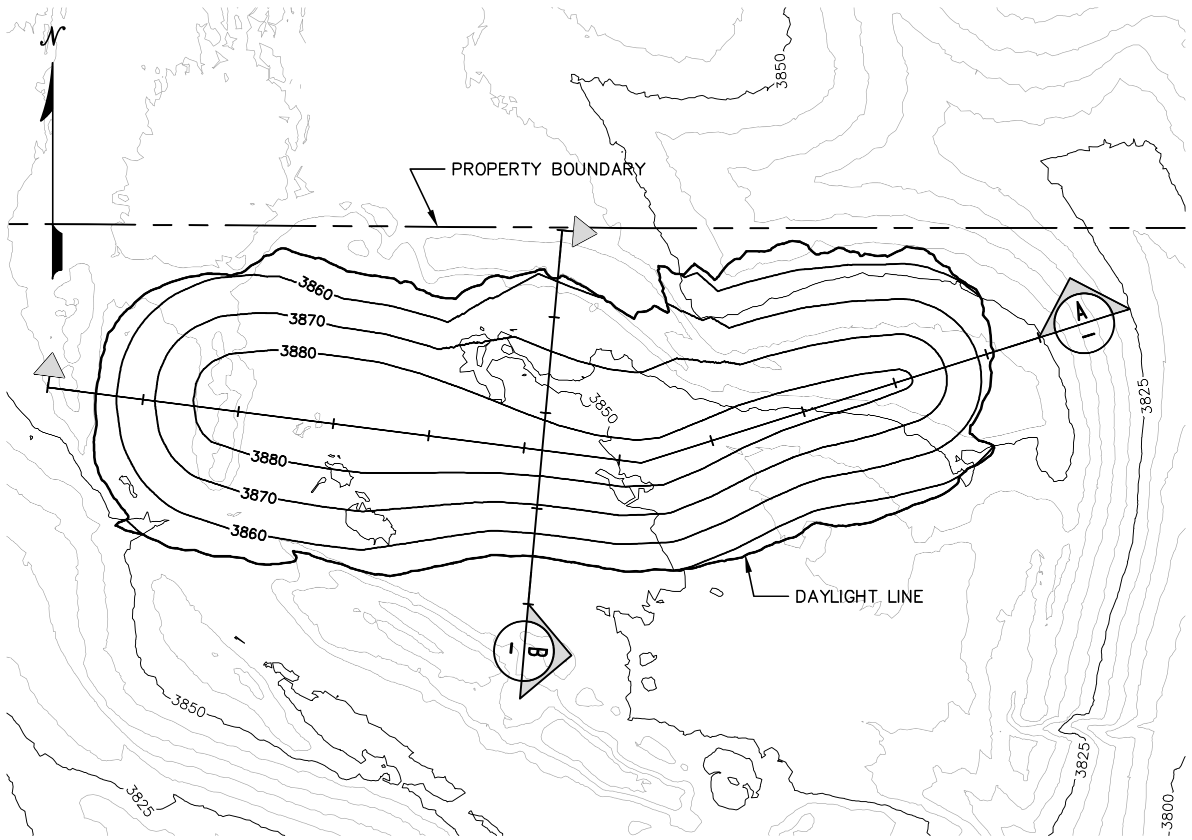


AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



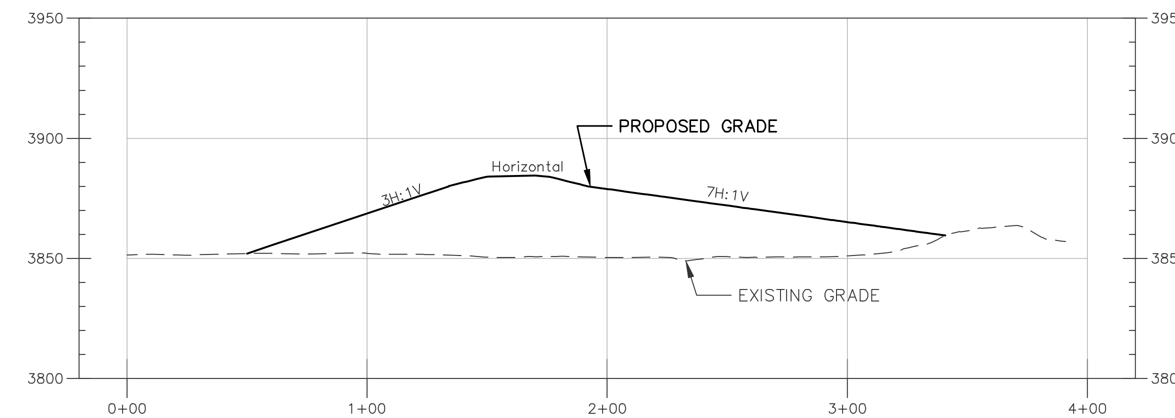
Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.2-1
J.C. Boyle Dam Removal Features and Limits
Sheet 9 of 9

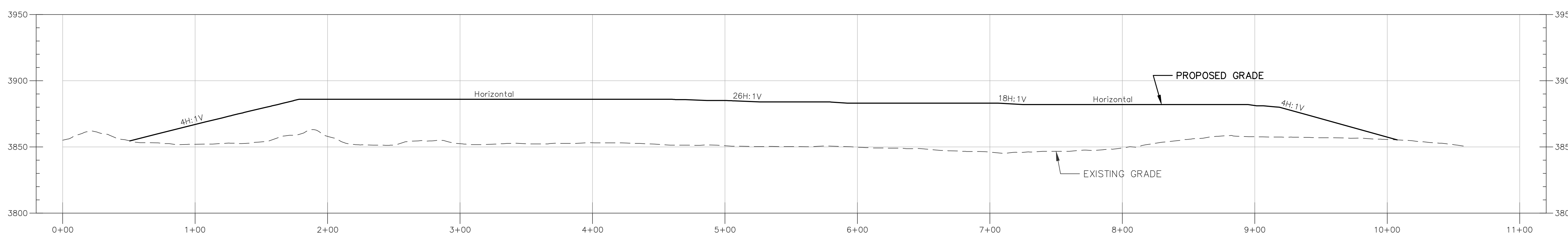


PLAN

0 100 200
HORIZ 1"=200'



B SECTION
HORIZ 1"=80', VERT 1"=80'



A SECTION
HORIZ 1"=80', VERT 1"=80'

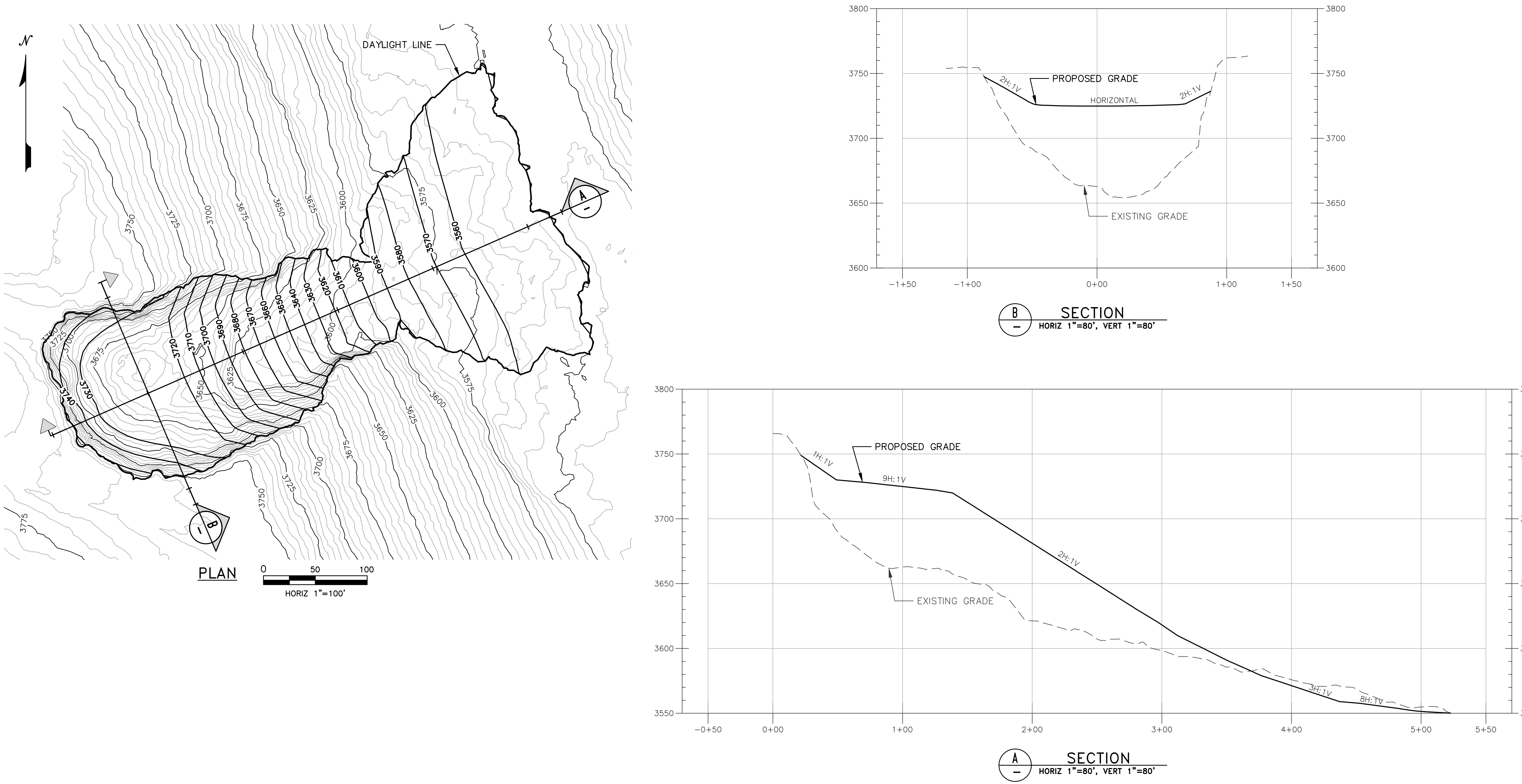
AECOM

Klamath River Renewal Corporation

Klamath River Renewal Project

FIGURE 5.2-8

J.C. Boyle Right Abutment Disposal Site Plan & Sections



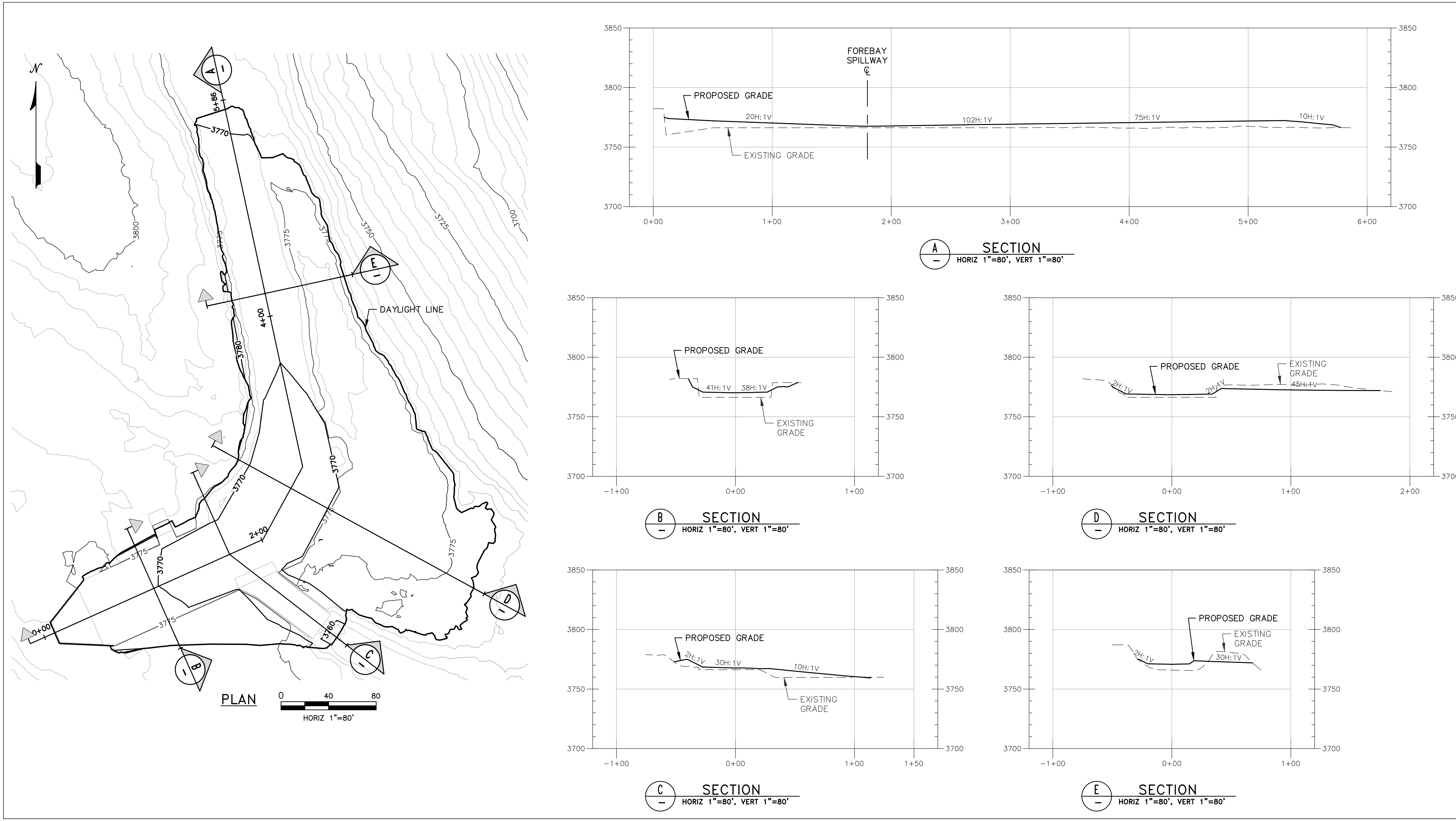
AECOM

Klamath River Renewal Corporation

Klamath River Renewal Project

FIGURE 5.2-9

J.C. Boyle Forebay Spillway Scour Hole Backfill Plan & Sections



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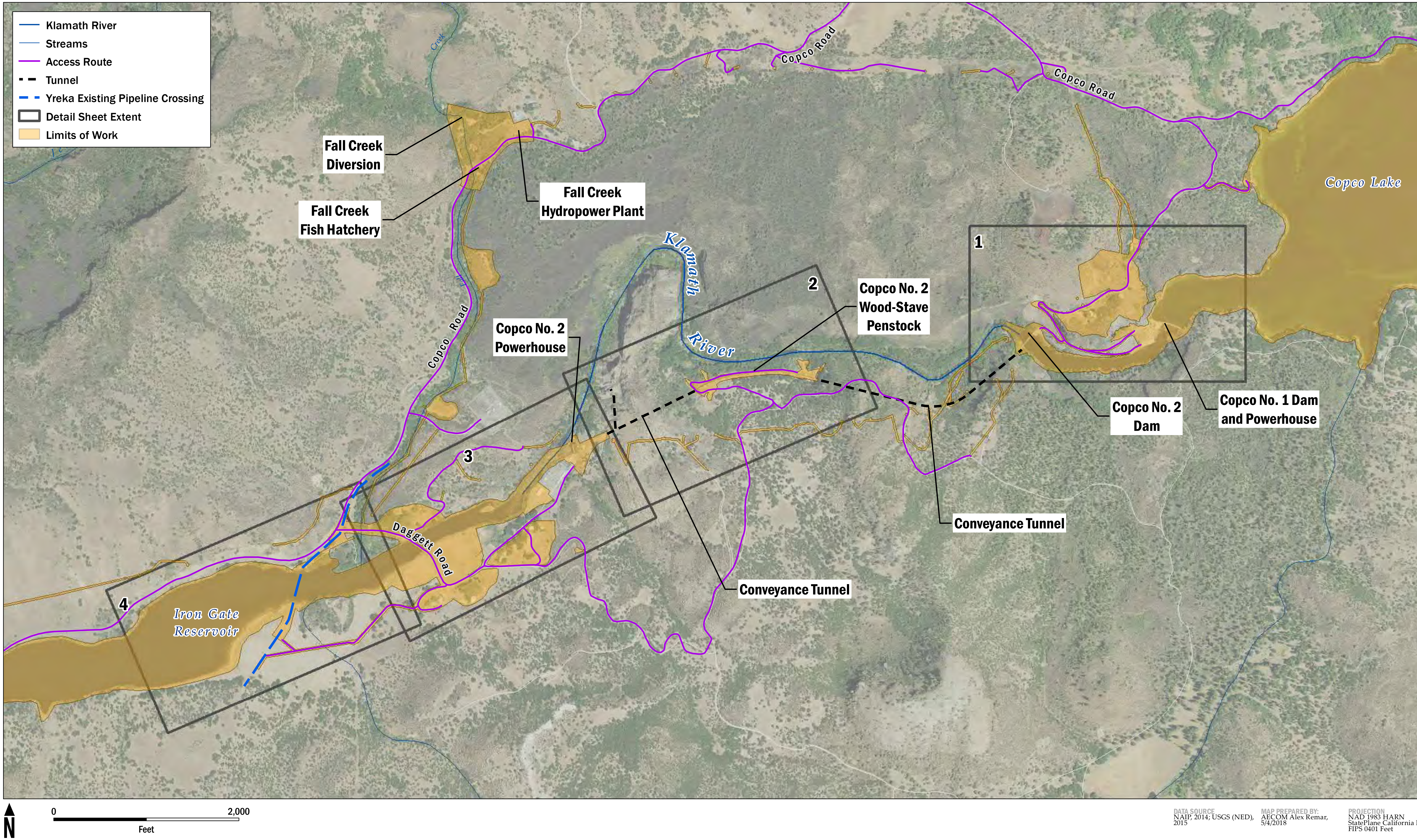
Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 5.2-11
J.C. Boyle Forebay Backfill Plan & Sections

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_3-1_Copco_RemovalFeatureAndLimits_Overview.mxd



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

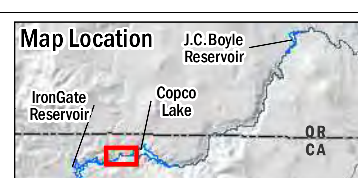
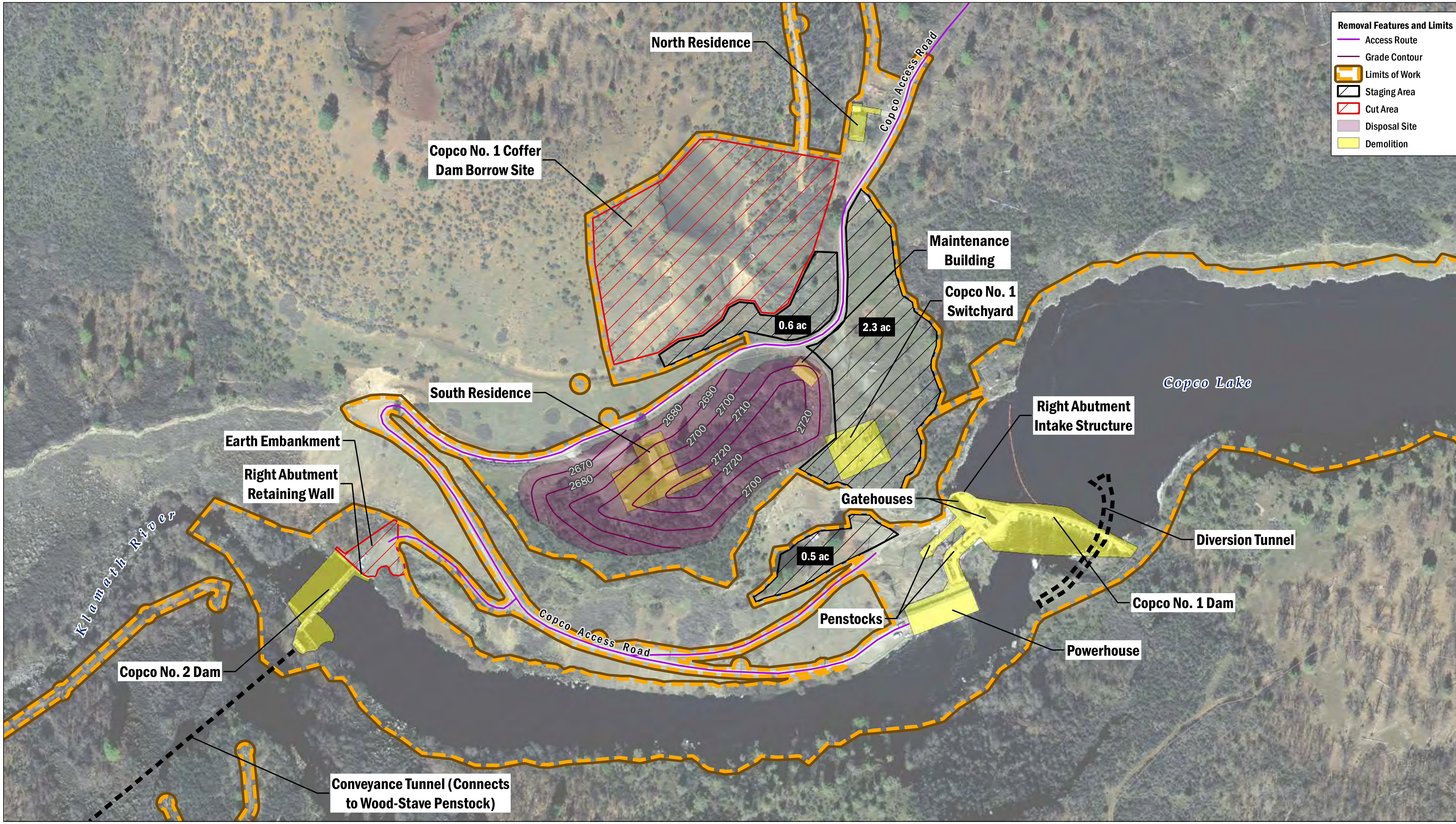


FIGURE 5.3-1

Copco No. 1 and Copco No. 2 Dams Removal Features and Limits Overview Sheet

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_3-1_Copco_RemovalFeatureAndLimits_Sheet1.mxd

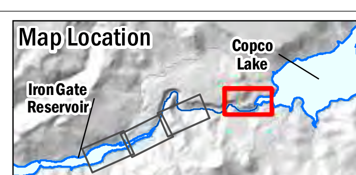


DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

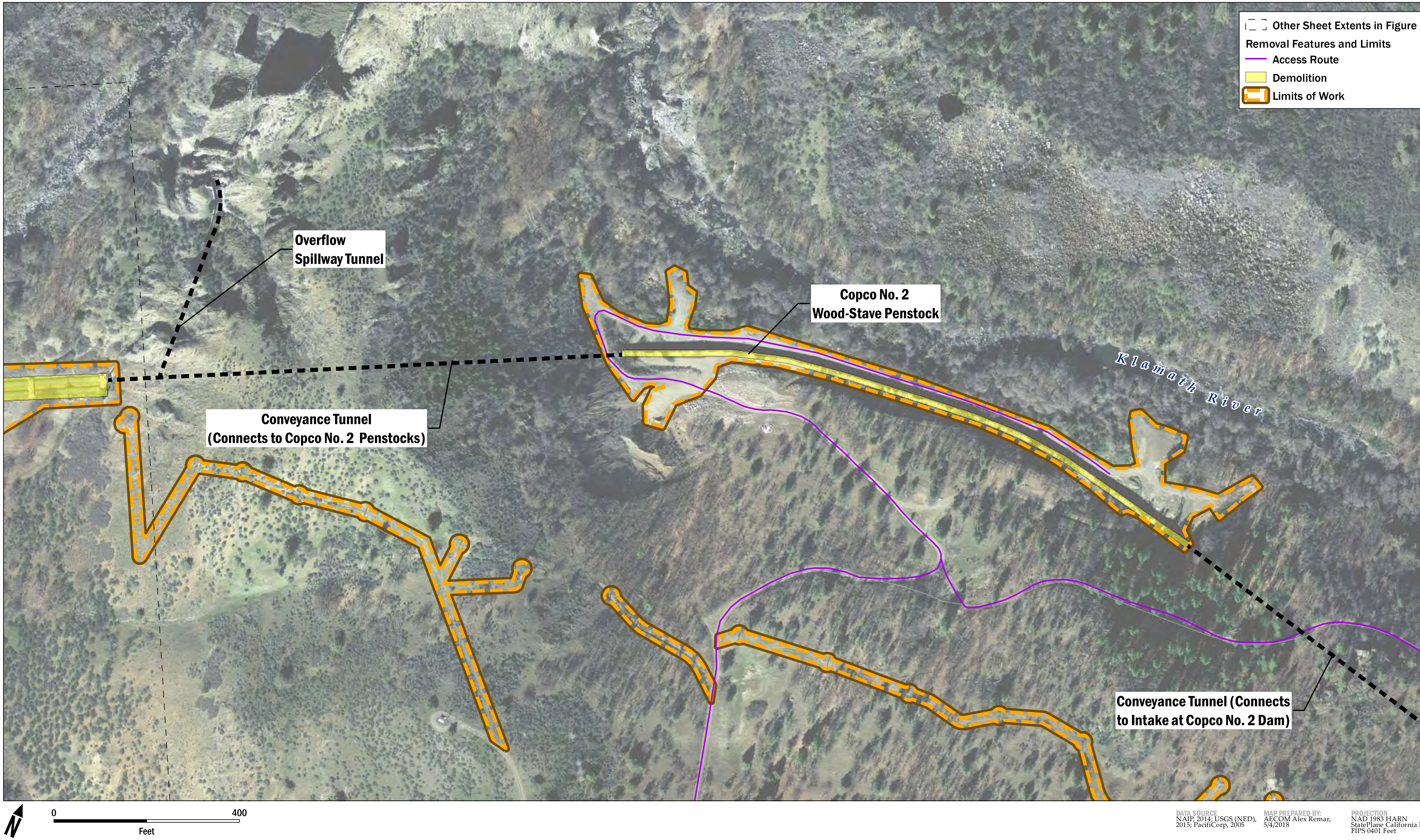
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.3-1

Copco No. 1 and Copco No. 2 Dams Removal Features and Limits
Sheet 1 of 4



DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
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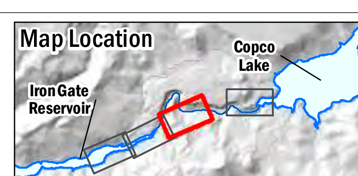
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



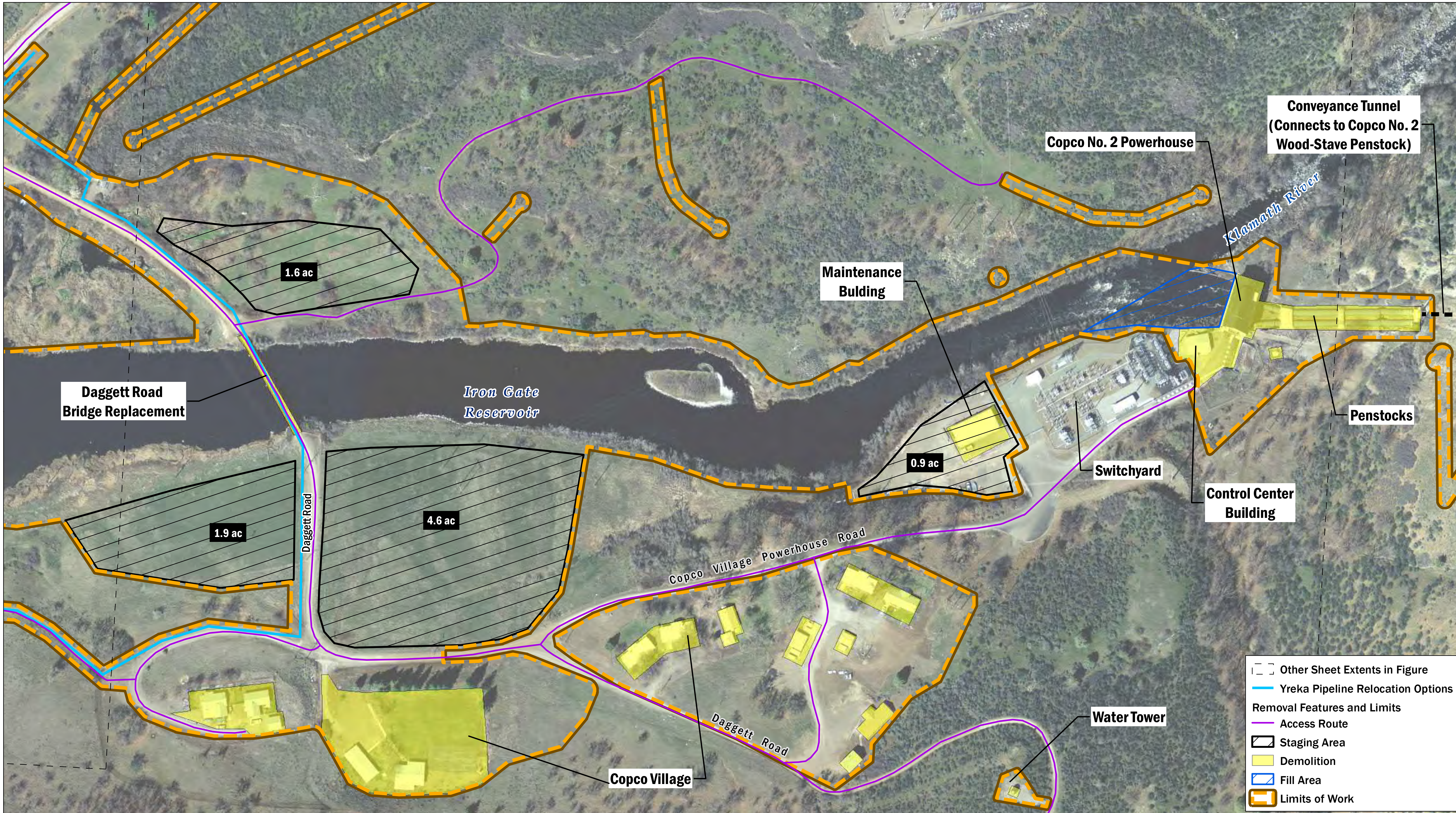
Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.3-1

Copco No. 1 and Copco No. 2 Dams Removal Features and Limits

Sheet 2 of 4

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_3-1_Copco_RemovalFeatureAndLimits_Sheet3.mxd



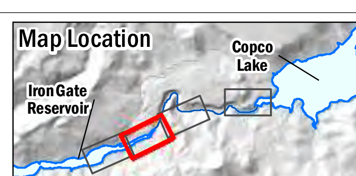
0 400
Feet

DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.3-1

Copco No. 1 and Copco No. 2 Dams Removal Features and Limits

Sheet 3 of 4

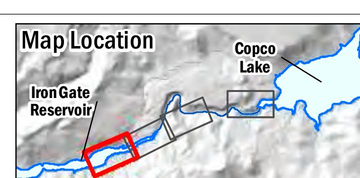
AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_3-1_Copco_RemovalFeatureAndLimits_Sheet4.mxd

DATA SOURCE
NAIP, 2014; USGS (NED), 2015; PacifiCorp, 2005

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

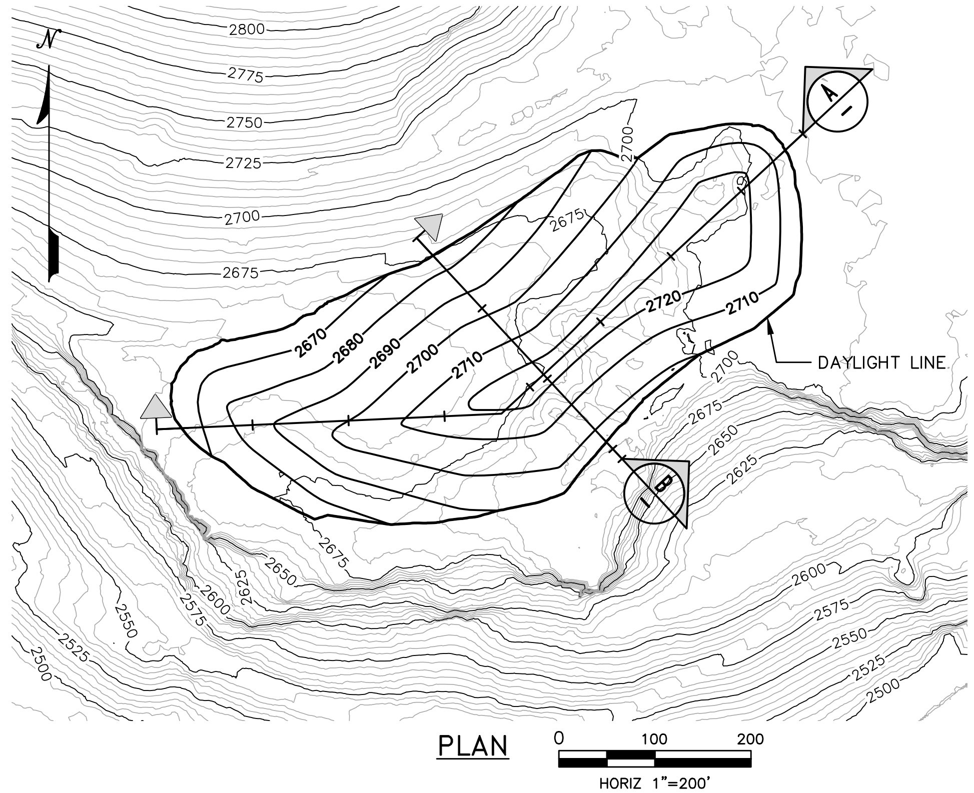
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

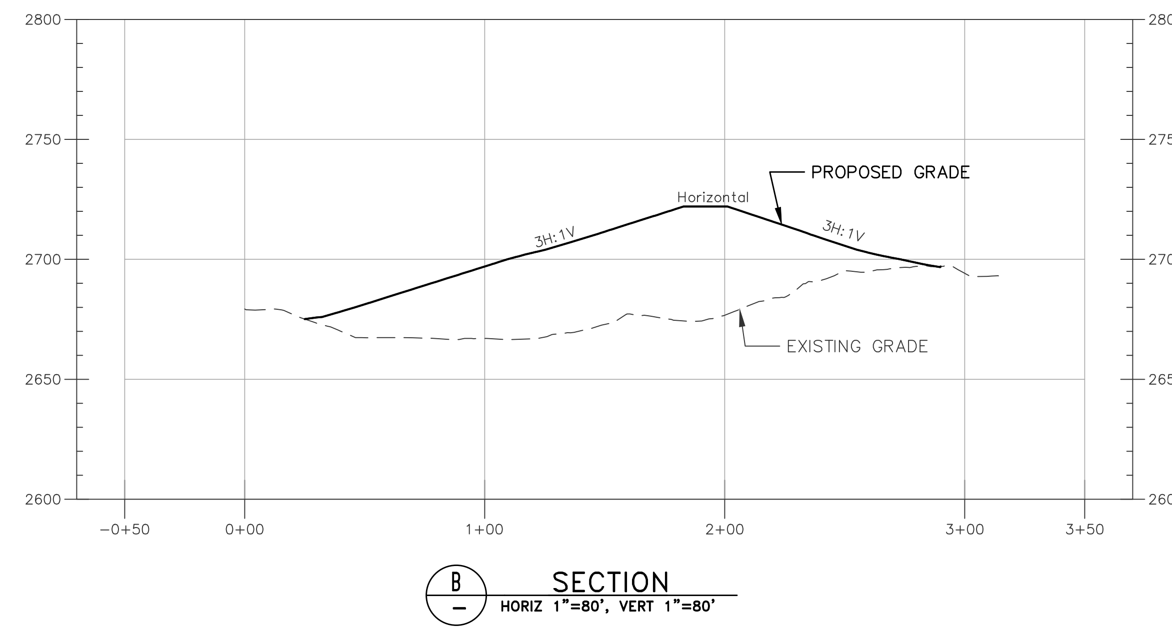


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.3-1

Copco No. 1 and Copco No. 2 Dams Removal Features and Limits
Sheet 4 of 4





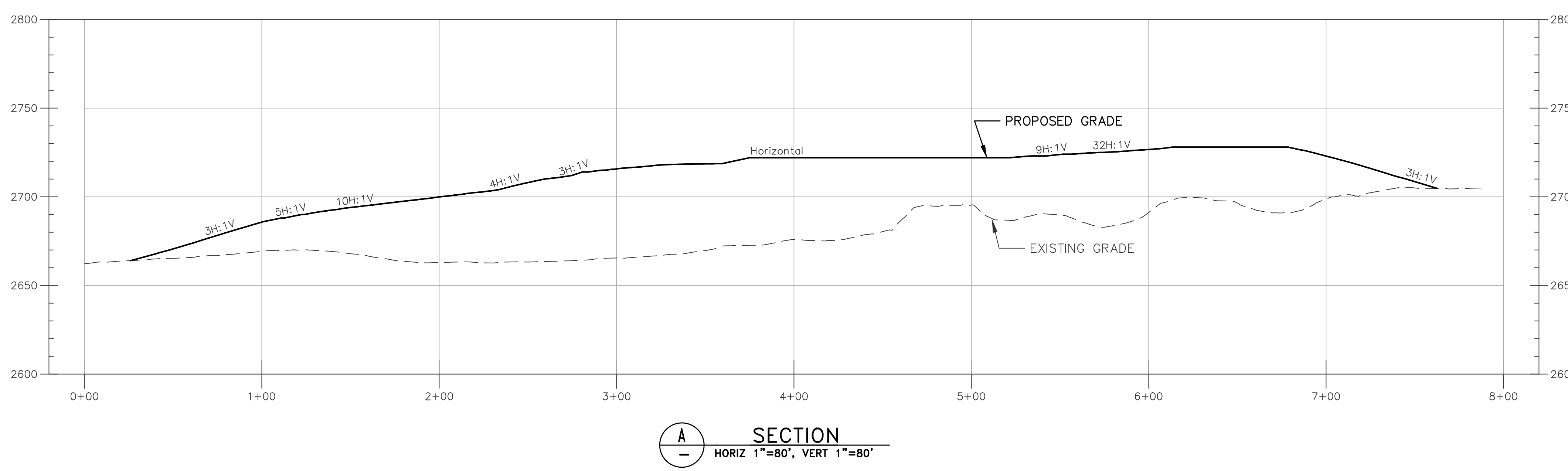
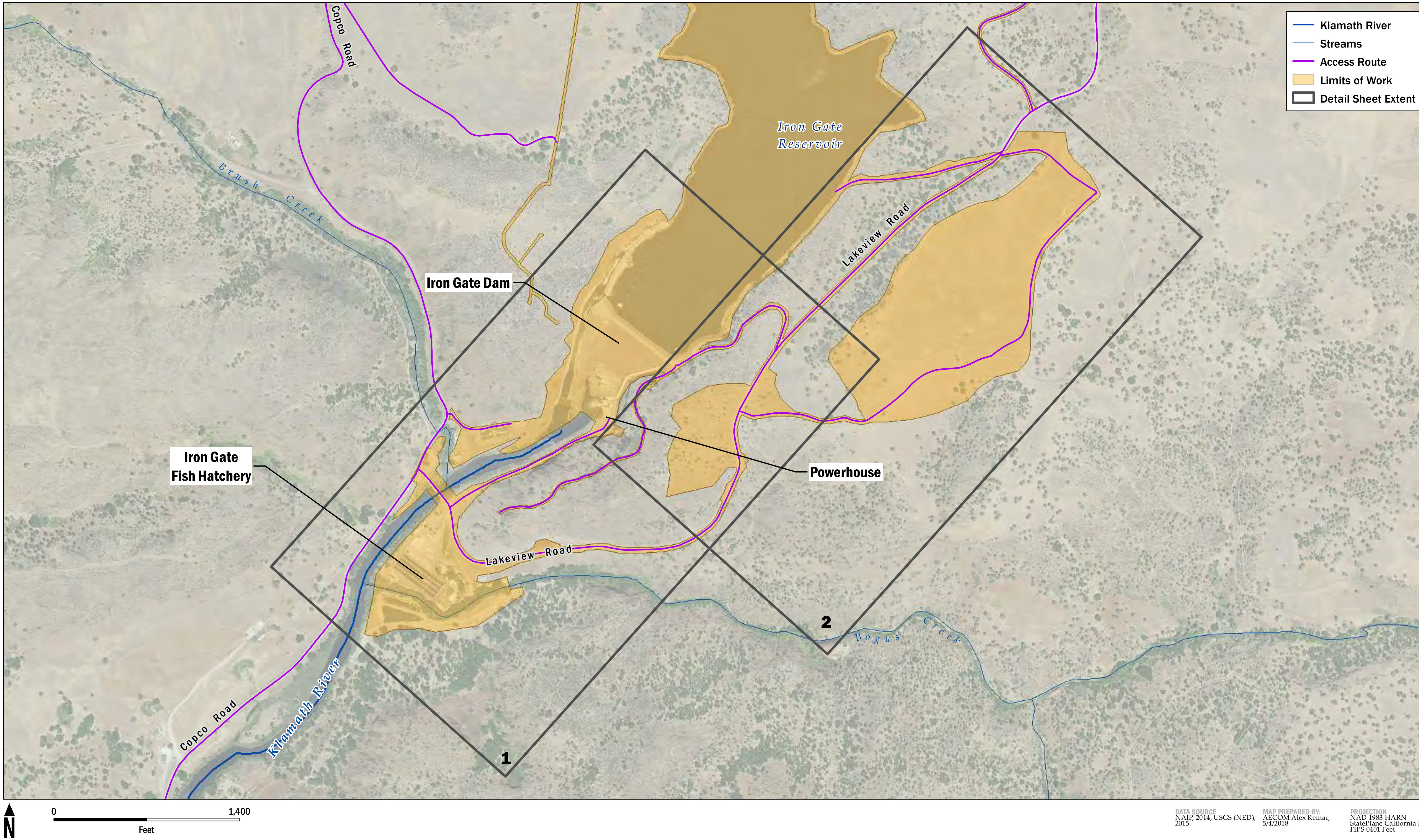


FIGURE 5.3-8

Copco No. 1 & Copco No. 2 Disposal Site Plan & Sections



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

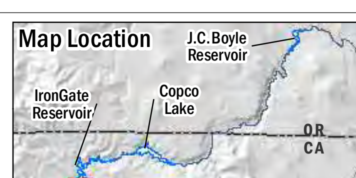
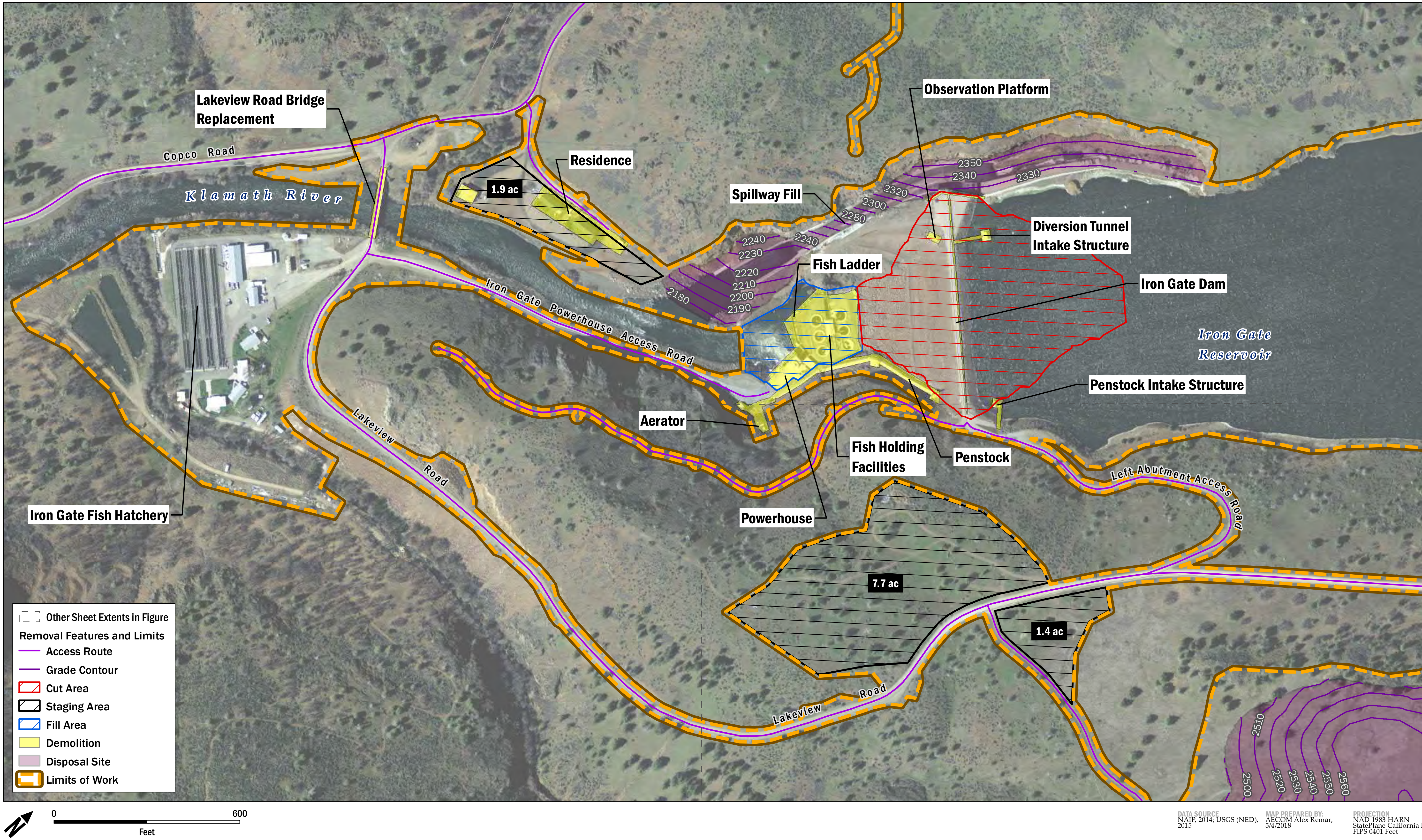


FIGURE 5.5-1

Iron Gate Dam Removal Features and Limits Overview Sheet

AECOM Oakland CA 5/4/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_5_5-1_IG_RemovalFeatureAndLimits_Sheet1.mxd

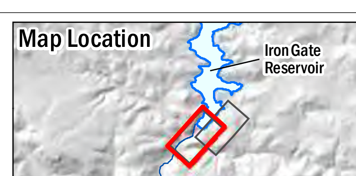


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

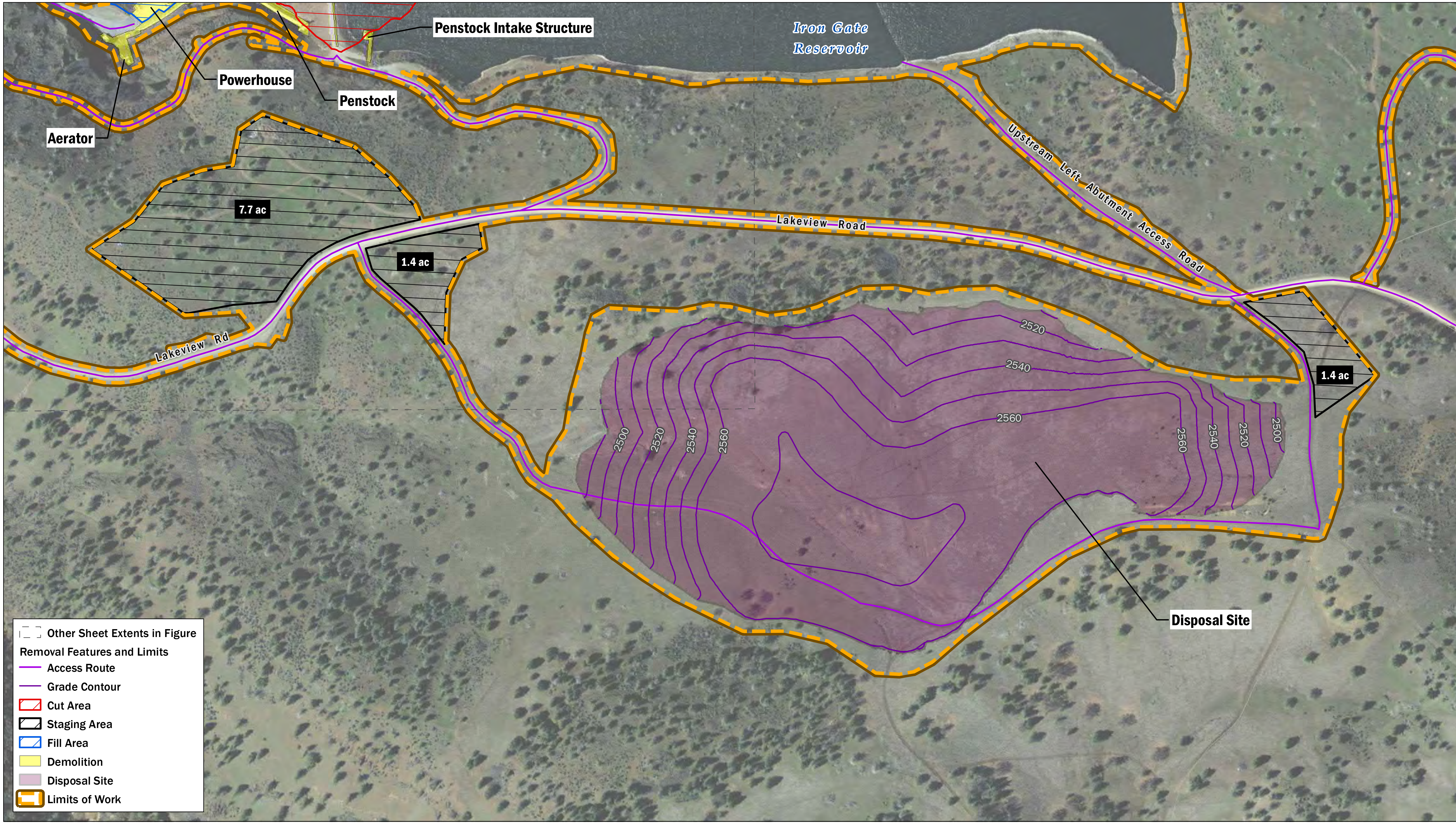


Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.5-1

Iron Gate Dam Removal Features and Limits

Sheet 1 of 2

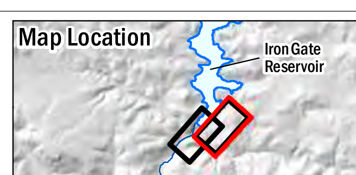


DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/4/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

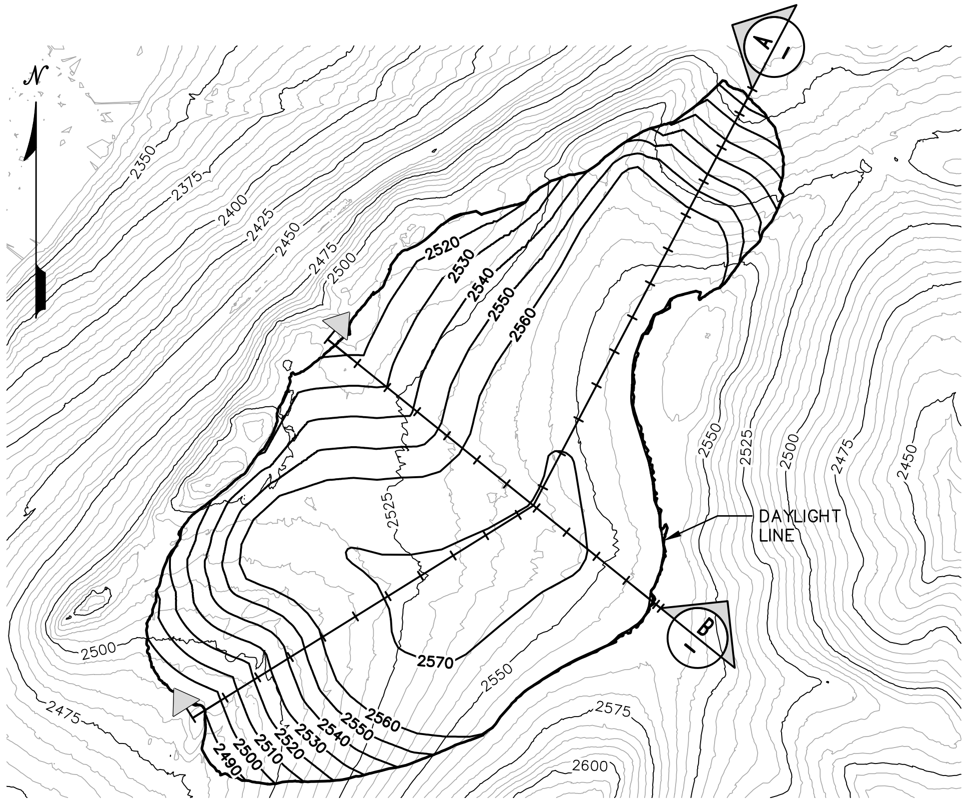
AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project



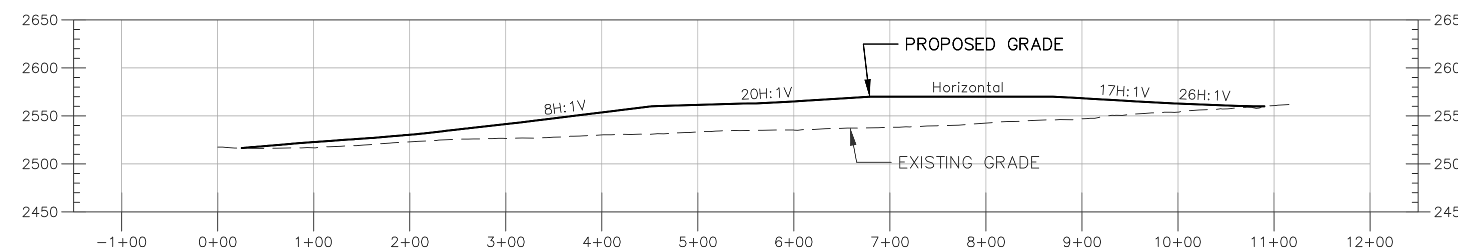
Note: Limits of work features that exist as small islands and/or narrow linear corridors are associated with project transmission line removal

FIGURE 5.5-1

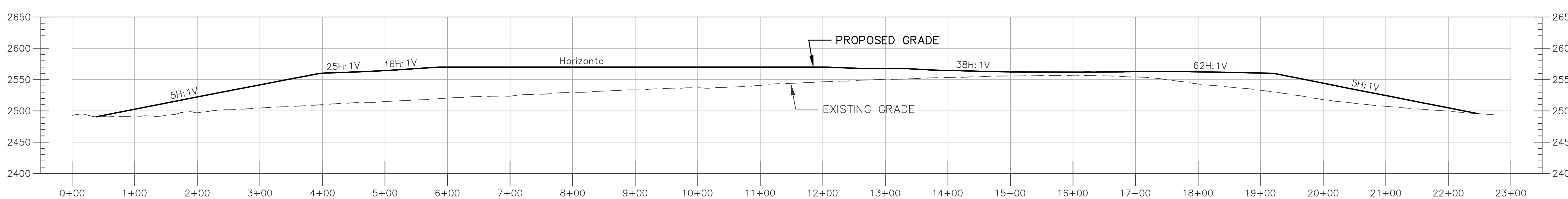
Iron Gate Dam Removal Features and Limits
Sheet 2 of 2



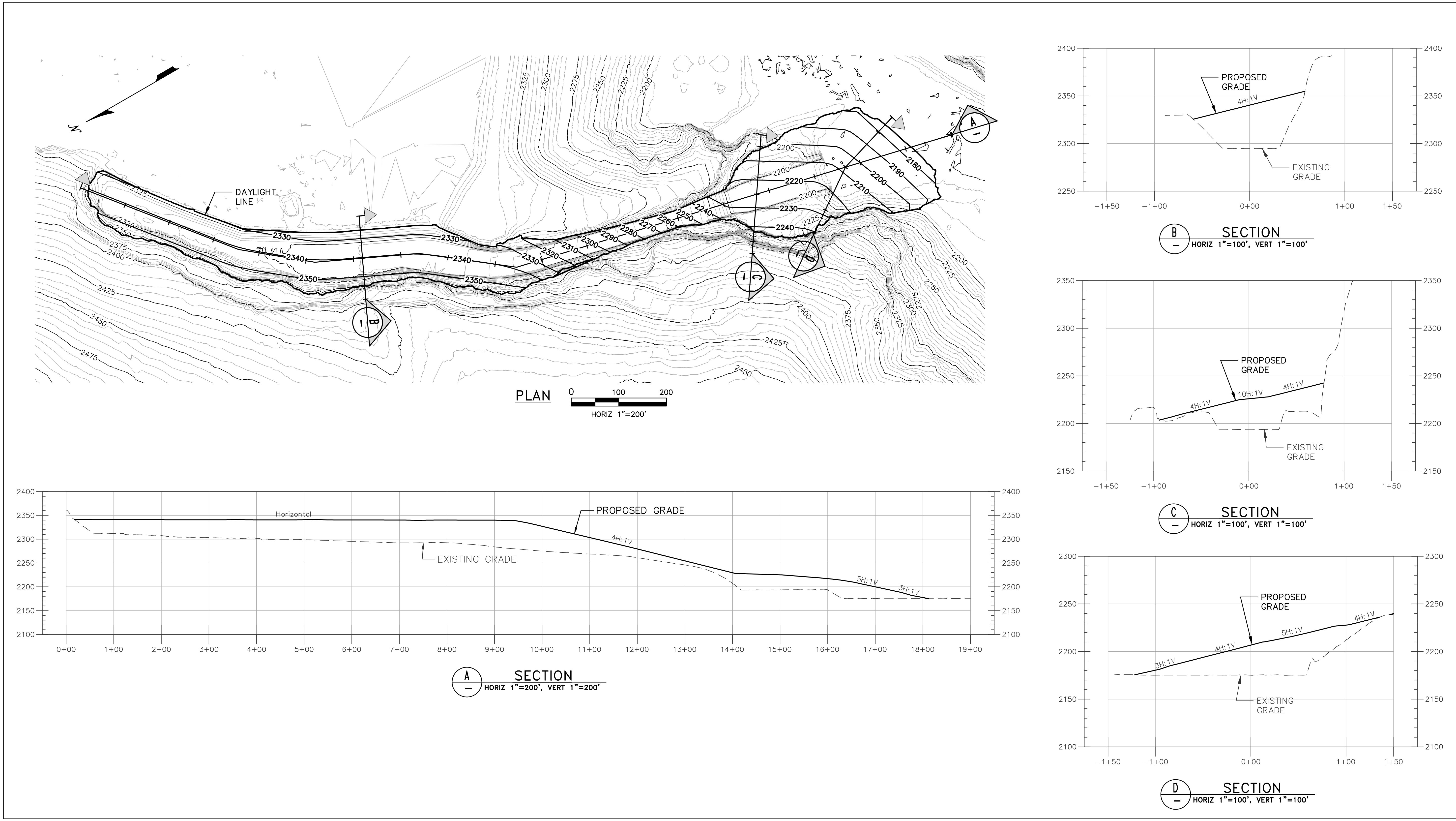
PLAN
0 250 500
HORIZ 1"=500'



B — SECTION
HORIZ 1"=200', VERT 1"=200'



A — SECTION
HORIZ 1"=200', VERT 1"=200'



AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 5.5-5
Iron Gate Spillway Backfill Plan & Sections

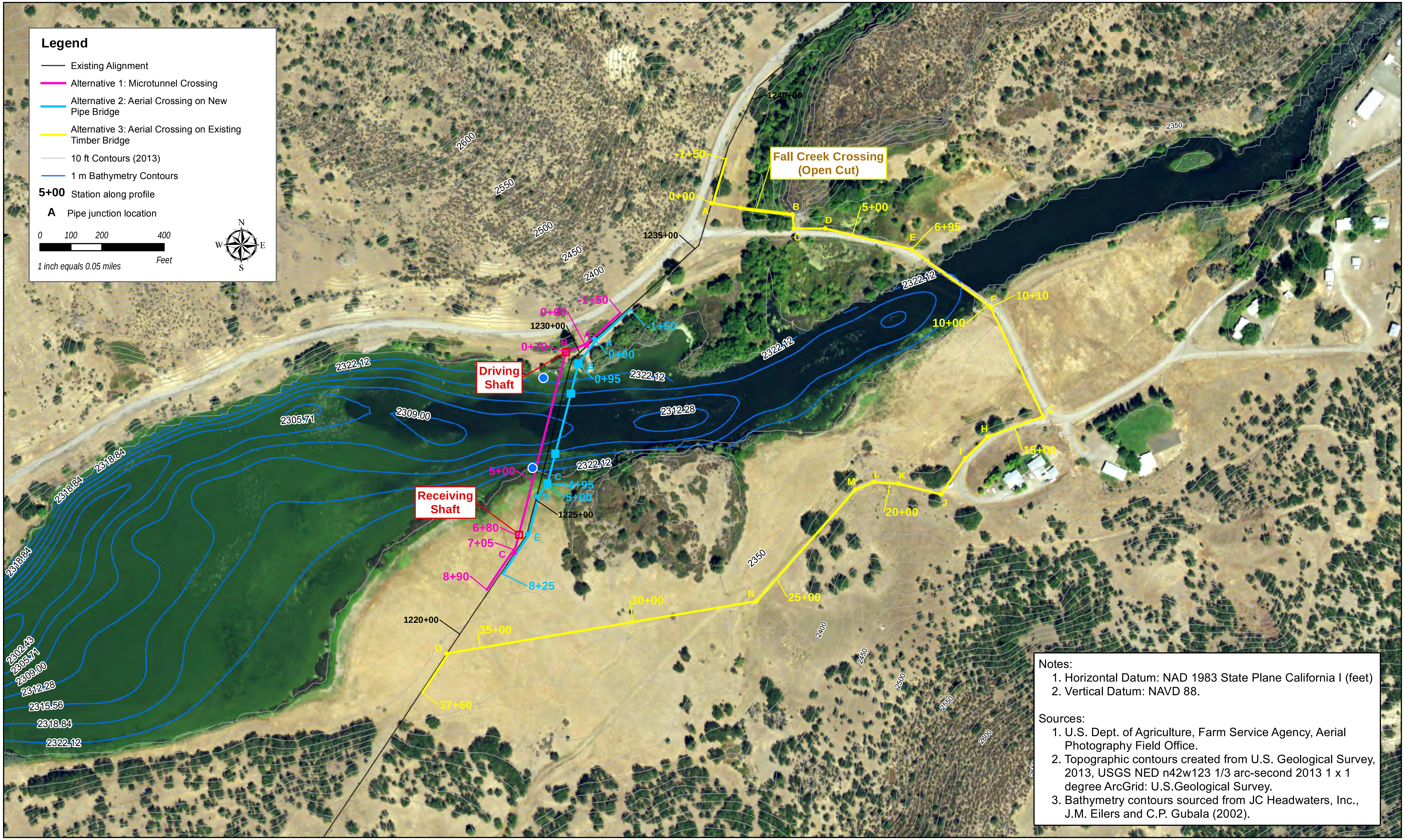


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FIGURE 7.5-2: ALIGNMENTS FOR KLAMATH RIVER CROSSING CONCEPTUAL ALTERNATIVES

Klamath Dams Removal Project – Yreka Waterline Replacement

September 14, 2017

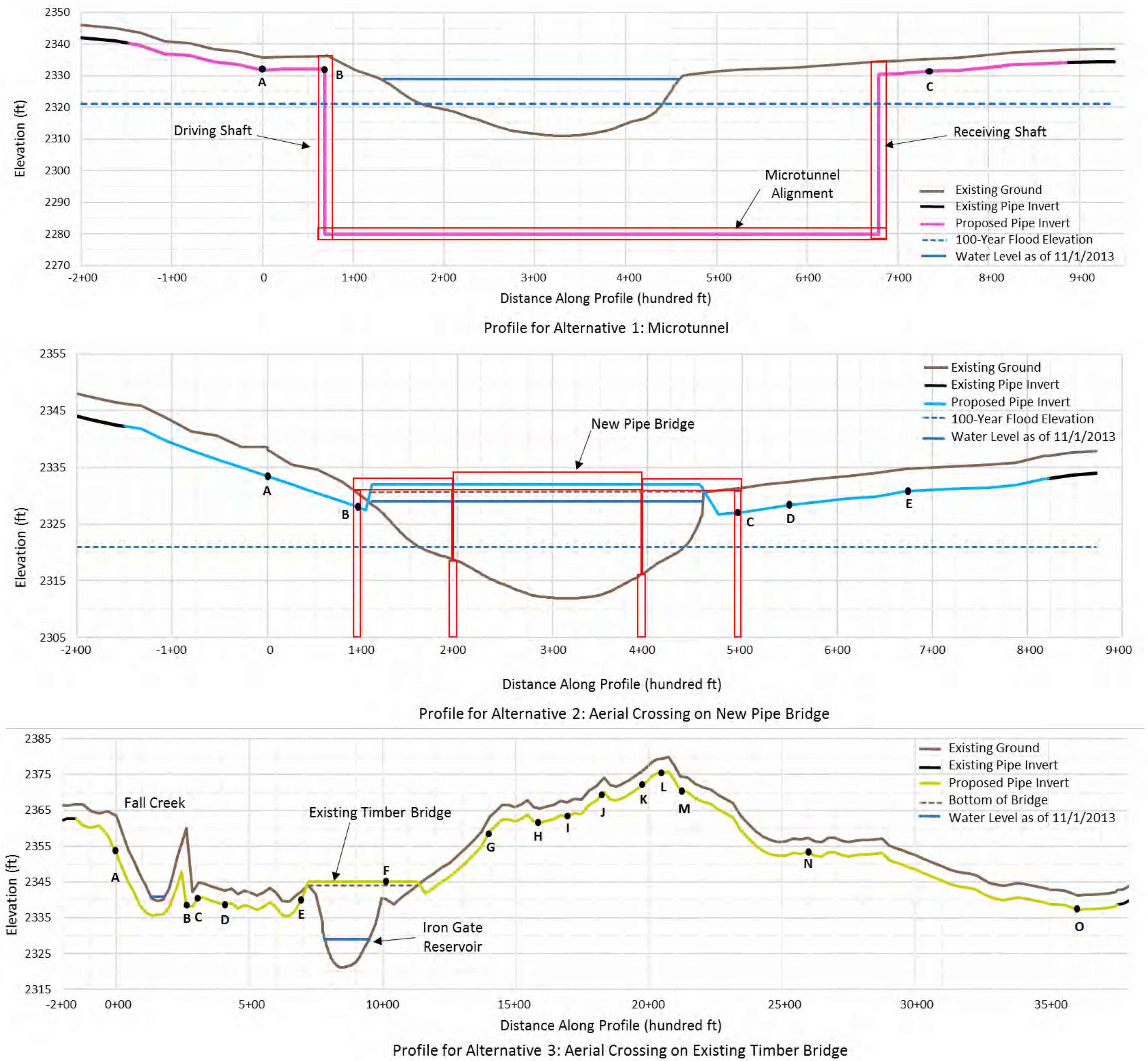
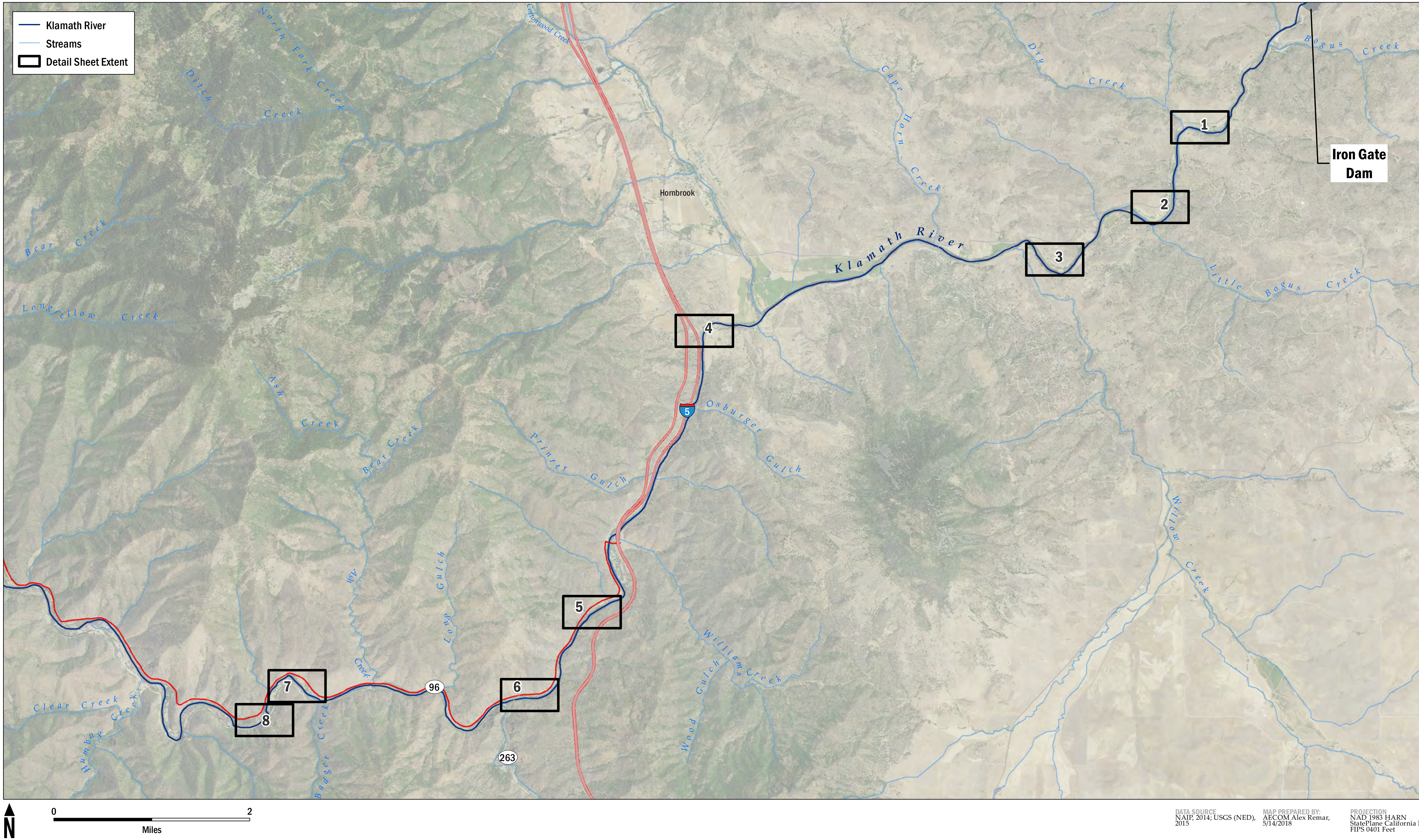


FIGURE 7.5-3: PROFILES FOR KLAMATH RIVER CROSSING CONCEPTUAL ALTERNATIVES
Klamath Dams Removal Project – Yreka Waterline Replacement
September 14, 2017

AECOM Oakland CA 5/14/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_7_7-1_Floodproofing_Overview.mxd



DATA SOURCE
NAIP, 2014; USGS (NED), 2015

MAP PREPARED BY:
AECOM Alex Remar, 5/14/2018

PROJECTION
NAD 1983 HARN StatePlane California I FIPS 0401 Feet

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

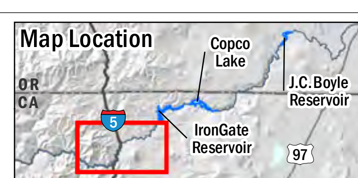
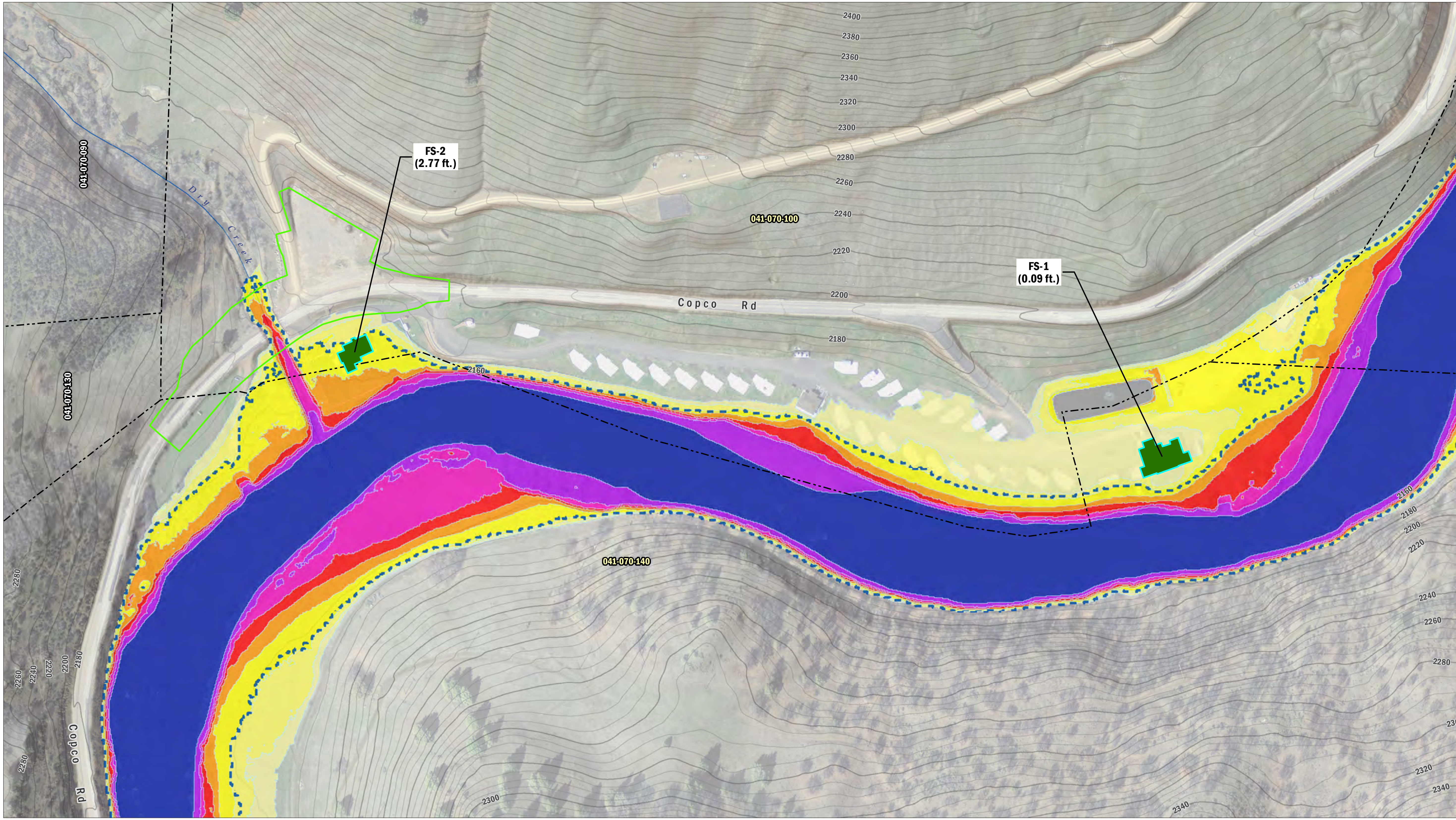


FIGURE 7.7-1

Structures in 100-Year Floodplain Following Dam Removal Overview Sheet

AECOM Oakland CA 5/14/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_7_7-1_Floodproofing_Sheets.mxd



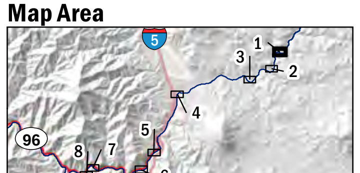
N

0 400
Feet

PacifiCorp, 2004; NAIP Imagery, 2014;
AECOM, 2018; FEMA, 2011

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

Map Area



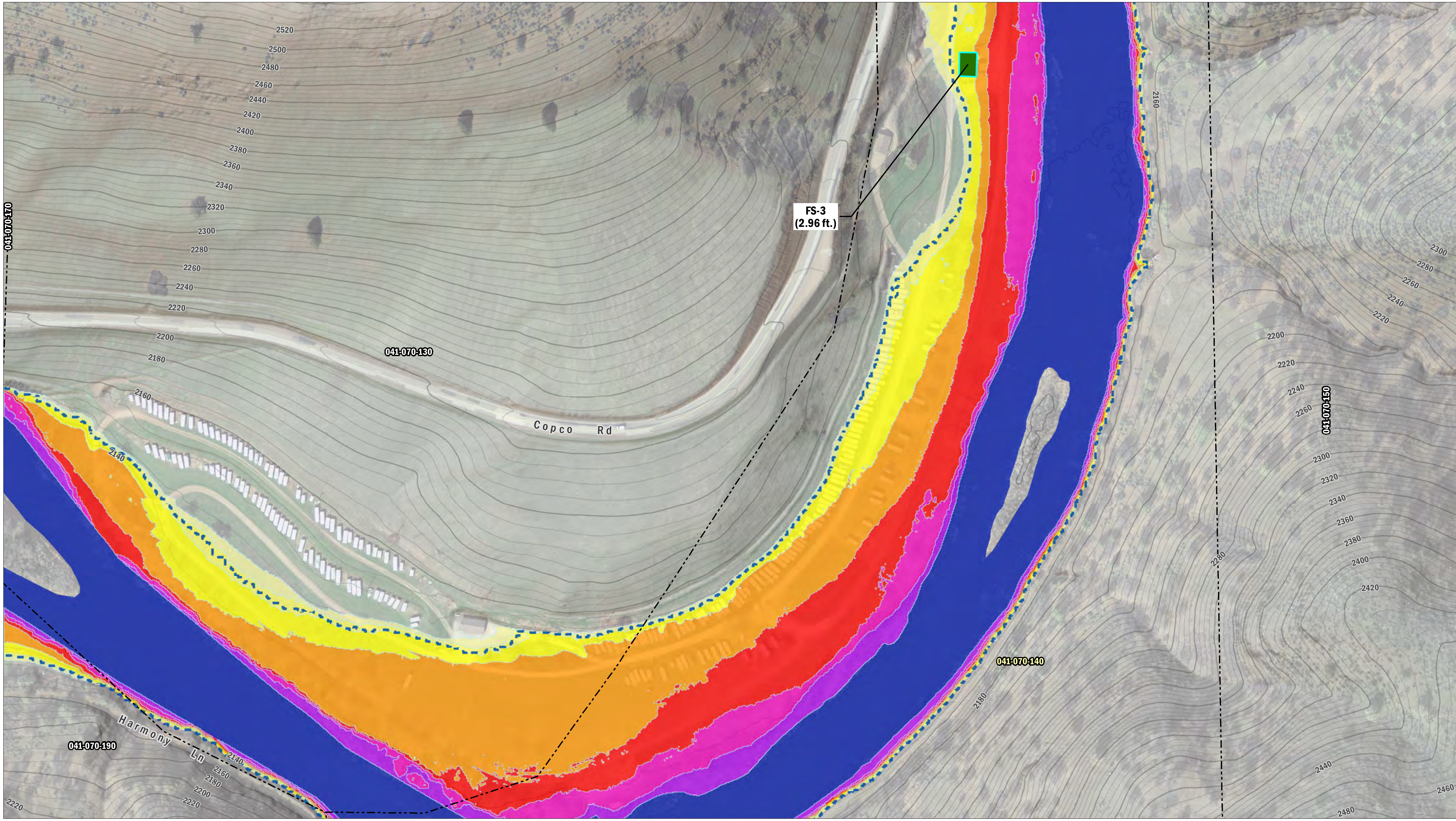
Structure ID (avg. flood depth)
Floodproofing Structures
Parcels
Limits of Work
Pre-Dam Removal Flood Extent

Contours
5 ft.
20 ft.

Post-Dam Removal Flood Depths (ft.)
0 - 1
1.01 - 2
2.01 - 4
4.01 - 6
6.01 - 8
8.01 - 10
10.01 - 15
15.01 - 20
> 20

Note: Parcel boundaries shown in this mapbook are data provided by Siskiyou County, CA, Klamath County, OR, PacifiCorp, and the Bureau of Land Management (BLM). There are inconsistencies among these datasets and between the datasets and LiDAR and aerial imagery. No ground-based parcel surveys have been completed; however, the County parcel data has been geo-rectified to align better with available LiDAR and aerial imagery data. APE and Sub Area 1 locations are based on field survey with GPS, LiDAR, and aerial imagery. Positions of the APE and Sub Area 1 with reference to parcel boundaries may be incorrect on the order of 10 to 50 feet.

FIGURE 7.7-1
Structures in 100-Year Floodplain Following Dam Removal
Sheet 1 of 8



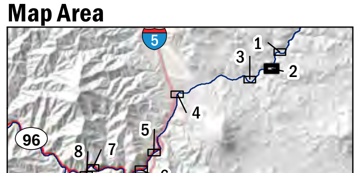
N

0 400
Feet

PacifiCorp, 2004; NAIP Imagery, 2014;
AECOM, 2018; FEMA, 2011

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

Map Area



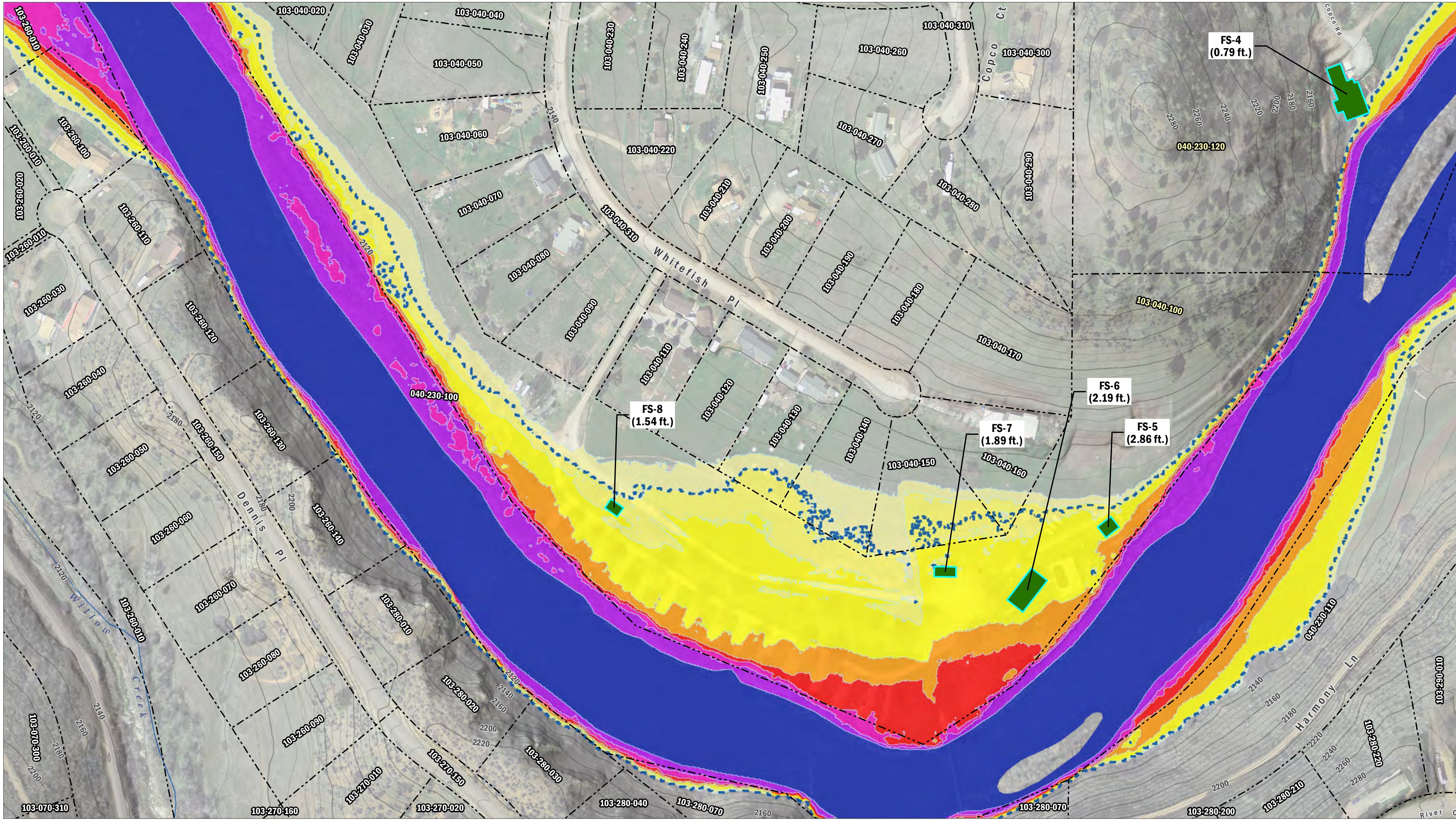
Structure ID (avg. flood depth)
Floodproofing Structures
Parcels
Pre-Dam Removal Flood Extent

Contours
5 ft.
20 ft.

Post-Dam Removal Flood Depths (ft.)
0 - 1
1.01 - 2
2.01 - 4
4.01 - 6
6.01 - 8
8.01 - 10
10.01 - 15
15.01 - 20
> 20

Note: Parcel boundaries shown in this mapbook are data provided by Siskiyou County, CA, Klamath County, OR, PacifiCorp, and the Bureau of Land Management (BLM). There are inconsistencies among these datasets and between the datasets and LiDAR and aerial imagery. No ground-based parcel surveys have been completed; however, the County parcel data has been geo-rectified to align better with available LiDAR and aerial imagery data. APE and Sub Area 1 locations are based on field survey with GPS, LiDAR, and aerial imagery. Positions of the APE and Sub Area 1 with reference to parcel boundaries may be incorrect on the order of 10 to 50 feet.

FIGURE 7.7-1
Structures in 100-Year Floodplain Following Dam Removal
Sheet 2 of 8

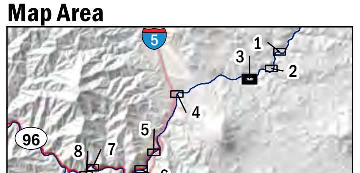


N
0 400
Feet

PacifiCorp, 2004; NAIP Imagery, 2014;
AECOM, 2018; FEMA, 2011

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

Map Area



Structure ID (avg. flood depth)
Floodproofing Structures
Parcels
Pre-Dam Removal Flood Extent

Contours
5 ft.
20 ft.

Post-Dam Removal Flood Depths (ft.)
0 - 1
1.01 - 2
2.01 - 4
4.01 - 6
6.01 - 8
8.01 - 10
10.01 - 15
15.01 - 20
> 20

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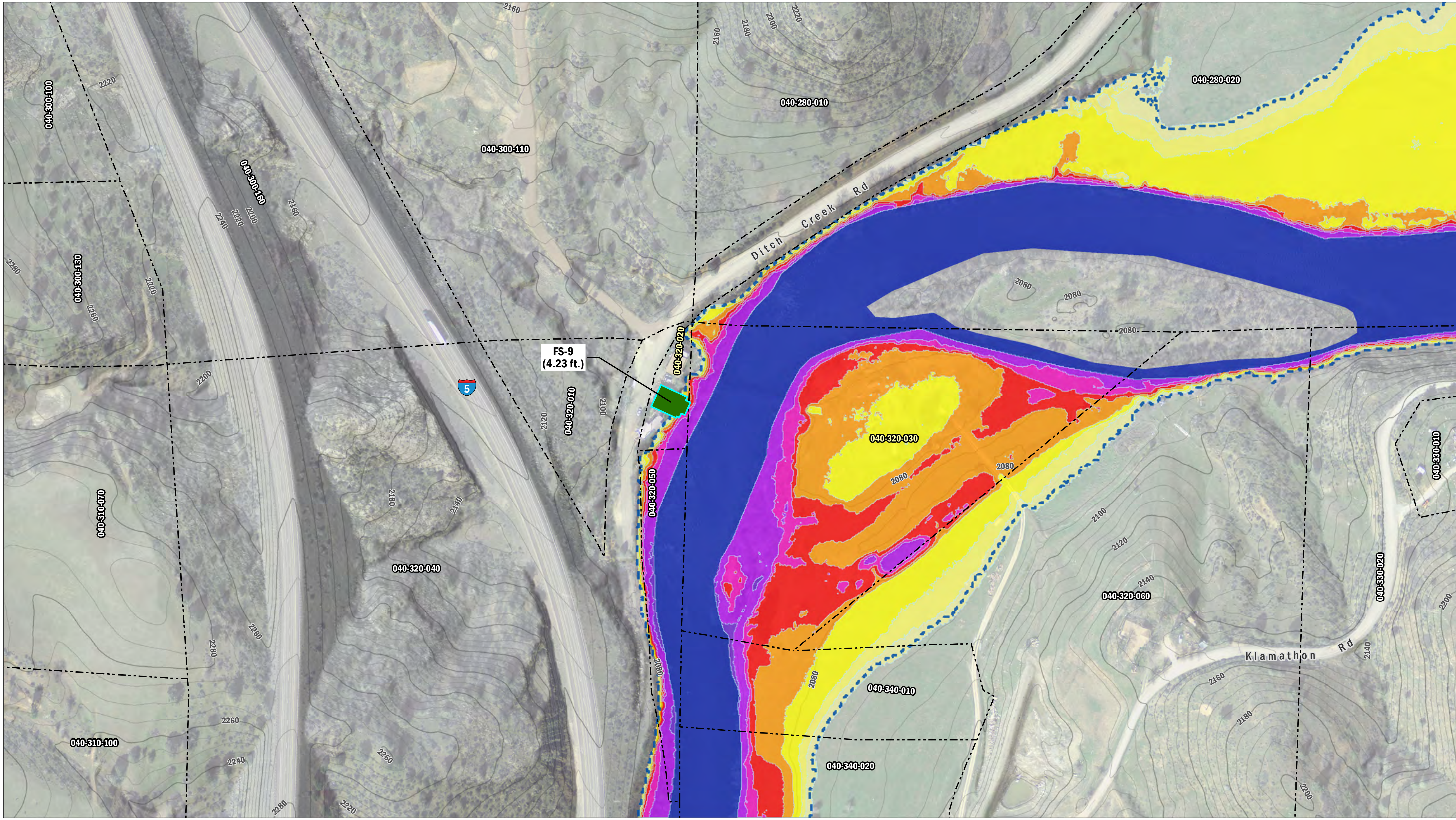
FIGURE 7.7-1

Structures in 100-Year Floodplain Following Dam Removal

Sheet 3 of 8

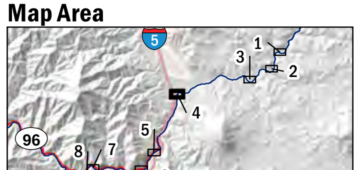
AECOM Oakland CA 5/14/2018 USER alexander.remar PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\Def_Plan\Figure_7_7-1_Floodproofing_Sheets.mxd



PacifiCorp, 2004; NAIP Imagery, 2014;
AECOM, 2018; FEMA, 2011

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

Map Area



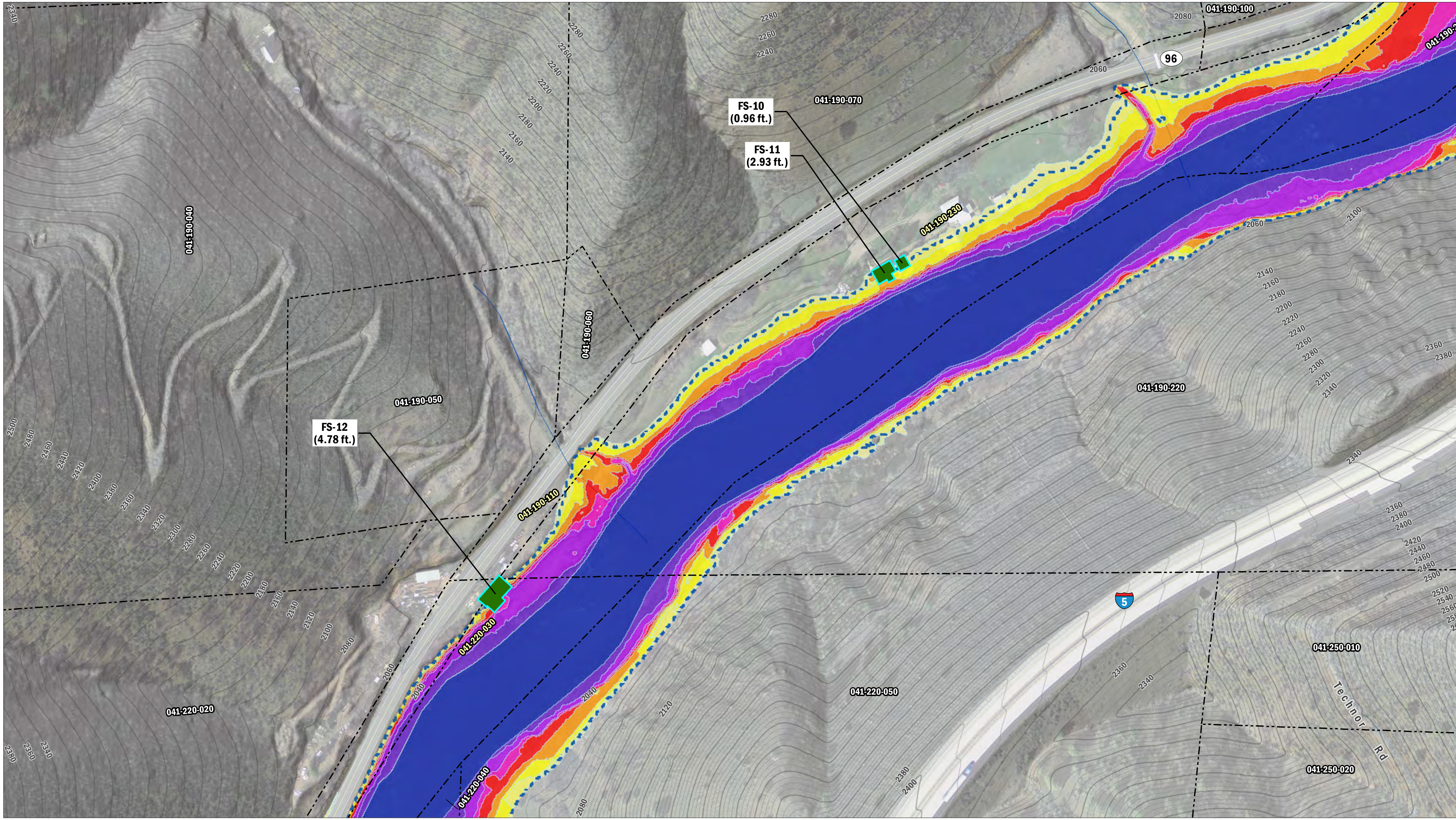
Structure ID (avg. flood depth)
Floodproofing Structures
Parcels
Pre-Dam Removal Flood Extent

Contours
5 ft.
20 ft.

Post-Dam Removal Flood Depths (ft.)
0 - 1
1.01 - 2
2.01 - 4
4.01 - 6
6.01 - 8
8.01 - 10
10.01 - 15
15.01 - 20
> 20

Note: Parcel boundaries shown in this mapbook are data provided by Siskiyou County, CA, Klamath County, OR, PacifiCorp, and the Bureau of Land Management (BLM). There are inconsistencies among these datasets and between the datasets and LiDAR and aerial imagery. No ground-based parcel surveys have been completed; however, the County parcel data has been geo-rectified to align better with available LiDAR and aerial imagery data. APE and Sub Area 1 locations are based on field survey with GPS, LiDAR, and aerial imagery. Positions of the APE and Sub Area 1 with reference to parcel boundaries may be incorrect on the order of 10 to 50 feet.

FIGURE 7.7-1
Structures in 100-Year Floodplain Following Dam Removal
Sheet 4 of 8

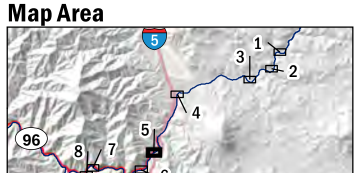


N
0 400
Feet

PacifiCorp, 2004; NAIP Imagery, 2014;
AECOM, 2018; FEMA, 2011

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

Map Area



Structure ID (avg. flood depth)
Floodproofing Structures
Parcels
Pre-Dam Removal Flood Extent

Contours
5 ft.
20 ft.

Post-Dam Removal Flood Depths (ft.)
0 - 1
1.01 - 2
2.01 - 4
4.01 - 6
6.01 - 8
8.01 - 10
10.01 - 15
15.01 - 20
> 20

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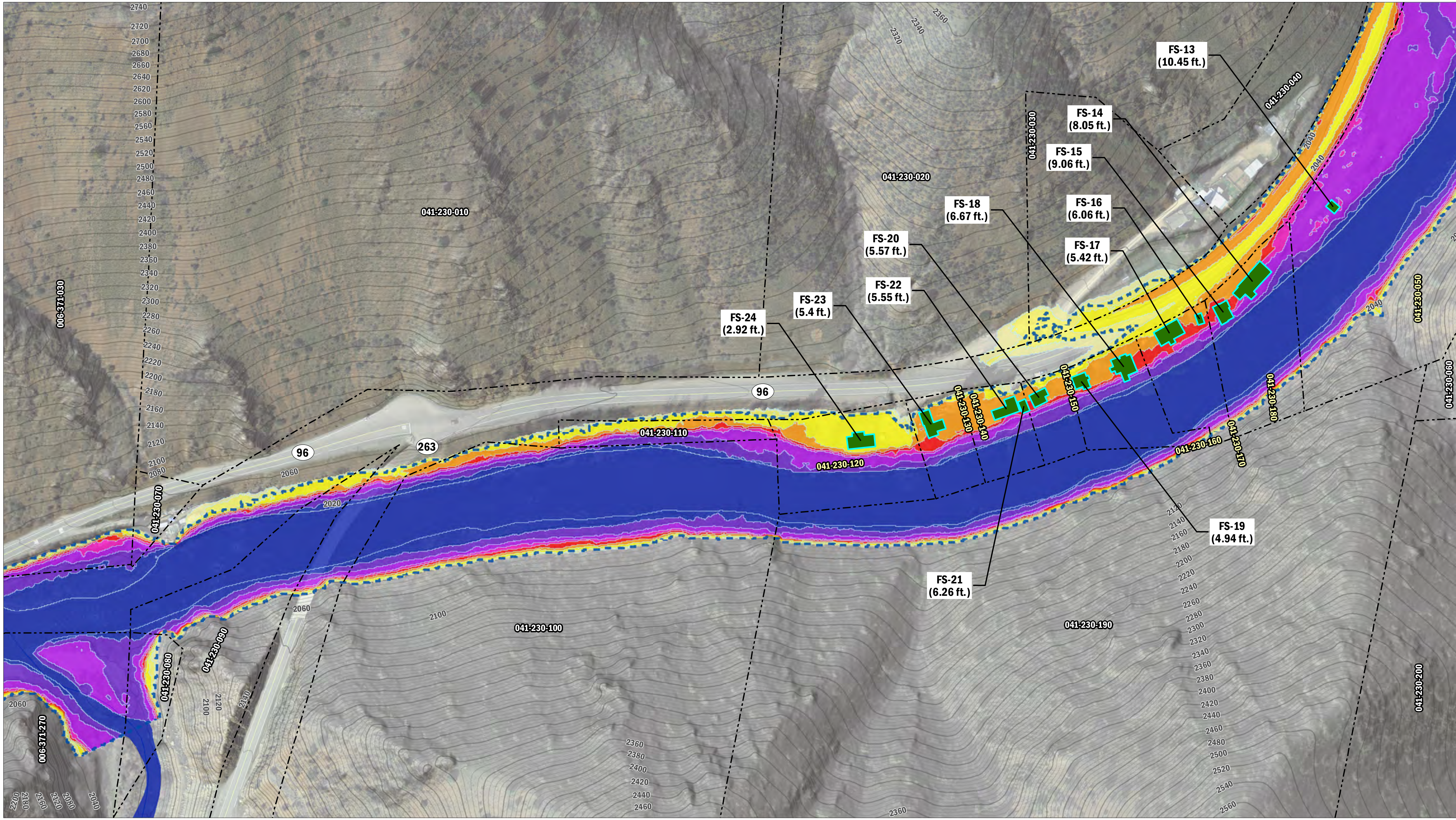
FIGURE 7.7-1
Structures in 100-Year Floodplain Following Dam Removal
Sheet 5 of 8



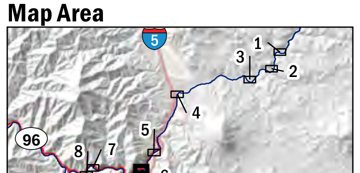
N

0 400
Feet

PacifiCorp, 2004; NAIP Imagery, 2014;
AECOM, 2018; FEMA, 2011

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

Map Area



Structure ID (avg. flood depth)
Floodproofing Structures
Parcels
Pre-Dam Removal Flood Extent

Contours
5 ft.
20 ft.

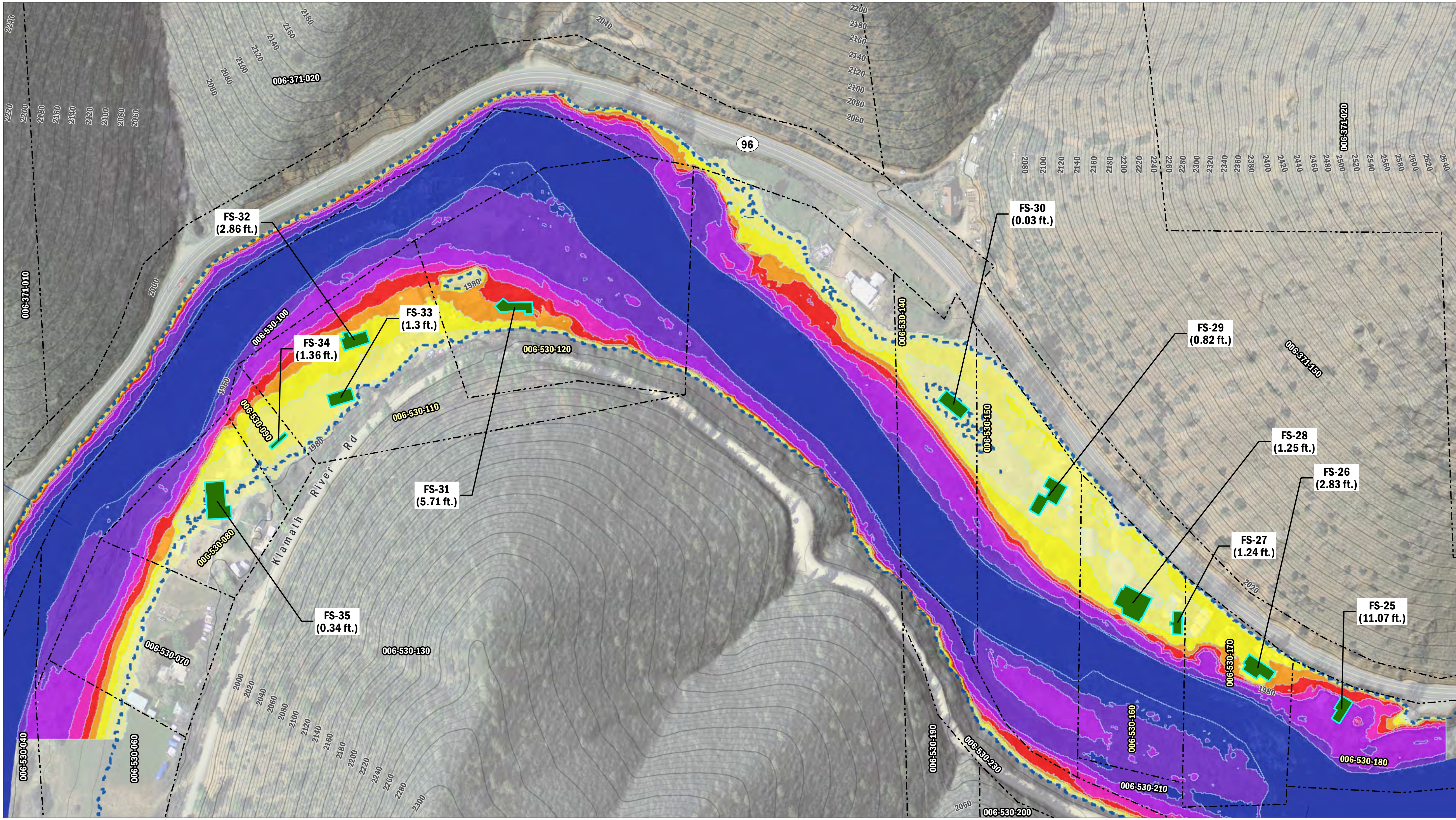
Post-Dam Removal Flood Depths (ft.)
0 - 1
1.01 - 2
2.01 - 4
4.01 - 6
6.01 - 8
8.01 - 10
10.01 - 15
15.01 - 20
> 20

Note: Parcel boundaries shown in this mapbook are data provided by Siskiyou County, CA, Klamath County, OR, PacifiCorp, and the Bureau of Land Management (BLM). There are inconsistencies among these datasets and between the datasets and LiDAR and aerial imagery. No ground-based parcel surveys have been completed; however, the County parcel data has been geo-rectified to align better with available LiDAR and aerial imagery data. APE and Sub Area 1 locations are based on field survey with GPS, LiDAR, and aerial imagery. Positions of the APE and Sub Area 1 with reference to parcel boundaries may be incorrect on the order of 10 to 50 feet.

FIGURE 7.7-1

Structures in 100-Year Floodplain Following Dam Removal

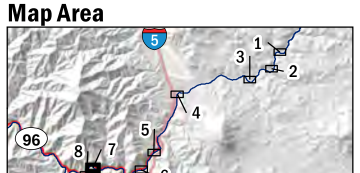
Sheet 6 of 8



PacifiCorp, 2004; NAIP Imagery, 2014;
AECOM, 2018; FEMA, 2011

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

Map Area



Structure ID (avg. flood depth)
Floodproofing Structures
Parcels
Pre-Dam Removal Flood Extent

Contours
5 ft.
20 ft.

Post-Dam Removal Flood Depths (ft.)
0 - 1
1.01 - 2
2.01 - 4
4.01 - 6
6.01 - 8
8.01 - 10
10.01 - 15
15.01 - 20
> 20

Note: Parcel boundaries shown in this mapbook are data provided by Siskiyou County, CA, Klamath County, OR, PacifiCorp, and the Bureau of Land Management (BLM). There are inconsistencies among these datasets and between the datasets and LiDAR and aerial imagery. No ground-based parcel surveys have been completed; however, the County parcel data has been geo-rectified to align better with available LiDAR and aerial imagery data. APE and Sub Area 1 locations are based on field survey with GPS, LiDAR, and aerial imagery. Positions of the APE and Sub Area 1 with reference to parcel boundaries may be incorrect on the order of 10 to 50 feet.

FIGURE 7.7-1

Structures in 100-Year Floodplain Following Dam Removal

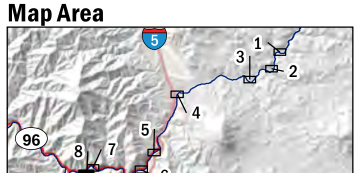
Sheet 7 of 8

0 400
Feet

PacifiCorp, 2004; NAIP Imagery, 2014;
AECOM, 2018; FEMA, 2011

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

Map Area



Structure ID (avg. flood depth)
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Note: Parcel boundaries shown in this mapbook are data provided by Siskiyou County, CA, Klamath County, OR, PacifiCorp, and the Bureau of Land Management (BLM). There are inconsistencies among these datasets and between the datasets and LiDAR and aerial imagery. No ground-based parcel surveys have been completed; however, the County parcel data has been geo-rectified to align better with available LiDAR and aerial imagery data. APE and Sub Area 1 locations are based on field survey with GPS, LiDAR, and aerial imagery. Positions of the APE and Sub Area 1 with reference to parcel boundaries may be incorrect on the order of 10 to 50 feet.

FIGURE 7.7-1
Structures in 100-Year Floodplain Following Dam Removal
Sheet 8 of 8

Appendix D Dam Stability Analyses

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Project name:
Klamath River Renewal Project

Project ref:
60537920

To: Klamath River Renewal Coporation

CC:

From:
John Roadifer, Kanax Kanagalingam, Benjamin Choy

Date:
June 20, 2018

Technical Memorandum

Subject: Definite Plan for the Lower Klamath Project
Analysis of Stability of J.C. Boyle and Iron Gate Dams During Reservoir Drawdown

INTRODUCTION

AECOM prepared this technical memorandum in support of the design for the removal of the Iron Gate Dam and J.C. Boyle Dam, which are located on the Klamath River in northern California and southern Oregon, respectively. The purpose of this technical memorandum is to review existing geotechnical data related to the Iron Gate and J.C. Boyle embankments, characterize the materials in the embankments, and evaluate the stability of the upstream slopes of the embankments under various conditions of rapid drawdown of the reservoirs prior to dam removal.

Iron Gate Dam is a 189-foot high zoned earthfill embankment, as measured from the crest to the rock foundation. The crest of the dam is at El. 2343[1] feet. The crest of the dam is 20 feet wide, and the dam is approximately 740 feet long. The embankment upstream slopes are 2:1 (H:V) above El. 2328 feet, 2.5:1 from El. 2328 feet to 2300 feet, and 3H:1V below El. 2300 feet. The downstream slopes are 1.75:1 above El. 2323 feet and 2:1 below El. 2323 feet. The dam also features a 29-foot wide bench and a 10-foot wide bench at El. 2275 feet on the upstream side and downstream side, respectively. The dam consists of a central impervious clay core, an upstream and a downstream compacted pervious shell with filter zones and a downstream drain. A 10-foot thick layer of riprap protects the upstream slope of the dam against erosion. A 5-foot thick riprap layer is present on the downstream slope. In 2003, the dam crest was raised 5 feet from El. 2338 feet to 2343 feet by over-steepening the upstream and downstream slopes. To provide additional freeboard, a sheet pile was installed upstream of the dam centerline that extends five (5) feet above the dam crest to an El. of 2348 feet.

J.C. Boyle Dam consists of two portions: an earthfill embankment on the right side and a concrete spillway and gravity section on the left side. This technical memorandum evaluates the earthfill embankment portion of the dam. The earthfill embankment is a 68-foot high zoned earthfill embankment. The crest of the dam is at El. 3800 feet. The crest of the embankment is 15 feet wide and approximately 413 feet long. The upstream slopes are 2.5:1 (H:V) above El. 3780 feet and 3H:1V below El. 3780 feet. The downstream slopes are 2.5:1. The downstream slope also includes a 16-foot wide bench at El. 3768 feet. The internal zoning of the dam consists of a central impervious clay core, an upstream and a downstream compacted pervious shell consisting of sand and gravels. A filter blanket underlies the downstream shell. Erosion protection of the upstream slope is provided by a 3-foot thick riprap layer above El. 3680 feet. A 2-foot thick riprap layer below El. 3768 feet protects the downstream slope against erosion due to elevated tailwater.

EXISITNG DATA REVIEW

[1] All elevations in this memorandum are in the original datum unless otherwise indicated.

A review of existing available pertinent information for Iron Gate Dam and J.C. Boyle Dam were performed as part of this study to judge whether additional geotechnical investigation would have to be conducted for evaluating the dams for the rapid drawdown conditions. The reviewed information included design drawings, laboratory testing data for the borrow source materials, construction history, specifications, previous stability analyses, and post construction subsurface investigation. The results from the review indicate the followings:

- Representative analysis cross sections can be developed at the maximum section using the design drawings for both the Iron Gate Dam and the J.C. Boyle Dam.
- A reasonable material characterization of embankment materials, in particular the core and shell materials, can be developed using the information in the construction history, drawings, and specifications for the two dams. The source of materials, loose lift thickness and compaction efforts were discussed in those documents (California Oregon Power Company, 1960a and Unknown Publisher, Unknown Date). The results from a post-construction subsurface investigation conducted for J.C. Boyle Dam in 1994 (Black and Veatch, 1998) provide additional information for shell material characterization.
- Material properties necessary for performing slope stability and seepage analyses can be reasonably developed using the reviewed information. The reviewed information included laboratory shear strength and permeability tests conducted on the borrow source materials (California Oregon Power Company, 1960b and Unknown Date) and previous rapid drawdown analyses performed by others (Bechtel, 1968, Department of Water Resources, 1986, Black and Veatch, 1998, and PanGEO, 1998) .

The existing information for both dams are deemed sufficient to perform rapid drawdown analyses with targeted sensitivity analysis to address uncertainties associated with material properties as discussed later in this memorandum.

MATERIAL CHARACTERIZATION

Iron Gate Dam

Iron Gate Dam, which was built in 1961, is a zoned earth and rock fill dam. The dam consists of six (6) main zones: an upstream pervious shell (Zone I), a downstream pervious shell (Zone II), a central impervious core (Zone III), a transition (Zone IA) upstream of the core, a downstream chimney two-stage filter (Zone IV and Zone IVA) and drain (Zone V), and a downstream blanket filter (Zone IV) and drain (Zone V). The analysis section for rapid drawdown stability is the maximum cross section as shown on Figure 1.

The shell materials mainly consist of locally borrowed, pervious talus rock and gravel placed in 3-foot loose lifts, moisture conditioned, and compacted with four (4) passes of 72-inch vibratory roller (PanGEO, 2006). The weight of the roller was not indicated in the documents reviewed. The impervious core mainly consists of high plasticity clay from a local borrow source. The core material was placed in 8-inch loose lifts and compacted to not less than 95% of the maximum dry density as determined by ASTM D698 (California Oregon Power Company , 1960a and PanGEO, 2006). The upstream transition zone consists of graded talus rock and is approximately 20 feet in thickness. The downstream chimney and blanket filters consist of fine sand to gravel and were constructed in three (3) vertical layers (California Oregon Power Company, 1960a). Based on the design drawings, the thicknesses of the chimney and blanket filters are 20 feet and 5 feet, respectively. The downstream chimney and blanket drains consist of selected talus, gravel, or other excavations that is essentially free of materials smaller than the #100 sieve (California Oregon Power Company, 1960a). The dam was founded on basalt that is generally hard, blocky, heavily jointed, and moderately weathered (DSOD, 1986).

Iron Gate Dam Material Properties

The shear strength parameters of shell and core are very important for the rapid drawdown analysis. Shear strength parameters for the core material were developed mainly based on results from isotropic consolidated undrained triaxial tests (TX-ICU) conducted on samples obtained from borrow sources during borrow source evaluation (California Oregon Power Company, 1960b). The results of the triaxial tests are included in Attachment A. However, no laboratory shear strength tests are available for the shell and other embankment materials. Therefore, shear strength parameters for these materials were selected based on available information such as the type of construction, parameters used in previous analyses, and published data (NAVFAC, 1986 and EPRI, 1990). As mentioned above, the shell materials consist of talus rock and gravel, which were compacted during placement. Based on the published data, the effective friction angle for compacted gravelly materials would be greater than 37 degrees. For this rapid drawdown analysis, the shell materials were conservatively assigned an effective friction angle of 35 degrees. In addition, transition zone, chimney filter and drain, and blanket filter and drain were compacted during placement. Therefore, these materials were also assigned an effective friction angle of 35 degrees. The bedrock is modeled as impenetrable in the slope stability model. Table 1 summarizes these engineering parameters (best estimate parameters) used in the slope stability analyses.

The unit weights for different embankment zones were selected based on the laboratory tests conducted on the samples collected from proposed borrow areas, compaction test results on samples collected during dam construction, previous analyses (DWR, 1986 and PanGEO, 2006), and published data (NAVFAC, 1986 and EPRI, 1990).

The permeability values for the core and shell materials were selected based on the results from the falling head permeability tests performed on samples from the core and shell material borrow sources during borrow source evaluation. The results of the falling head permeability tests are included in Attachment B. Permeability values of the filter, chimney drain, the blanket drain, the riprap, and the random fill were estimated based on the characteristics of the materials, published data, and engineering judgment. The permeability parameters were selected conservatively based on typical ranges (Holtz and Kovacs, 1981), which is included in Attachment C. Table 1 summarizes permeability parameters used in the seepage analysis.

Anistropic ratios (k_h/k_v) typically range from 1 to 4 for uniform soil deposits without significant interbedding or stratification but can be higher for soil deposits with significant stratification. An anisotropic ratio of 10 for the core is selected considering the nature of the materials and its placement method. For the shell and random fill, an anisotropic ratio of 2 was selected as typical anisotropic ratios for similar materials range from 1 to 2. Anisotropic ratio for the filter/drain and riprap is selected to be 1 as the materials are expected to drain freely in both directions.

Table 1. Material Properties Used for the Analyses of Iron Gate Dam

Material	Unit Weight (pcf)	Effective Stress		Total Stress		Horizontal Permeability, k_h (cm/s)[1,3]	k_h/k_v
		Cohesion, c' (psf)	Friction Angle, ϕ' (°)[1,2]	Cohesion, c (psf)	Friction Angle, ϕ (°)		
Core	130	0	22	300	16	1.00E-07	10
Shell	135	0	35	-	-	8.00E-03	2
Filter/ Drain/ Transition Zones	135	0	35	-	-	1.00E-02	1
Riprap	135	0	35	-	-	1.00E-02	1
Random Fill	135	0	25	-	-	8.00E-03	2

Note:
1. The parameter that was used for sensitivity analyses is provided in parenthesis.
2. For compacted sand and gravel materials, the friction angles are typically greater than 34 degrees (NAVFAC, 1986 and EPRI, 1990).
3. For clean coarse materials, permeability ranges from 10^{-3} cm/s to 1 cm/s per Holtz and Kovacs (1981).

J.C. Boyle Dam

The earthfill embankment of the J.C. Boyle Dam is a zoned earth fill dam built in 1958. The dam consists of two (2) major zones: a central impervious clay core (Zone 1) and the upstream and downstream pervious shells (Zone 2). A filter blanket with thickness of 12 inches was placed between the Zone 2 materials and its foundation for the whole downstream area. An 18-inch thick gravel drain zone was also installed over part of the downstream foundation. A waste rock fill was placed at the downstream toe of the dam. Ripraps are placed on both the upstream and downstream sides of the dam. For analysis purpose, the gravel drain is modeled as part of the filter blanket. The rapid drawdown analyses were performed on maximum cross section of J.C. Boyle Dam, which is shown on Figure 2.

The impervious clay core is constructed of selected clay materials, which are described as rust colored sandy clay with some pea gravel. The shell materials were constructed of a mixture of well graded gravel with sand and well graded sand. Based on the specifications, the embankment materials were to be constructed in 8-inch loose lift and compacted with a minimum of twelve (12) passes of sheepfoot rollers to obtain a minimum of 95% of the dry density which correspond to the optimum moisture content of the materials placed The filter blanket is approximately 12 inches thick and consists of well graded sandy gravel. The waste rock fill was constructed of gravel placed under water without compaction. Specific information regarding size and compaction effort is not available for the upstream and downstream ripraps and the gravel drain. The dam is mostly founded on basalt with the exception of the right abutment, which is founded on satisfactory overburden (Bechtel, 1968).

J.C. Boyle Dam Material Properties

The effective shear strength parameters for the core material are developed based on the results of direct shear tests performed on samples from core borrow sources during borrow source evaluation. The results show that the effective friction angle is greater than that of Iron Gate Dam's core. This is consistent with the material descriptions which suggest that the core in J.C. Boyle Dam consists of lower plasticity clay and pea gravel. The results of the direct shear test are included in Attachment D. The total stress shear strength parameters are not available from the direct shear tests. For the purpose of rapid drawdown slope stability analysis, those parameters were conservatively assumed the same as those of the Iron Gate Dam core. No laboratory shear strength data are available for the other embankment materials. Previous slope stability analyses performed by others selected the shear strength parameters based on the SPT blow count data (Black and Veatch, 1998). Review of available data suggests that the shell materials consist of up to 50% of gravel. The shear strength parameters that were previously selected did not account for the presence of high gravel percentage in the shell material. Considering the high gravel content, the borrow source, and how the shell material was placed and compacted, for the purpose of the rapid drawdown analysis a friction angle of 34 degrees (the previous analysis used a friction angle of 37 degrees) was assumed. The strength parameters of the riprap are conservatively assumed to be the same as the shell materials as the anticipated effect from the riprap on the overall stability performance is not significant due to its relative thickness to the shell. The bedrock is modeled as impenetrable in the slope stability model. Table 2 summarizes the best estimate engineering parameters used in slope stability analyses.

As no total strength parameters are available for the core materials, a sensitivity analysis is performed on the strength parameters for the core materials. Total cohesion of 100 psf and total friction angle of 12 degrees were conservatively selected considering very soft soil conditions for this sensitivity analysis. This sensitivity analysis also considers a lower effective friction angle of 19.4 degrees for the core materials, which was selected based on the lowest values from the direct shear tests. As the core is relatively thin compared to the shell, it is anticipated that reducing the strength parameters for the core materials will not significantly impact the analysis results. Table 2 includes the engineering parameters used in the sensitivity analysis in parenthesis.

Compaction tests performed on the samples from the core and shell borrow sources during borrow source evaluation were used as the basis for unit weight of the materials. The results of the compaction tests are included in Attachment E. The selection of the unit weight used in the rapid drawdown analysis is based on the compaction test results, published data (NAVFAC, 1986 and EPRI, 1990), and previous analyses. Table 2 summarizes the unit weights used in the slope stability analysis.

Falling head permeability tests performed on samples from the core borrow sources during borrow source evaluation were used as the basis for permeability values of the core material. The results of the permeability test are included in Attachment F. Permeability values for the shell materials and filter blankets are estimated based on results of the grain size analysis using the Kozemy-Carmen permeability correlations, characteristics of the materials, published data, and engineering judgement. The permeability of the riprap is assumed to be the same as the shell materials, whereas the permeability of the wasterock fill is assumed to be the same as the shell. Table 2 summarizes the best estimate engineering properties used in the seepage analyses.

Similar to Iron Gate Dam, anisotropic ratios of 10 and 2 are selected for the core and shell materials with the exception of riprap, respectively. An anisotropic ratio of 1 is selected for the ripraps.

In addition, a set of sensitivity analysis was performed based on typical permeability ranges for gravel and sand materials (Holtz and Kovacs, 1981). This set of sensitivity analysis conservatively assumes the lower permeability values within the typical ranges for the shell, riprap, filter blanket, and waste rock fill. Table 2 includes the engineering parameters used in the sensitivity analysis in parenthesis.

Table 2. Material Properties Used for the Analyses of J.C. Boyle Dam

Material	Unit Weight (pcf)	Effective Stress		Total Stress		Horizontal Permeability, k_h (cm/s)[1,3]	k_h/k_v
		Cohesion, c' (psf)	Friction Angle, ϕ' (°)[1,2]	Cohesion, c (psf)[1]	Friction Angle, ϕ (°)[1]		
Core	120	0	27 (19)	300 (100)	16 (12)	1.71E-04	10
Shell	130	0	34	-	-	6.62E-01 (4.00E-03)	2
Upstream Riprap	140	0	34	-	-	1.04E-00 (4.00E-03)	1
Downstream Riprap	140	0	34	-	-	1.04E-00 (4.00E-03)	1
Filter Blanket	125	0	35	-	-	1.04E-00 (4.00E-03)	2
Waste Rock Fill	145	0	40	-	-	6.62E-01 (4.00E-03)	2

Note:
1. The parameter that was used for sensitivity analyses is provided in parenthesis.
2. For compacted sand and gravel materials, the friction angles are typically greater than 34 degrees (NAVFAC, 1986 and EPRI, 1990).
3. For clean coarse materials, permeability ranges from 10^{-3} cm/s to 1 cm/s per Holtz and Kovacs (1981).

PREVIOUS SLOPE STABILITY ANALYSIS PERFORMED BY OTHERS

Iron Gate Dam

After the construction of the Iron Gate dam, stability analyses of the dam were originally performed by the Division of Safety of Dams (DSOD) in 1962 (DWR, 1986). The slope stability analyses were performed for static, rapid drawdown, and pseudo-static loading conditions with assumed effective friction angles of 30 and 17 degrees with no cohesion for the shell and core, respectively. A minimum factor of safety of 1.67 was calculated for the rapid drawdown conditions. Bechtel Corporation analyzed stability of the embankment in 1968 using effective friction angles of 35 degrees for the shell and 22 degrees for the core. The rapid drawdown analysis performed as part of Bechtel's analyses calculated a minimum factor of safety of 1.99 (DWR, 1986). In 1986, DSOD reanalyzed the dam by assigning an effective friction angle of 35 degrees for the shell zones and drained zones, and calculated a minimum factor of safety of 2.00 for rapid drawdown. These stability evaluations were then updated in 1995 and 2004 to account for the then planned dam raises (Section 8 of STID, 2015). The existing dam incorporates the sheet-pile raised crest, and has an effective crest elevation of 2348.0 feet.

As the latest stability analysis, PanGEO performed the preliminary assessment of the stability of upstream slope under rapid drawdown conditions and presented the results in a technical memorandum (PanGEO, 2008).

J.C. Boyle Dam

Based on available information, two (2) rapid drawdown analyses were performed in 1968 and 1996 (Bechtel, 1968 and Black and Veatch, 1996). The 1968 analysis assumed a very conservative strength for the shell materials, in which the shear strength of the shell materials was assumed to be the same as the shear strength of the core materials (effective friction angle of 26 degrees). The phreatic surface used in the analysis was derived by a flow net analysis, which considered partial pore dissipation within the shell materials. The rapid drawdown analysis resulted in a factor of safety of 1.03. In 1994, three (3) borings were drilled on the downstream side of the dam to collect additional subsurface information for better material characterization for the shell materials. Based on the results of this subsurface investigation, the 1996 analysis assumed a higher shear strength for the shell material (effective friction angle of 37 degrees). No additional seepage analysis was performed, and the phreatic surface from the 1968 analysis was assumed in the 1996 analysis. The rapid drawdown analysis resulted in a factor of 1.88.

CURRENT RAPID DRAWDOWN ANALYSIS

Sudden or rapid drawdown is the most critical condition controlling the lowering of the reservoir prior to dam removal because deep slides in the upstream slope of the dam during the drawdown could lead to dam failure. Rapid drawdown reduces the total stress on the upstream face and lowers the head driving seepage through the embankment. The shear stresses within the upstream slope increase which may lead to instability. In principle, the stability of the upstream slope can be evaluated using either total stress (undrained) or effective stress (drained) strength parameters. The rapid drawdown analysis approach used for this Project involves the following steps:

1. Develop analysis sections and material properties,
2. Establish a base case by performing conventional rapid drawdown stability analysis under instantaneous drawdown for two scenarios that provide the upper and lower bound for stability of the dams during rapid drawdown:
   a. The first scenario (least conservative bound) assumes full pore pressure dissipation within the pervious shell after drawdown from the steady state condition.
   b. The second scenario (most conservative bound) assumes no pore pressure dissipation within the pervious shell from after drawdown from the steady state condition.
3. Perform transient drawdown analysis for various drawdown rates:
   a. Seepage analysis to determine the location of the phreatic surface at different time steps during reservoir drawdown
   b. Slope stability analysis for each corresponding phreatic surface during reservoir drawdown.
4. Additional sensitivity analyses, if needed.

SEEP/W (Geo-Studio, 2016) presents a method for using uncoupled transient seepage analysis along with limit equilibrium to evaluate the stability of slopes affected by changing hydraulic boundary conditions such as the conditions during rapid drawdown. The latest version of the USBR Embankment Dam design standards (2011) recommends using the effective stress approach with pore pressures from uncoupled transient seepage analysis to analyze stability following rapid drawdown. For these reasons, a transient analysis was considered as listed above. Because the shells of the dams are constructed of pervious materials rapid drawdown of the reservoir level behind the dams will result in concurrent (but slower) lowering of the phreatic surface (groundwater level) in the upstream shell of the dams. To account for this, transient seepage analyses are required. The computer programs SEEP/W and SLOPE/W (Geo-Studio, 2016) were utilized for the seepage and slope stability. SEEP/W is a two-dimensional, finite element analysis software program that has the capability to analyze both steady-state and transient seepage conditions. Slope/W is used to perform limit equilibrium slope stability analyses. Slope/W uses the phreatic surface developed in SEEP/W as input to the stability analysis. The limit equilibrium slope stability calculations use Spencer's method, which satisfies both moment and force equilibrium simultaneously.

Acceptance Criterion

According to the Engineering Manual (EM-110-2-1902) of United States Army Corps of Engineers (USACE), the factor of safety for the rapid drawdown analyses of the upstream slope of the dam should be greater than the range of 1.1 to 1.3. Given, the importance of safety to both workers on site and the public downstream of the dams, the minimum rapid drawdown factor of safety for transient seepage analyses is selected to be 1.3.

Analysis Results

Rapid drawdown slope stability analyses were performed to calculate the minimum factors of safety for the following five (5) scenarios as described below:

1. Instantaneous drawdown from steady state condition with full pore pressure dissipation in the shell materials (least conservative bound).
2. Instantaneous drawdown from steady state condition with no pore pressure dissipation in the shell materials (most conservative bound).
3. Slow drawdown rate (3 ft/day for Iron Gate Dam and 2 ft/day for J.C. Boyle Dam)
4. Intermediate drawdown rate (6 ft/day for Iron Gate Dam and 5 ft/day for J.C. Boyle Dam)
5. Rapid drawdown rate (10 ft/day for Iron Gate Dam and 10 ft/day for J.C. Boyle Dam)

For Iron Gate Dam, the reservoir was drawn down from El. 2328 feet to El. 2202 feet. For J.C. Boyle Dam, the reservoir was drawn down from El. 3793 feet to El. 3762 feet. The results of the rapid drawdown slope stability analyses for Iron Gate Dam are summarized in Table 3. Table 3 also includes the results of the sensitivity analyses, which consider the potential lower bound strength for the shell materials. The results of rapid drawdown slope stability analyses for J.C. Boyle Dam are summarized in Table 4. Table 4 also includes the results of the sensitivity analyses, which consider the lower bounds for both the core strength and the shell permeability. The analysis results for the best estimate parameters are also shown on Figures 3 through 7 for Iron Gate Dam, and on Figures 8 through 12 for J.C. Boyle Dam. It should be noted that the plotted phreatic surfaces shown on the figures for the transient rapid drawdown analyses correspond to the phreatic surfaces at the specific time when the calculated factors of safety are minimum.

Table 3. Rapid Drawdown Slope Stability Analysis Results for Iron Gate Dam

Scenario	Factors of Safety for Best Estimate Parameters	
	Mid-Slope	Full-Slope
1. Instantaneous drawdown, full pore pressure dissipation	1.91	2.02
2. Instantaneous drawdown, no pore pressure dissipation within upstream shell	1.42	1.46
3. Slow drawdown rate (3 ft/day)	1.51	1.77
4. Intermediate drawdown rate (6 ft/day)	1.49	1.74
5. Rapid drawdown rate (10 ft/day)	1.48	1.70

Table 4. Rapid Drawdown Slope Stability Analysis Results for J.C. Boyle Dam

Scenario	Factor of Safety for Best Estimate for Core Strength		Factor of Safety from Sensitivity Analyses Using Potential Lower Bound Strength for Core	
	Mid-Slope	Full-Slope	Mid-Slope	Full-Slope
1. Instantaneous drawdown, full pore pressure dissipation	2.06 (2.06)	1.86 (1.86)	1.97 (1.97)	1.85 (1.85)
2. Instantaneous drawdown, no pore pressure dissipation within upstream shell	1.11 (1.12)	1.18 (1.18)	1.10 (1.10)	1.18 (1.18)
3. Slow drawdown rate (2 ft/day)	1.77 (1.76)	1.84 (1.74)	1.70 (1.70)	1.83 (1.73)
4. Intermediate drawdown rate (5 ft/day)	1.78 (1.76)	1.85 (1.66)	1.70 (1.69)	1.83 (1.66)

5. Rapid drawdown rate (10 ft/day)	1.78 (1.72)	1.85 (1.61)	1.75 (1.69)	1.82 (1.61)

Note: The values in parenthesis refer to the results of the sensitivity analysis using the lower permeability for the shell materials.

Conclusions

Rapid drawdown analysis results for the Iron Gate Dam and J.C. Boyle Dam indicate that the calculated factors of safety are greater than the selected minimum factor of safety of 1.3 for all cases analyzed except some cases instantaneous drawdown without any pore pressure dissipations for the J.C. Boyle Dam. However, in these cases, the minimum factors of safety are still within the range recommended by USACE. In addition, it should be noted that these cases conservatively assume no pore pressure dissipation within the upstream shell. Based on the analyses, reservoir drawdown could be as high as 10 feet/day. However, we recommend that reservoir drawdown be 5 feet/day, except as noted for J,C. Boyle Dam below.

It is our understanding that the demolition of J.C. Boyle Dam includes removal of concrete stoplogs within two diversion culverts. The removal of the concrete stoplogs (likely by blasting) will result in drawdown of approximately 10 feet for the first culvert and 8 feet for the second culvert within less than 24 hours. Although we conclude that the J.C. Boyle Dam will perform satisfactorily under these rapid drawdown conditions, we recommend a hold period of one week be implemented between removal of the stoplogs from the first culvert until the stoplogs from the second culvert are removed to allow for pore pressure dissipation.

The analysis results indicated that no slope instability would result during reservoir drawdown. However, there is a potential for shallow slumping along the upstream embankment slopes due to the potential strength loss of surficial materials during the drawdown. Therefore, we recommend frequent visual inspection during the reservoir drawdown process. If any shallow slumping is observed, riprap can be placed to provide additional resistance.

It is recommended that instrumentation should be installed to monitor the upstream slopes during reservoir drawdown for dam removal. The types of recommended instrumentation include survey monuments, inclinometers, and piezometers. Daily readings are recommended to closely monitor if there are any unanticipated slope movements or pore pressure accumulation. It is also recommended that the instrumentation be installed the year prior to reservoir drawdown. The piezometers would be monitored during reservoir drawdown to confirm that the transient phreatic surfacewithin the upstream shell of the dam falls as the reservoir elevation drops.

Limitations

AECOM represents that our services were conducted in a manner consistent with the standard of care ordinarily applied as the state of practice in the profession within the limits prescribed by our client. No other warranties, either expressed or implied, are included or intended in this technical memorandum.

Background information and other data have been furnished to AECOM by Pacific Corp and/or third parties, which AECOM has used in preparing this technical memorandum. AECOM has relied on this information as furnished, and is neither responsible for nor has confirmed the accuracy of this information.

The analyses and results presented in this report are for the current study only and should not be extended or used for any other purposes.

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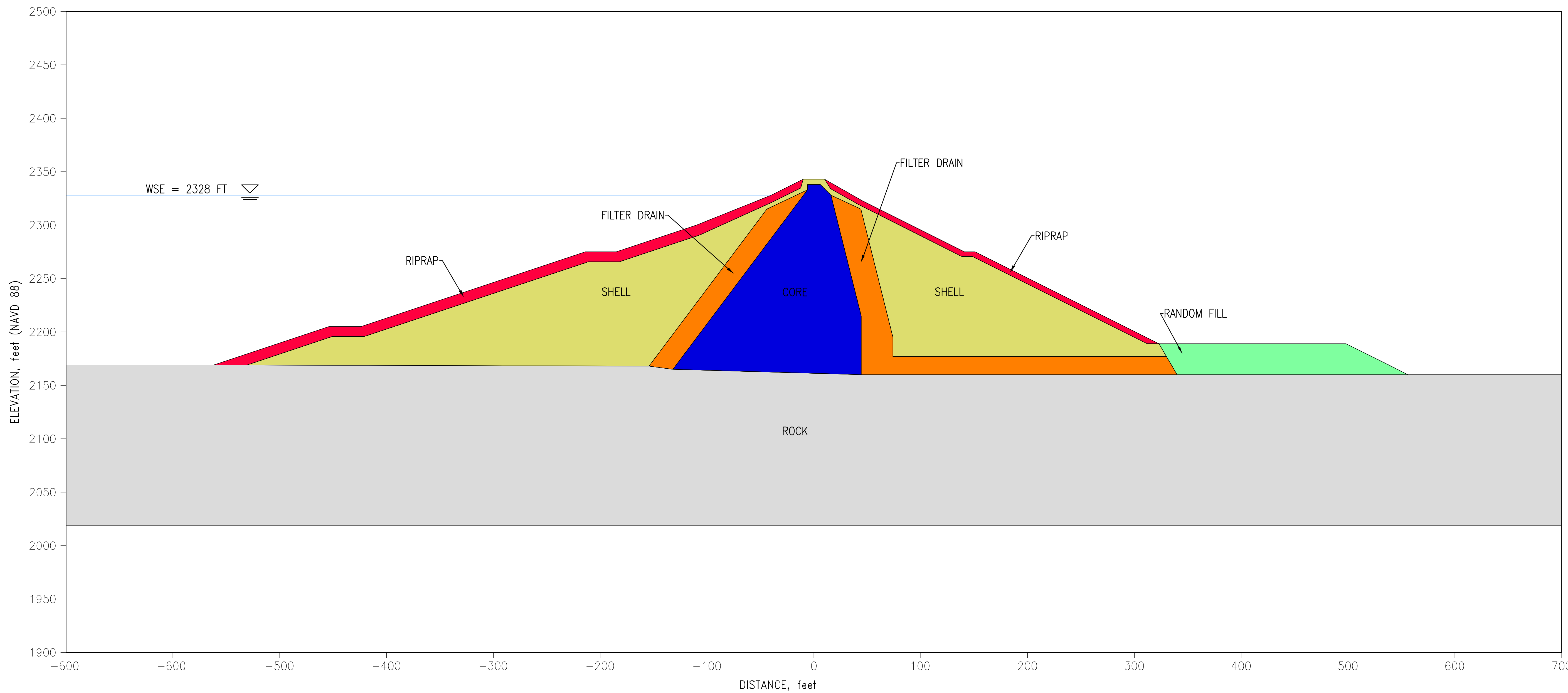
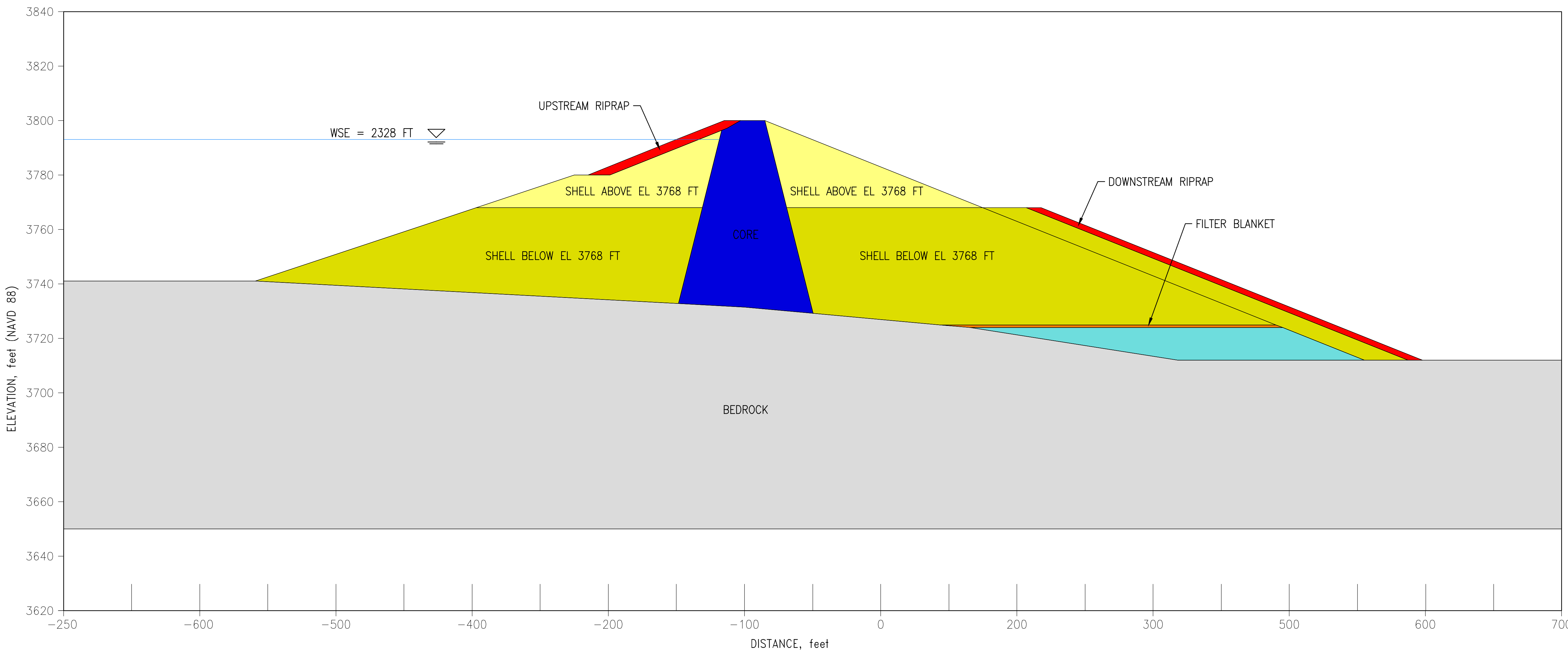
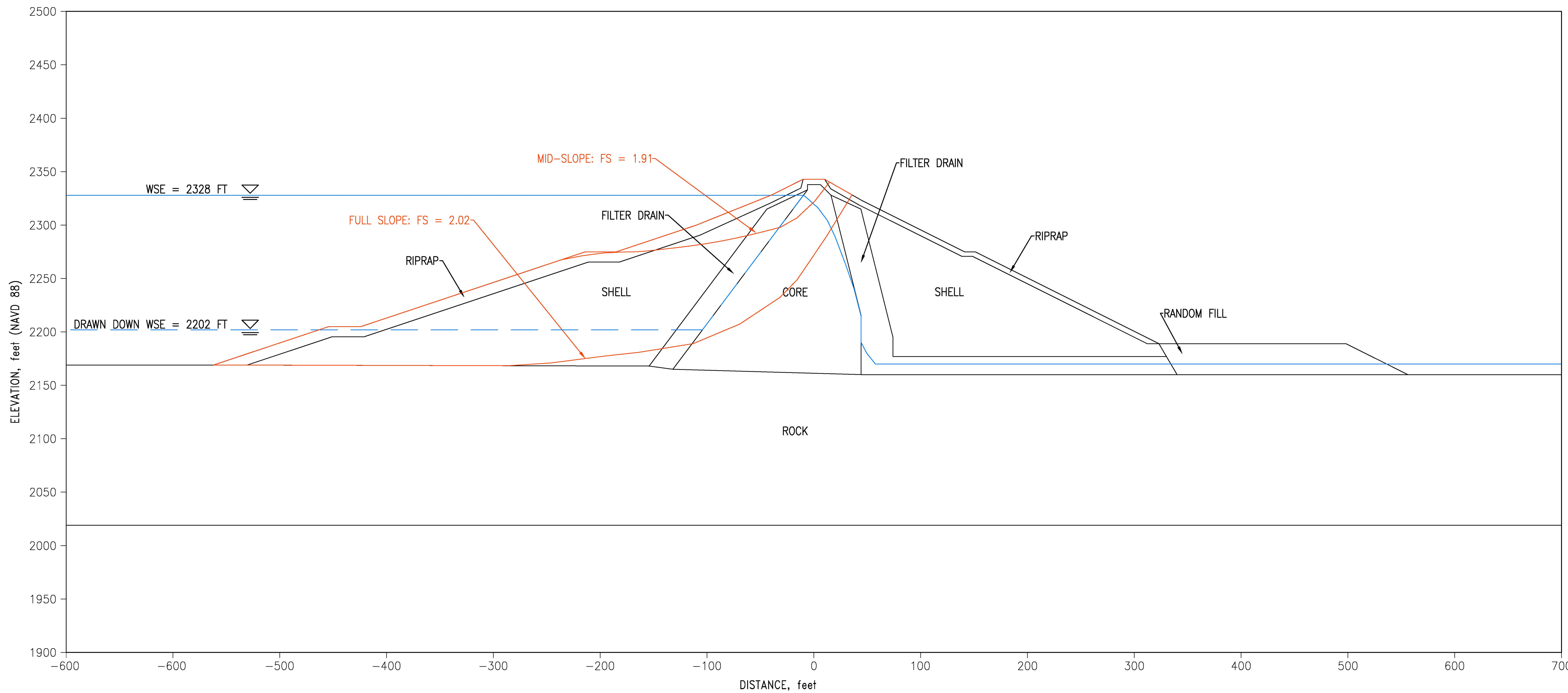
Figures



PROJECT NUMBER 60537920	PREPARED BY KANAX KANAGALINGAM	KLAMATH RIVER DAM REMOVAL	ANALYSIS MODEL GEOMETRY IRON GATE DAM	FIGURE 1
REVISION 0	CHECKED BY BENJAMIN CHOY			



PROJECT NUMBER 60537920	PREPARED BY BENJAMIN CHOY	KLAMATH RIVER DAM REMOVAL	ANALYSIS MODEL GEOMETRY JC BOYLE DAM	FIGURE 2
REVISION 0	CHECKED BY KANAX KANAGALINGAM			



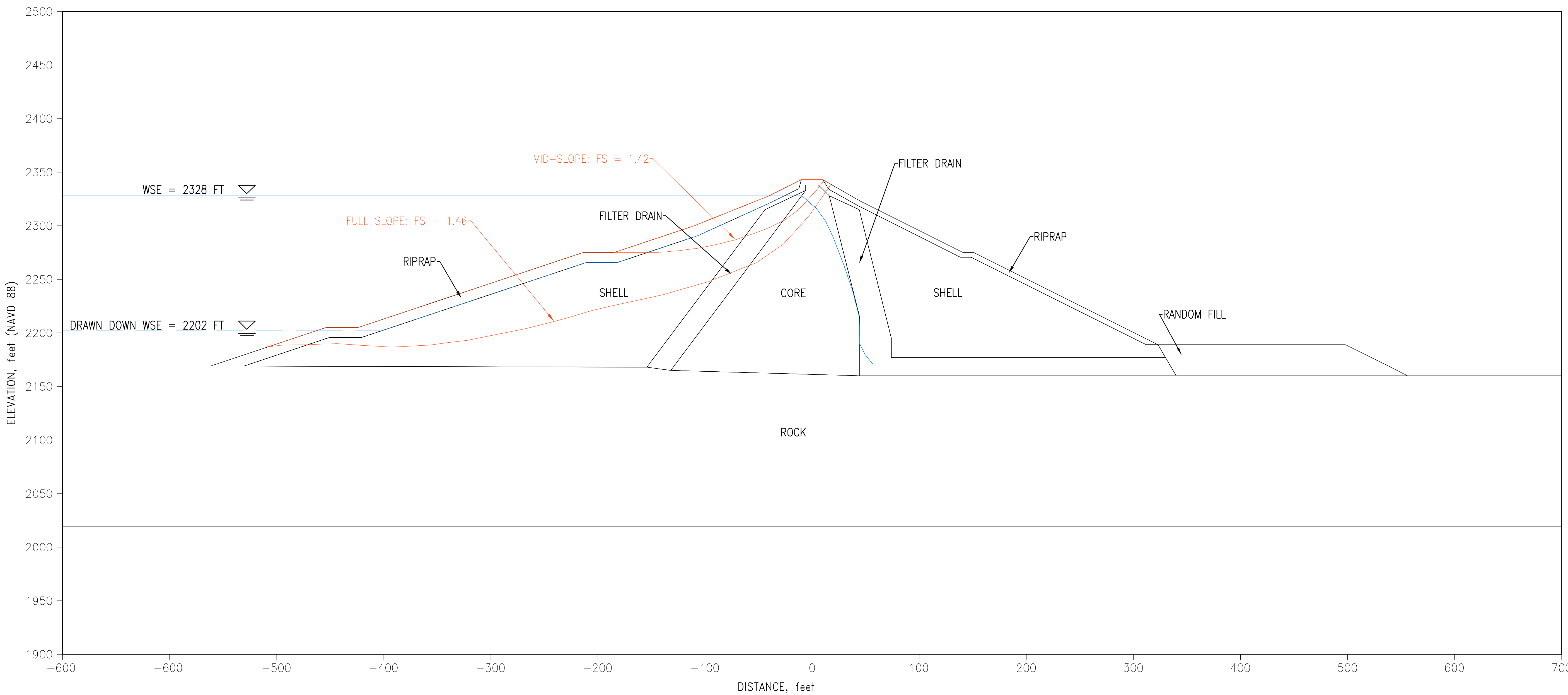
PLOT BY: BENJAMIN.CHOY – Sep 07, 2017 – 2:12:23pm
DRAWING: K:\400-Technical\430 Engineering\3.2 Tech Assess\5. Embank Stability\Iron Gate\Figures\Figure 5.dwg

PROJECT NUMBER	PREPARED BY
60537920	KANAX KANAGALINGAM
REVISION	CHECKED BY
0	BENJAMIN CHOY

KLAMATH RIVER DAM REMOVAL

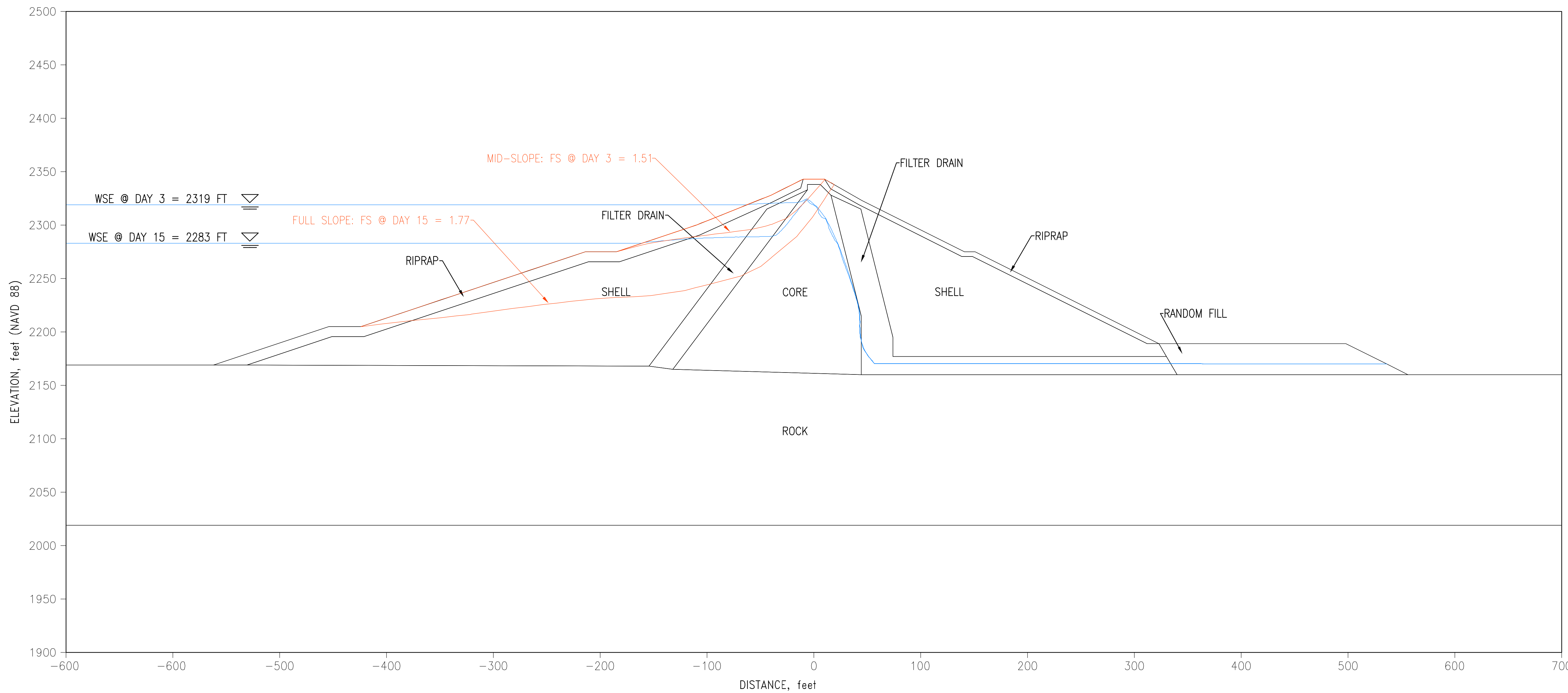
RAPID DRAWDOWN STABILITY ANALYSIS
IRON GATE DAM
INSTANTANEOUS DRAWDOWN SCENARIO
FULL PORE PRESSURE DISSIPATION

FIGURE
3

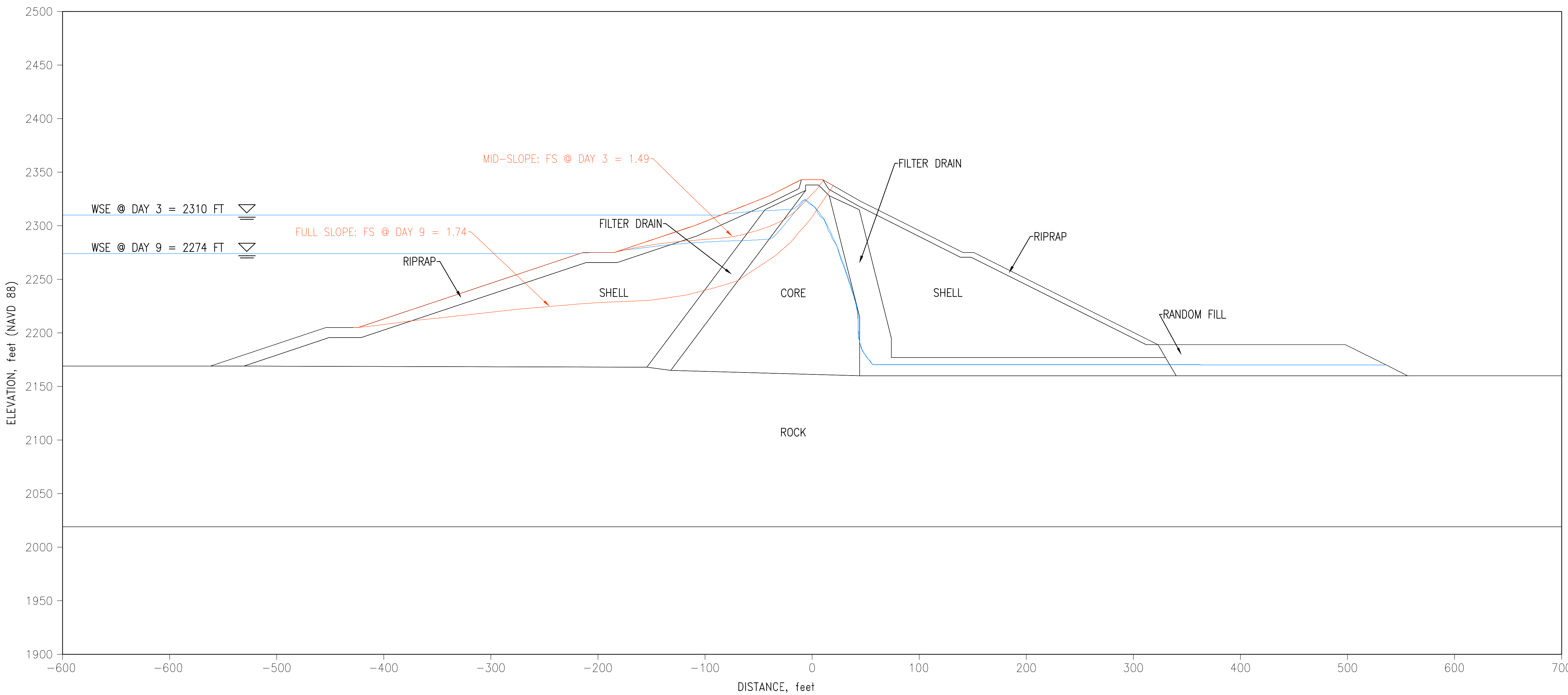


PROJECT NUMBER 60537920	PREPARED BY KANAX KANAGALINGAM	KLAMATH RIVER DAM REMOVAL	RAPID DRAWDOWN STABILITY ANALYSIS IRON GATE DAM INSTANTANEOUS DRAWDOWN SCENARIO NO PORE PRESSURE DISSIPATION	FIGURE 4
REVISION 0	CHECKED BY BENJAMIN CHOY			

PLOT BY: BENJAMIN.CHOY – Sep 07, 2017 – 2:19:24pm
DRAWING: K:\400–Technical\430 Engineering\3.2 Tech Assess\5. Embank Stability\Iron Gate\Figures\Figure 6.dwg

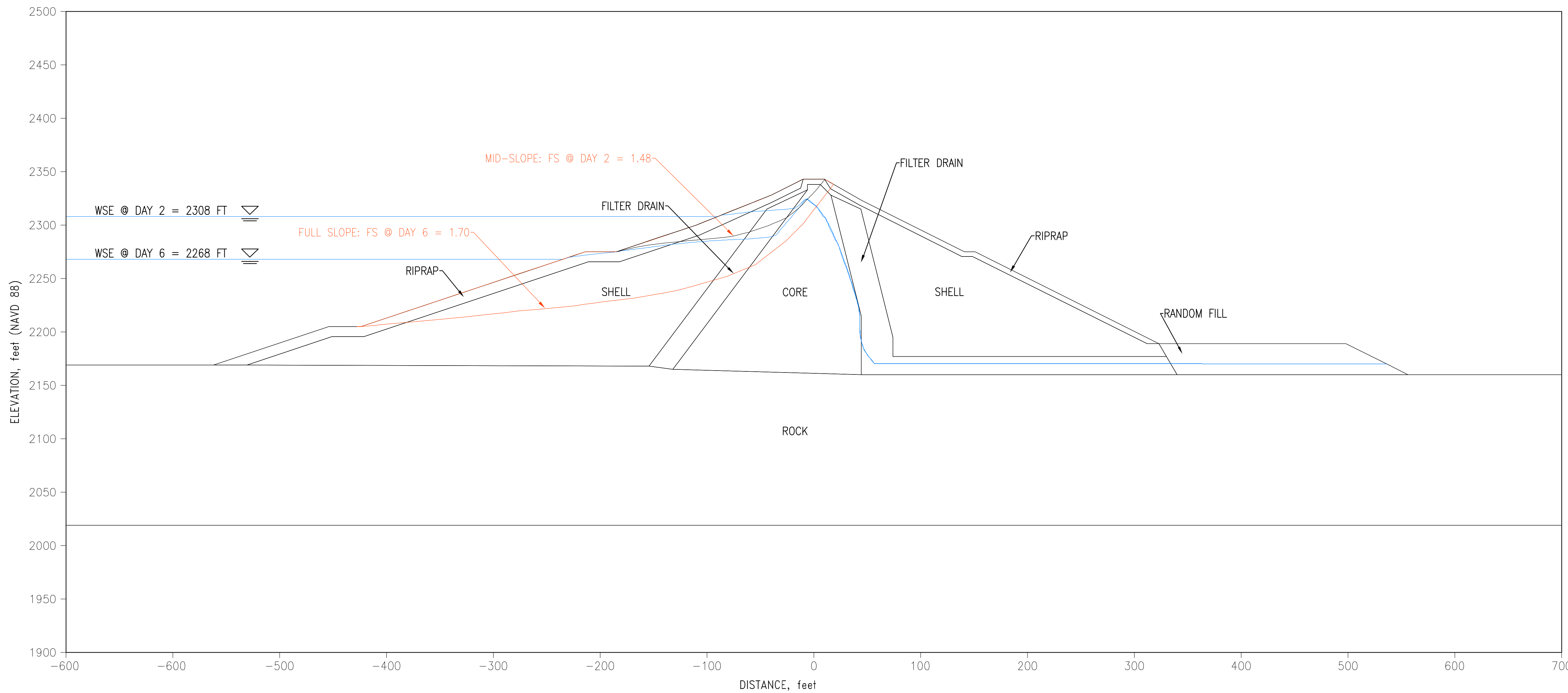


PROJECT NUMBER	PREPARED BY			
60537920	KANAX KANAGALINGAM	KLAMATH RIVER DAM REMOVAL	RAPID DRAWDOWN STABILITY ANALYSIS IRON GATE DAM SLOW DRAWDOWN SCENARIO 3 FT/DAY DRAWDOWN RATE	FIGURE 5
REVISION	CHECKED BY			
0	BENJAMIN CHOY			



PROJECT NUMBER 60537920	PREPARED BY KANAX KANAGALINGAM	KLAMATH RIVER DAM REMOVAL	RAPID DRAWDOWN STABILITY ANALYSIS IRON GATE DAM SLOW DRAWDOWN SCENARIO 6 FT/DAY DRAWDOWN RATE	FIGURE 6
REVISION 0	CHECKED BY BENJAMIN CHOY			

PLOT BY: BENJAMIN.CHOY – Sep 07, 2017 – 2:26:05pm
DRAWING: K:\400-Technical\430 Engineering\3.2 Tech Assess\5. Embank Stability\Iron Gate\Figures\Figure 8.dwg



PLOT BY: BENJAMIN.CHOY – Sep 07, 2017 – 2:29:50pm
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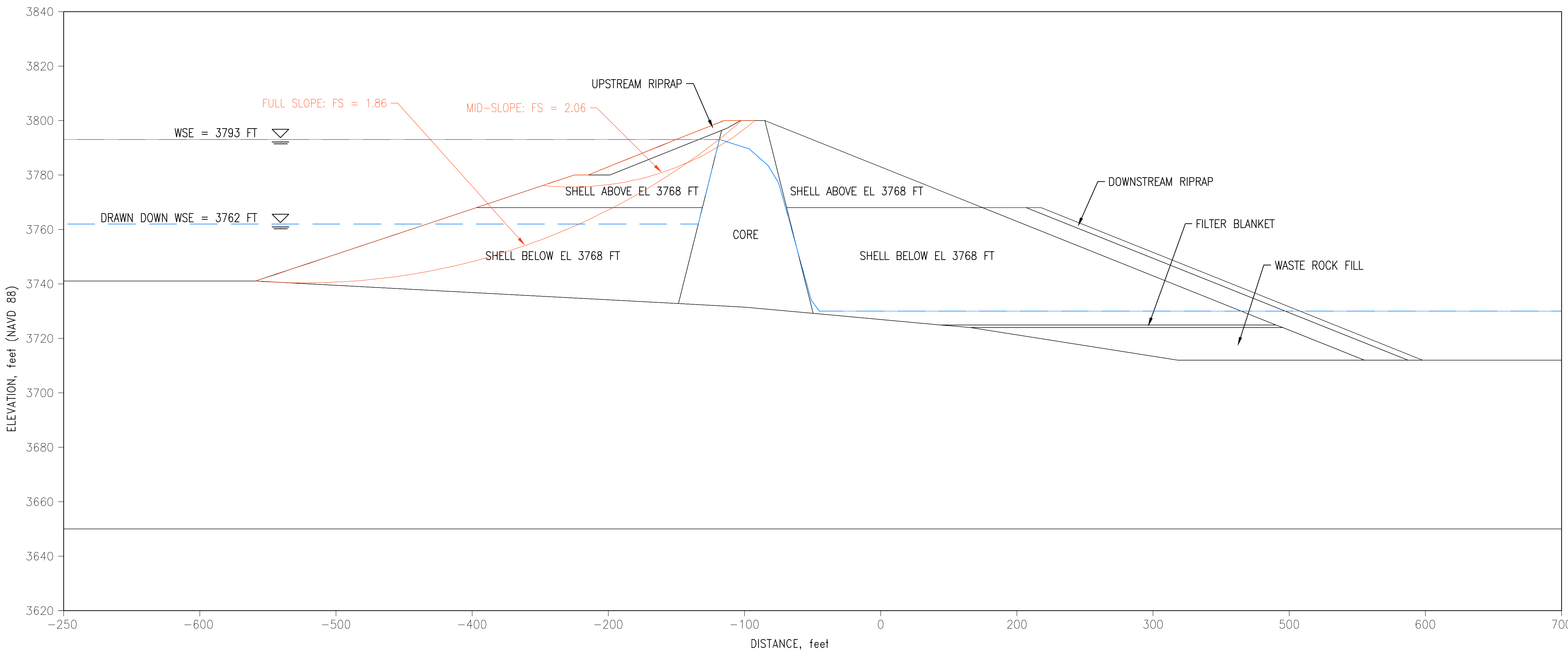
PROJECT NUMBER 60537920	PREPARED BY KANAX KANAGALINGAM	KLAMATH RIVER DAM REMOVAL	RAPID DRAWDOWN STABILITY ANALYSIS IRON GATE DAM SLOW DRAWDOWN SCENARIO 10 FT/DAY DRAWDOWN RATE	FIGURE 7
REVISION 0	CHECKED BY BENJAMIN CHOY			



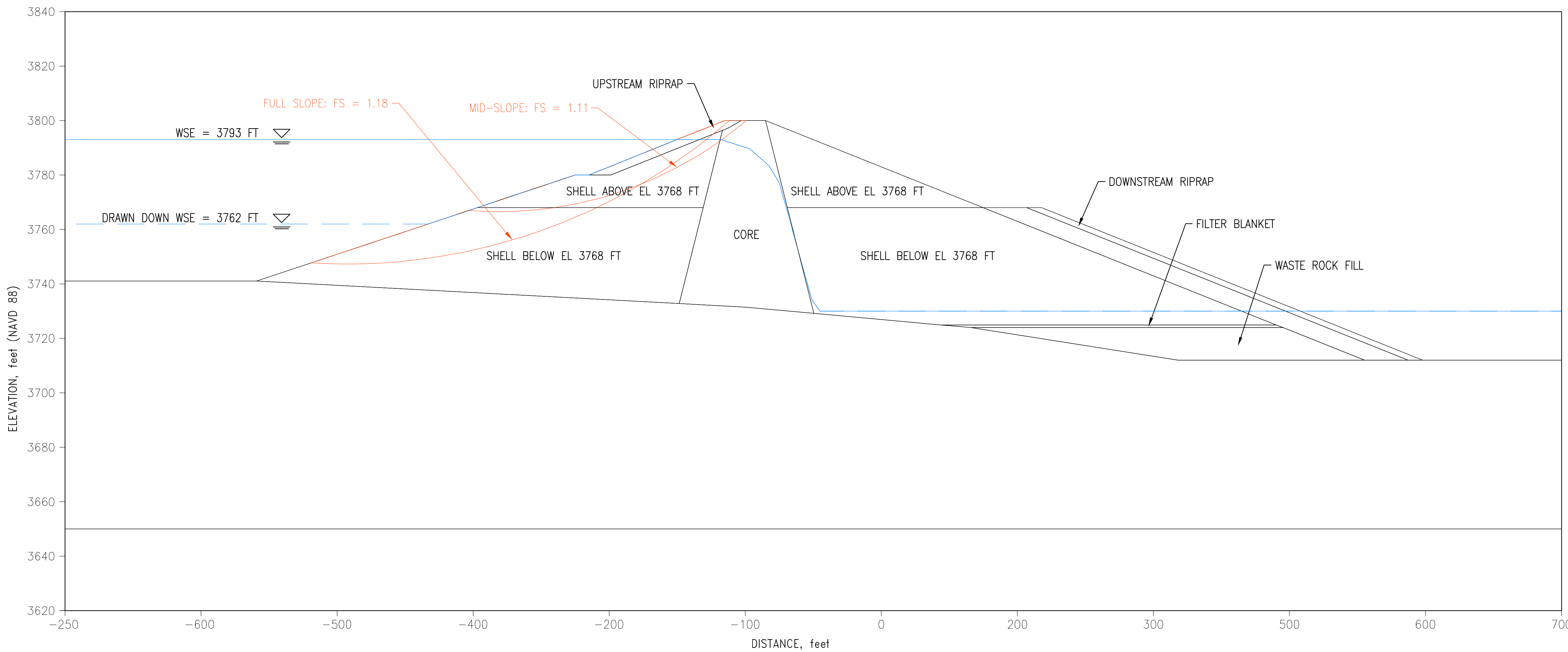
PLOT BY: BENJAMIN.CHOY – Sep 11, 2017 – 10:26:44am
DRAWING: K:\400-Technical\430 Engineering\3.2 Tech Assess\5. Embank Stability\JC Boyle\Figures\Figure 10.dwg

PROJECT NUMBER	PREPARED BY
60537920	BENJAMIN CHOY
REVISION	CHECKED BY
0	KANAX KANAGALINGAM

KLAMATH RIVER DAM REMOVAL

RAPID DRAWDOWN STABILITY ANALYSIS
JC BOYLE DAM
INSTANTANEOUS DRAWDOWN SCENARIO
FULL PORE PRESSURE DISSIPATION

FIGURE
8



PROJECT NUMBER	PREPARED BY			
60537920	BENJAMIN CHOY	KLAMATH RIVER DAM REMOVAL	RAPID DRAWDOWN STABILITY ANALYSIS JC BOYLE DAM INSTANTANEOUS DRAWDOWN SCENARIO NO PORE PRESSURE DISSIPATION	FIGURE 9
REVISION	CHECKED BY			
0	KANAX KANAGALINGAM			

PLOT BY: BENJAMIN.CHOY – Sep 12, 2017 – 4:29:57pm
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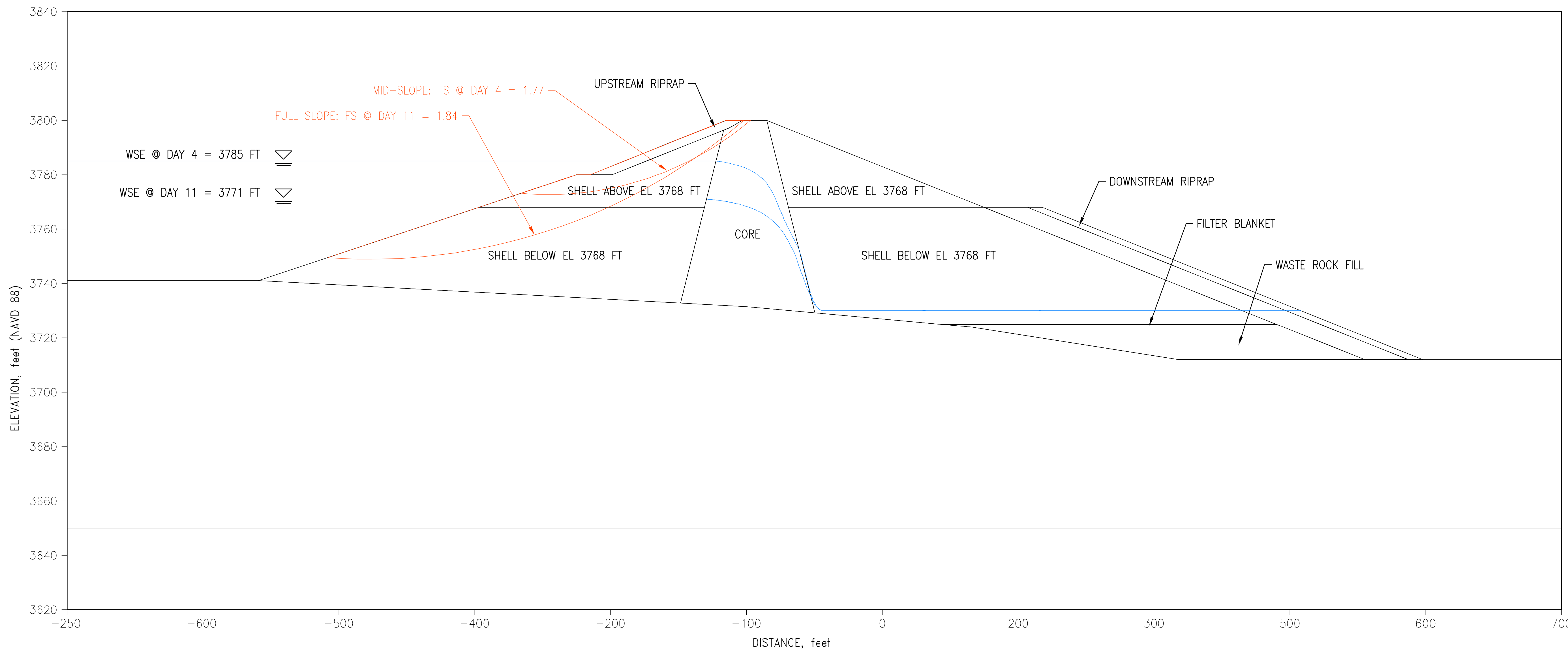
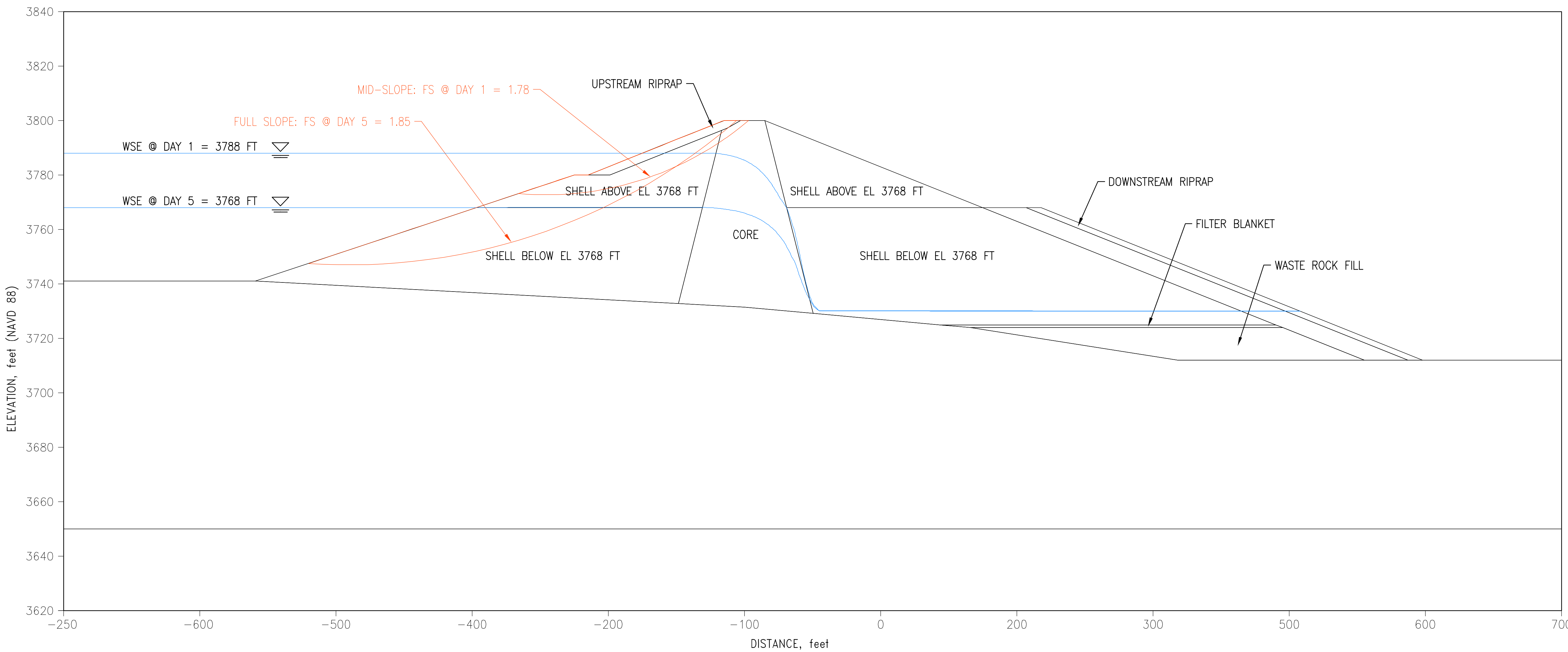


PLOT BY: BENJAMIN.CHOY – Sep 11, 2017 – 10:47:21am
DRAWING: K:\400-Technical\430 Engineering\3.2 Tech Assess\5. Embank Stability\JC Boyle\Figures\Figure 12.dwg

PROJECT NUMBER 60537920	PREPARED BY BENJAMIN CHOY	KLAMATH RIVER DAM REMOVAL	RAPID DRAWDOWN STABILITY ANALYSIS JC BOYLE DAM SLOW DRAWDOWN SCENARIO 2 FT/DAY DRAWDOWN RATE	FIGURE 10
REVISION 0	CHECKED BY KANAX KANAGALINGAM			

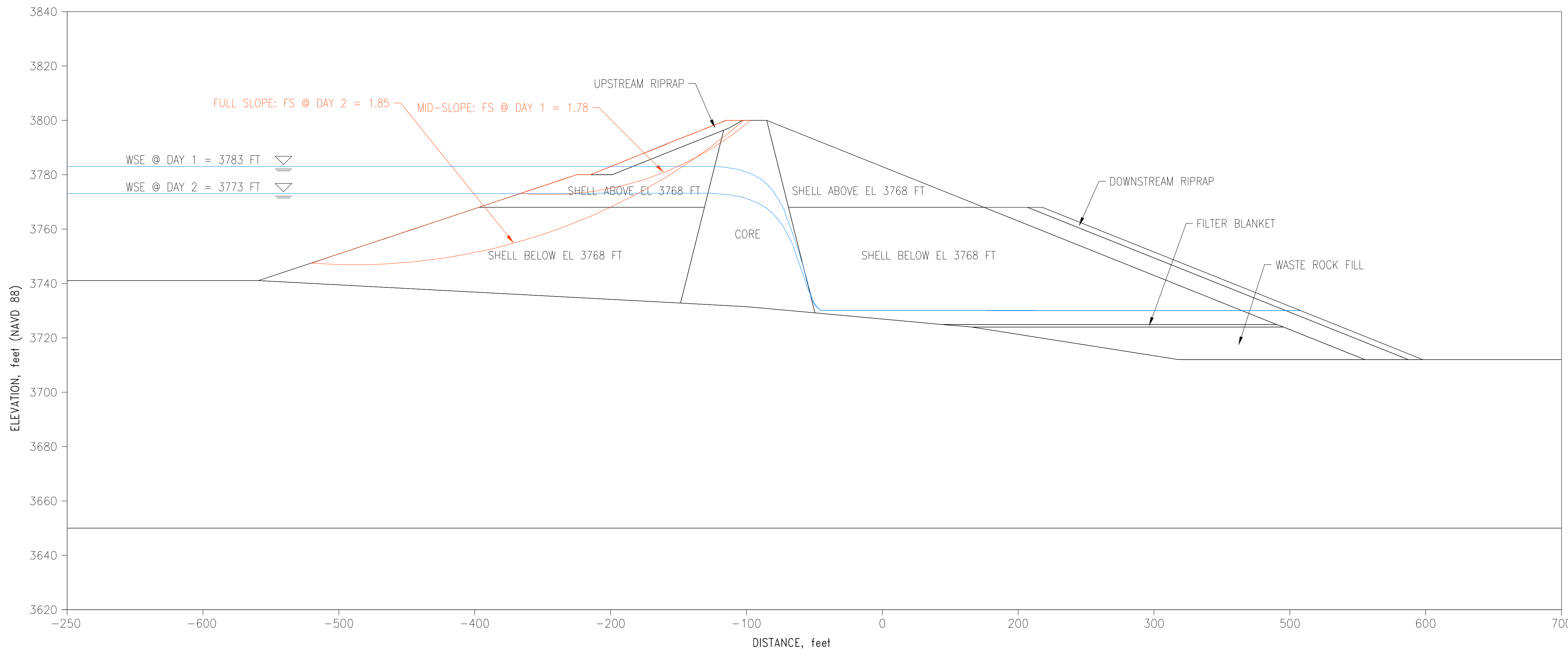


PROJECT NUMBER	PREPARED BY
60537920	BENJAMIN CHOY
REVISION	CHECKED BY
0	KANAX KANAGALINGAM

KLAMATH RIVER DAM REMOVAL

RAPID DRAWDOWN STABILITY ANALYSIS
JC BOYLE DAM
SLOW DRAWDOWN SCENARIO
5 FT/DAY DRAWDOWN RATE

FIGURE
11



PLOT BY: BENJAMIN.CHOY – Sep 11, 2017 – 10:59:18am
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PROJECT NUMBER	PREPARED BY	KLAMATH RIVER DAM REMOVAL	RAPID DRAWDOWN STABILITY ANALYSIS JC BOYLE DAM SLOW DRAWDOWN SCENARIO 10 FT/DAY DRAWDOWN RATE	FIGURE
60537920	BENJAMIN CHOY			12
REVISION	CHECKED BY			
0	KANAX KANAGALINGAM			

Attachment A Triaxial Test Results

ABBOT A. HANKS, INC.
ESTABLISHED 1866
1300 SANSOME STREET · SAN FRANCISCO 11, CALIFORNIA · EXBROOK 7-2464

Engineers
Assayers
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Metallurgists
Spectrographers
Soils and Foundations
Consulting · Testing · Inspecting

File No. 1732.1
Lab. No. 46938

May 11, 1960

Mr. W. L. Warren
Assistant Chief Engineer
The California Oregon Power Company
216 West Main Street
Medford, Oregon

Re: Iron Gate Dam
Soil Samples

Dear Sir:

Enclosed are the findings from tests performed on soil samples marked Hole No. 1, which is the only sample for which all tests are complete. Tests of remaining samples are in various stages of completion.

As you may recall from your recent visit, there appeared to be a possibility that samples from Holes 2 and 3 had been mislabelled. It now appears that all samples marked Holes 2 and 3 are nearly identical, and we are performing further tests to distinguish between them. It is quite possible that these soils are exceptionally sensitive to seasoning period, owing to the porous nature of the parent rock, and that test results, particularly optimum moisture content, are influenced by the length of seasoning period. We have completed triaxial shear and consolidation tests on the sample labelled Hole No. 2, but are not yet certain that the samples were compacted at optimum moisture content and maximum density.

We shall advise you of results of our identification tests, and shall forward sets of test data as they are completed.

Very truly yours,

ABBOT A. HANKS, INC.

L. O. Long

L. O. Long

LOL:hms
Encls.
Reports to:
3-The California Oregon Power Company

Iron Gate Dam
Klamath River
File No. 1732.1

Abbot A. Hanka, Inc.
Lab. No. 46938
May 10, 1960

TEST RESULTS

Hole No. 1.
Specific Gravity: 2.77.

Triaxial Shear Test

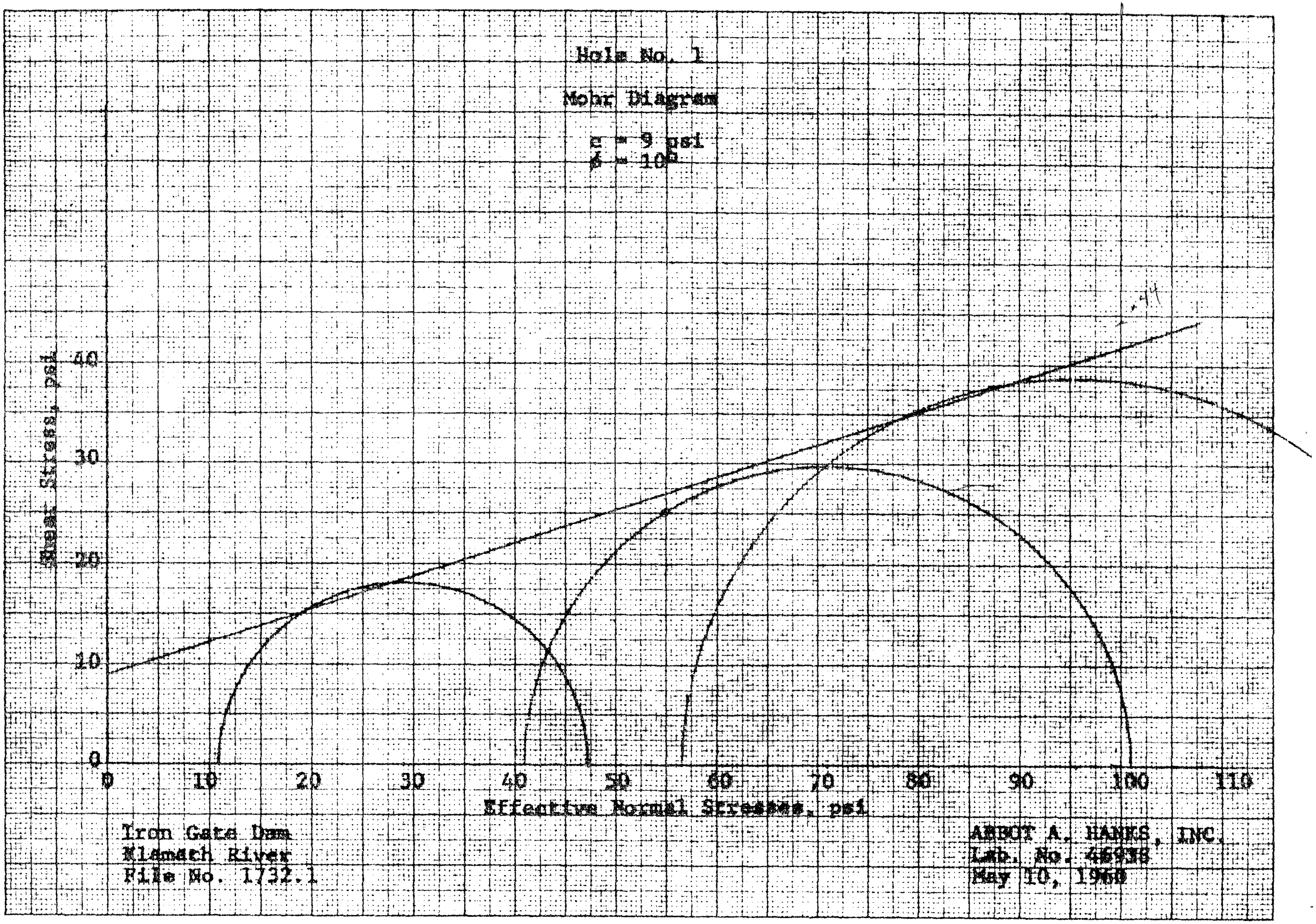
	Sample A	Sample B	Sample C
Chamber Pressure, psi	15	50	80
Unit Dry Weight at Compaction, lb/ft^3	103.3	103.6	104.3
Moisture Content at Compaction, %	21.3	22.1	20.8
Unit Dry Weight at Test, lb/ft^3	103.0	108.6	110.5
Moisture Content at Test, %	23.7	21.6	20.4
Degree of Saturation at Test, %	97	100+	100
Maximum Deviator Stress, psi	36	60	77
Pore Pressure at Max. Deviator Stress, psi	4	9	23

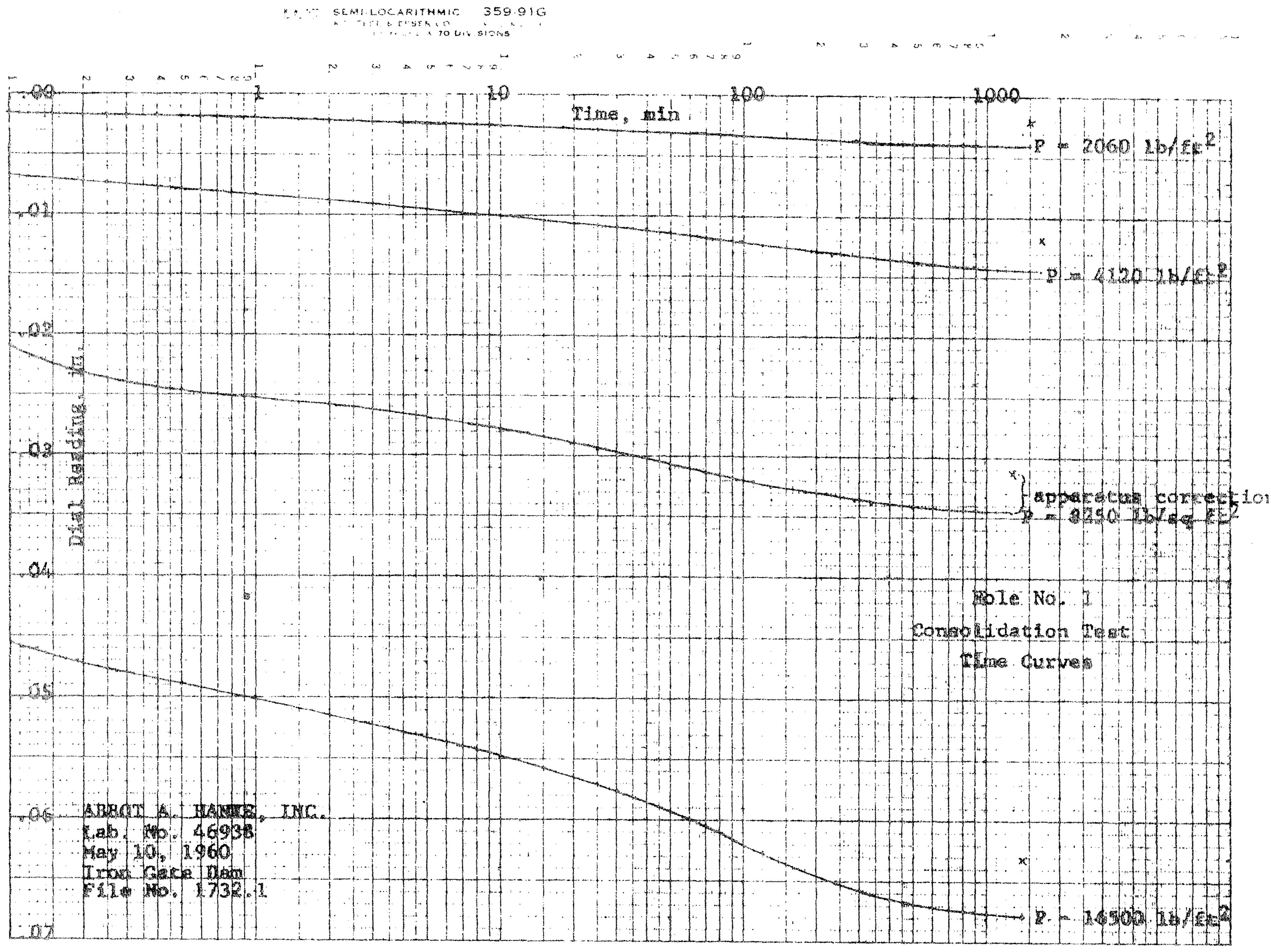
Permeability Test
(Constant Head Test)

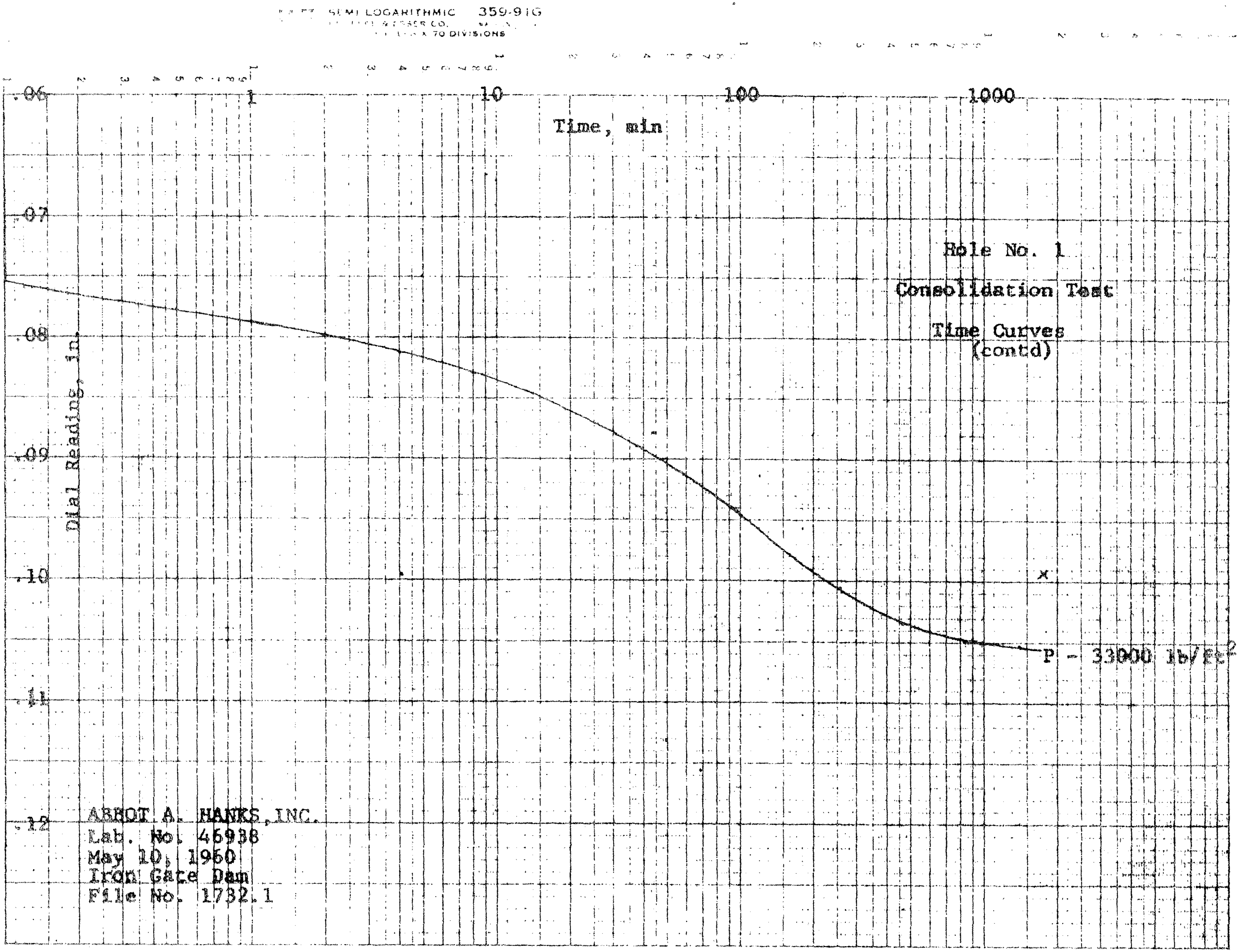
Unit Dry Weight at Compaction, lb/ft	100.6
Moisture Content at Compaction, %	23.6
Moisture Content at Test, %	24.4
Degree of Saturation at Test, %	95
Permeability coefficient, ft per yr	Less than .01
" " , cm/sec	Less than 10^{-8}

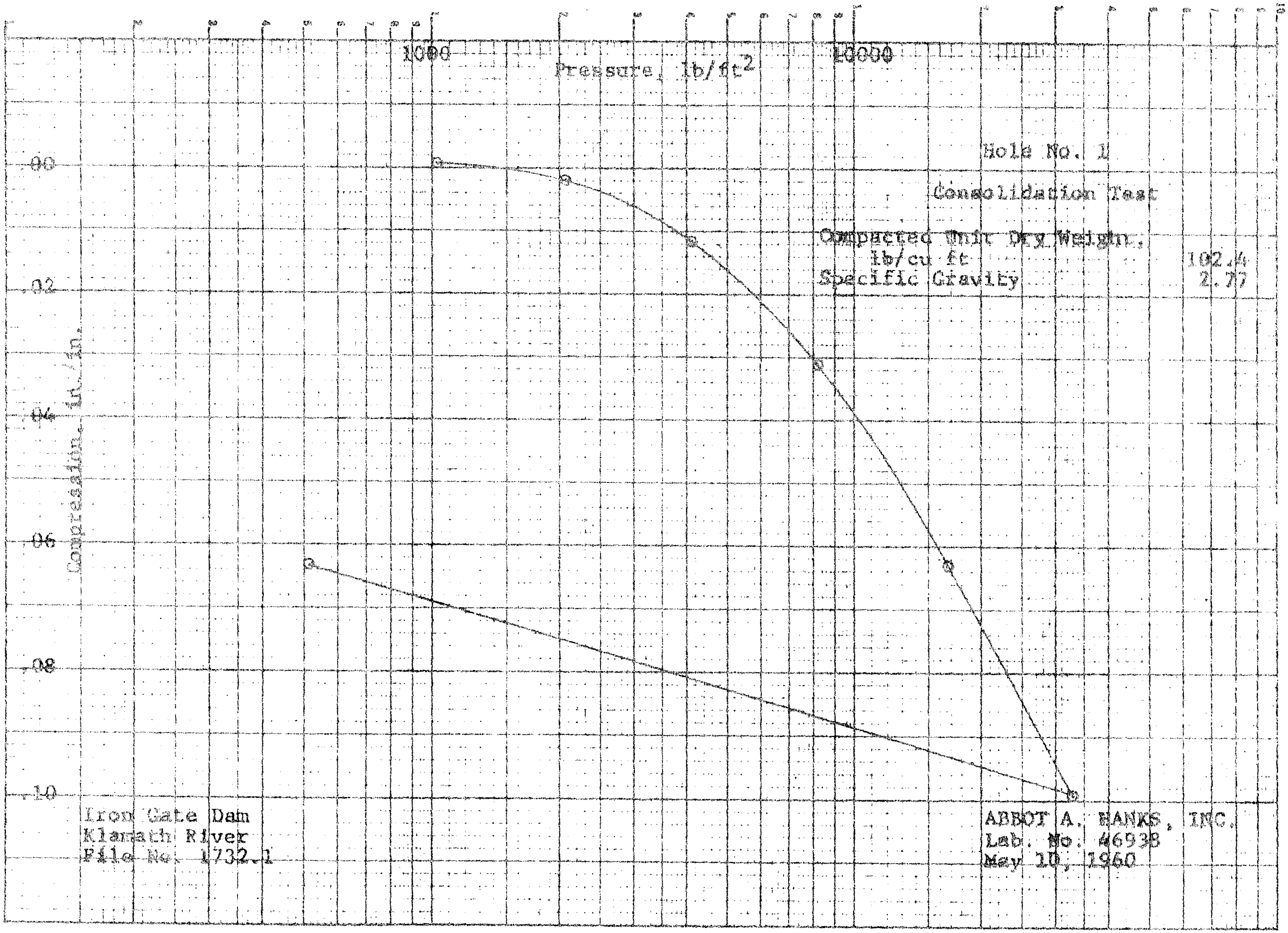
~~Report~~ ~~Letter~~
~~optimum moisture — 22% 22.7~~
~~max dry density 102.8 lb/cu ft. 103~~

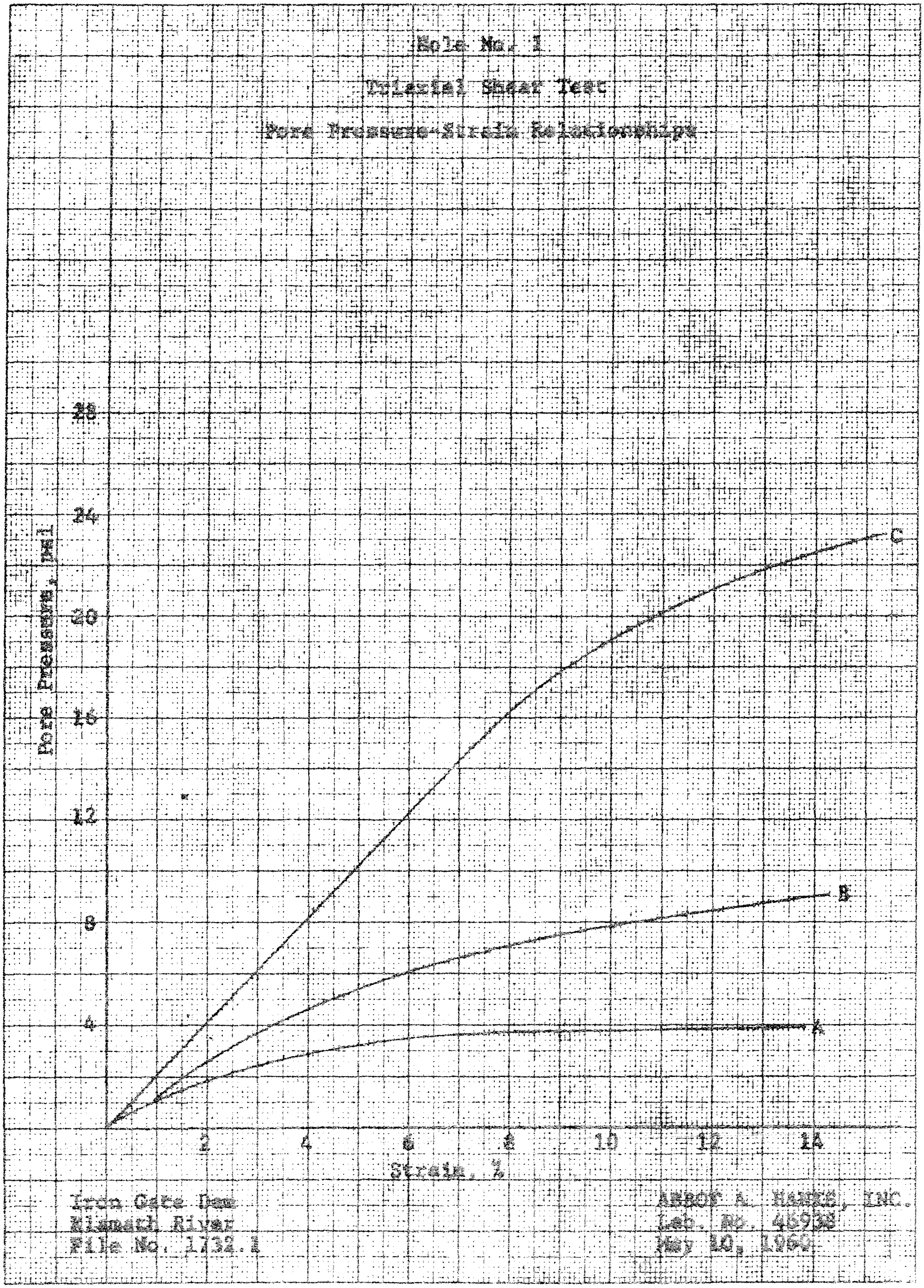
K+E 10 X 10 TO THE CM KEUFFEL & ESSER CO. 359-14G MADE IN U.S.A.




K&E SEMI-LOGARITHMIC 359-91G
Time, min
Dial Reading, in.
.00
.01
.02
.03
.04
.05
.06
.07
1
10
100
1000
P = 2060 lb/ft²
P = 4120 lb/ft²
apparatus correction
P = 8250 lb/sq ft²
P = 16500 lb/ft²
Hole No. 1
Consolidation Test
Time Curves
ABBOT A. HANKS, INC.
Lab. No. 46938
May 10, 1960
Iron Gate Dam
File No. 1732.1


SEMI-LOGARITHMIC 359-91G
70 DIVISIONS
Time, min
.06
.07
.08
.09
.10
.11
.12
1
10
100
1000
Dial Reading, in.
Hole No. 1
Consolidation Test
Time Curves
(contd)
P - 33000 lb/ft2
ABBOT A. HANKS, INC.
Lab. No. 46938
May 10, 1960
Iron Gate Dam
File No. 1732.1

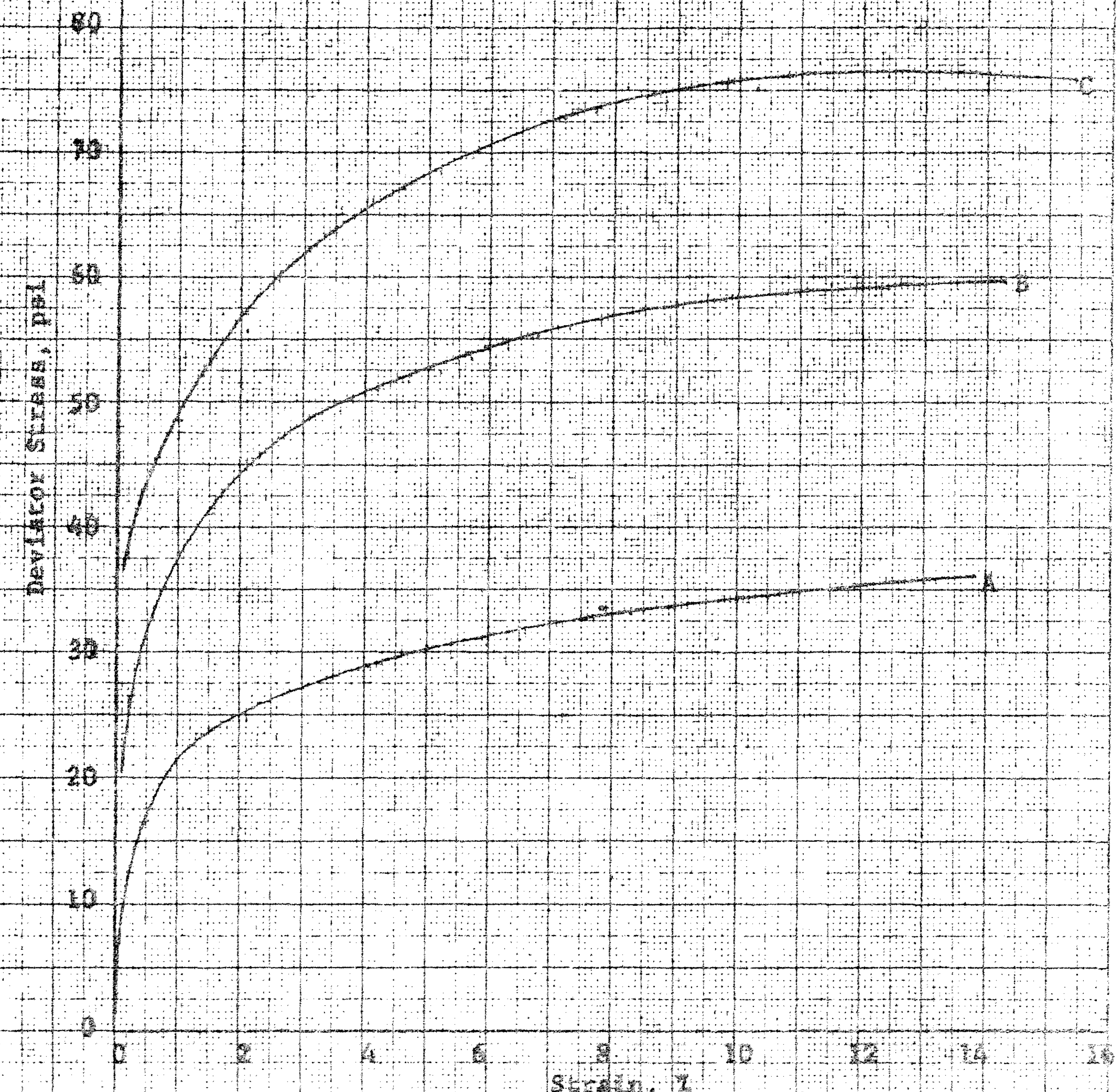

1000
Pressure, lb/ft2
10000
.00
.02
.04
.06
.08
.10
Compression, in./in.
Hole No. 1
Consolidation Test
Compacted Unit Dry Weight, lb/cu ft 102.4
Specific Gravity 2.77
Iron Gate Dam
Klamath River
File No. 1732.1
ABBOT A. HANKS, INC.
Lab. No. 46938
May 10, 1960


Hole No. 1
Triaxial Shear Test
Pore Pressure-Strain Relationships
Pore Pressure, psi
28
24
20
16
12
8
4
2
4
6
8
10
12
14
Strain, %
C
B
A
Iron Gate Dam
Klamath River
File No. 1732.1
ABBOT A. HANKS, INC.
Lab. No. 46938
May 10, 1960

Hole No. 1

Triaxial Shear Test

Stress-Strain Relationships



Iron Gate Dam
Klamath River
File No. 1732.1

ABBOT A. HANKS, INC.
Lab. No. 46938
May 10, 1960

BRANCH LABORATORY 1086 MARTIN AVENUE • SANTA CLARA • CHERRY 8 5262
BRANCH OFFICE 10 DE LUCA PLACE • SAN RAFAEL • GLENWOOD 4 8650

CABLE: HANK

ABBOT A. HANKS, INC.
ESTABLISHED 1866
1300 SANSOME STREET • SAN FRANCISCO 11, CALIFORNIA • EXBROOK 7 2464

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File No. 1732.1
Lab. No. 46938

June 29, 1960

Mr. W. L. Warren
Assistant Chief Engineer
The California Oregon Power Company
216 West Main Street
Medford, Oregon

Re: Iron Gate Dam
Soil Samples

Dear Mr. Warren:

Enclosed are results of triaxial tests that were performed on Sample No. 2 before it was noted that this sample required an exceptionally small compactive effort relative to the other samples submitted.

We are also enclosing miscellaneous test results not shown on previously submitted reports.

If you require additional tests of Sample No. 2, we should have a complete new sample of about 100 lb.

Very truly yours,

ABBOT A. HANKS, INC.

L. O. Long

L. O. Long

LOL:hms
Encls.
Reports to:
15-The California Oregon Power Company

Iron Gate Dam
Klamath River
File No. 1732.1

Abbot A. Hanks, Inc.
Lab. No. 46938
July 1, 1960

TEST RESULTS

Hole No. 2.
Specific Gravity: 2.77.

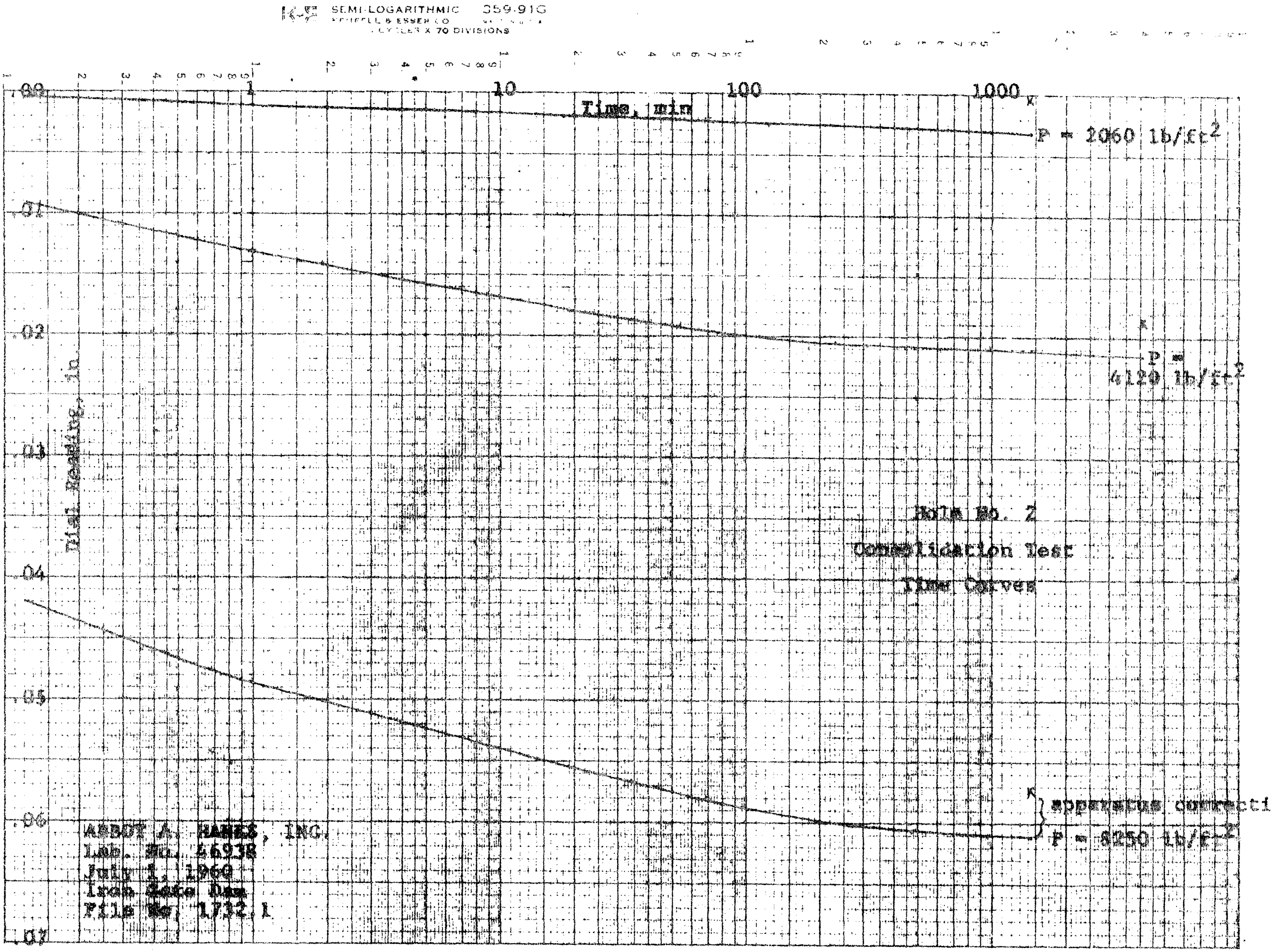
Triaxial Shear Test

	Sample A	Sample B	Sample C	Sample D
Chamber Pressure, psi	15	50	50	80
Unit Dry Weight at Compaction, lb/ft^3	98.0	95.1	98.8	99.3
Moisture Content at Compaction, %	21	21	21	21
Unit Dry Weight at Test, lb/ft^3	99.4	109.0	106.3	100.2
Moisture Content at Test, lb/ft^3	24.4	22.3	21.6	20.3
Degree of Saturation at Test, %	93	100+	97	93
Maximum Deviator Stress, psi	19	40	45	69
Pore Pressure at Maximum Deviator Stress, psi	8	26	24	15

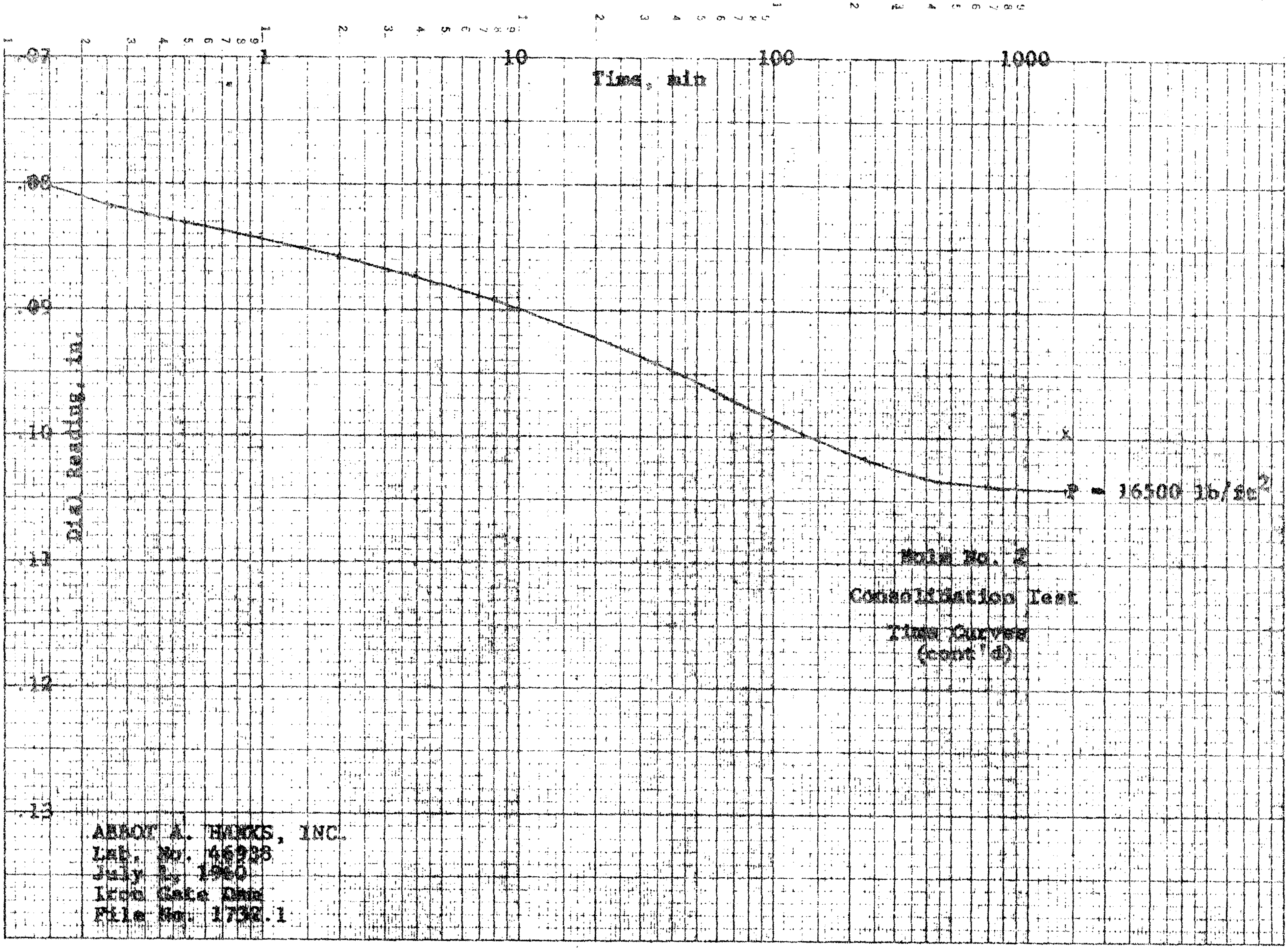
~~Report — Letter~~

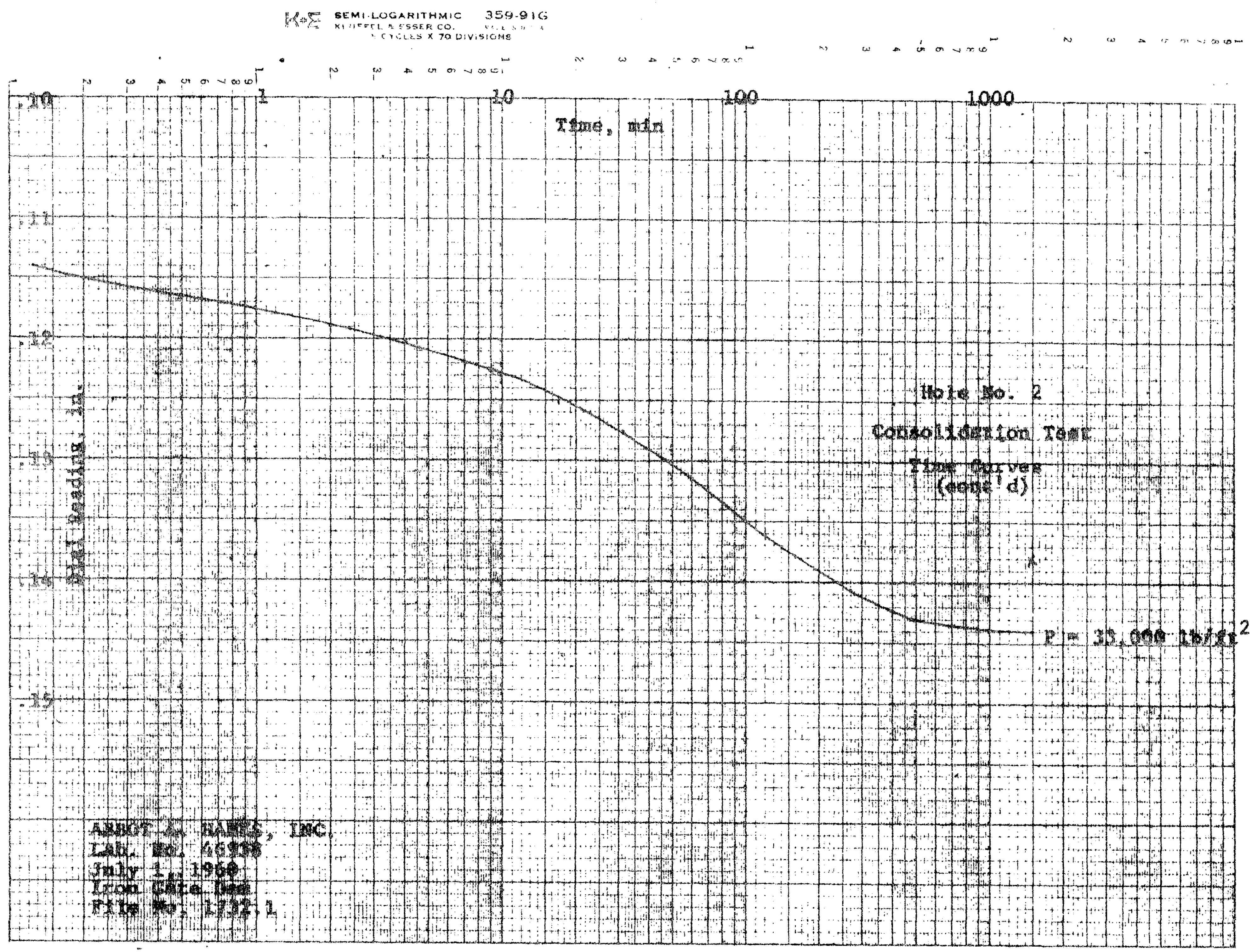
~~Optimum moisture — 21 — 21~~

~~Max dry density — 102.8 — 103~~

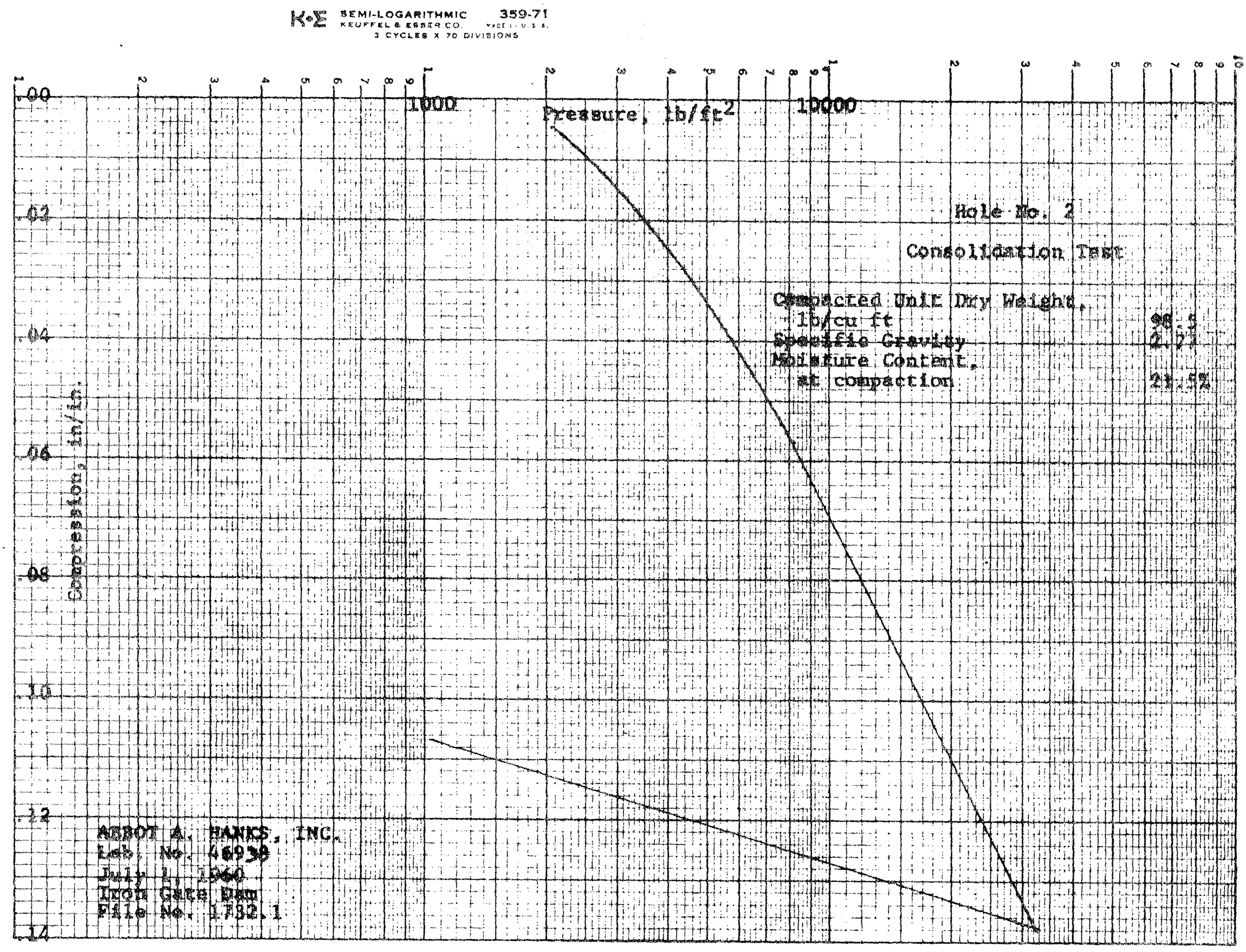

SEMI-LOGARITHMIC 359-91G
Time, min
1
10
100
1000
Dial Reading, in.
.00
.01
.02
.03
.04
.05
.06
.07
P = 2060 lb/ft²
P = 4120 lb/ft²
apparatus correcti
Hole No. 2
Consolidation Test
Time Curves
INC.
July 1, 1960
1732.1

SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO.
5 CYCLES X 70 DIVISIONS





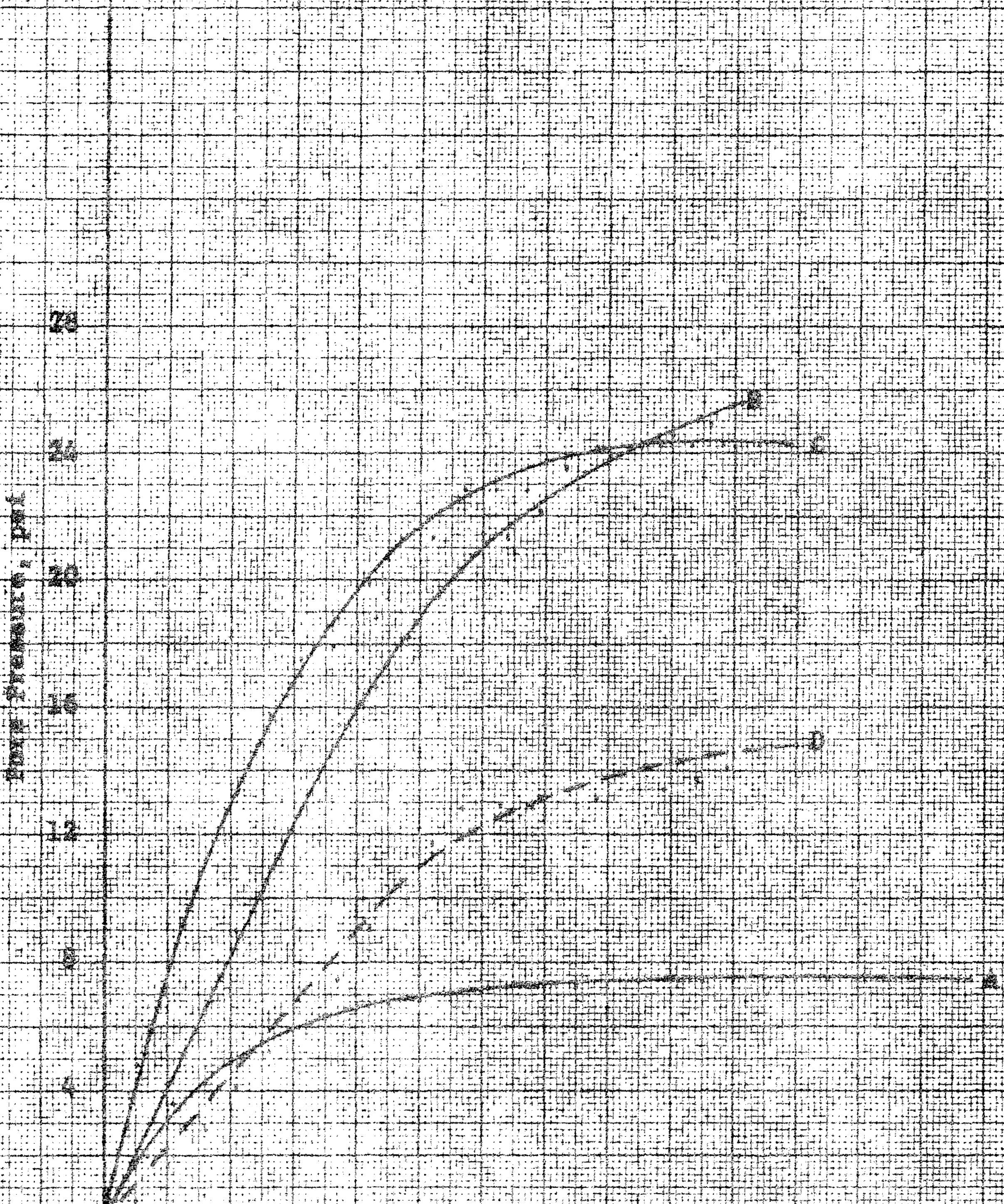
SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO.
Time, min
.10
.11
.12
.13
.14
.15
1
10
100
1000
Hole No. 2
Consolidation Test
Time Curves
(cont'd)
P = 33,000 lb/ft²
July 1, 1960


K+E SEMI-LOGARITHMIC 359-71
KEUFFEL & ESSER CO.
3 CYCLES X 70 DIVISIONS
Pressure, lb/ft²
1000
10000
Compression, in/in.
.00
.02
.04
.06
.08
.10
.12
.14
Hole No. 2
Consolidation Test
Compacted Unit Dry Weight, lb/cu ft 98.5
Specific Gravity 2.71
Moisture Content, at compaction 21.5%
ABBOT A. HANKS, INC.
Lab. No. 46930
July 1, 1960
Iron Gate Dam
File No. 1782.1

Hole No. 2

Triaxial Shear Test

Pore Pressure-Strain Relationships



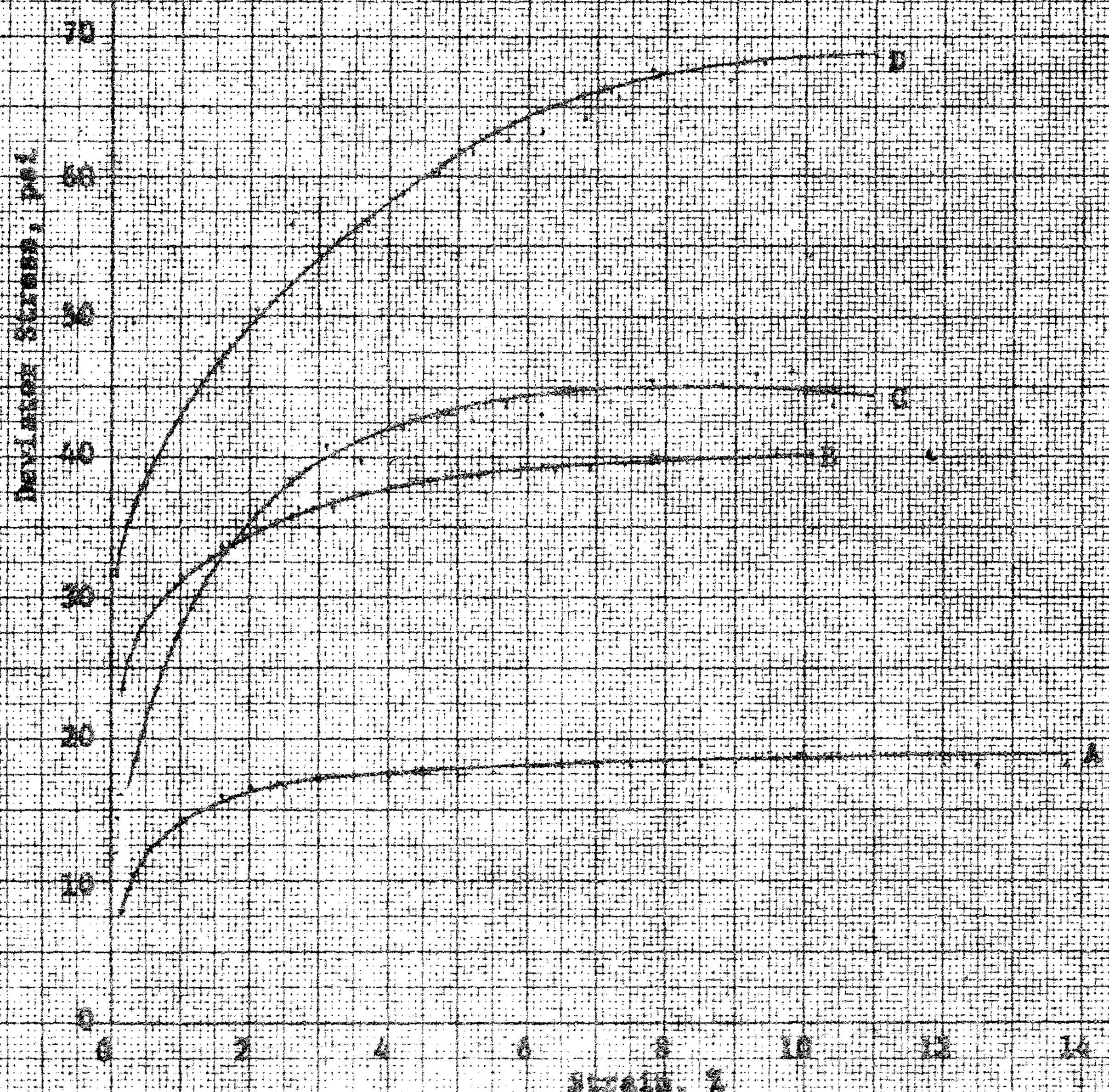
Iron Gate Dam
Klamath River
File No. 1732.1

[illegible], INC.
Lab. No. [illegible]
July 1, 1965

Hole No. 2

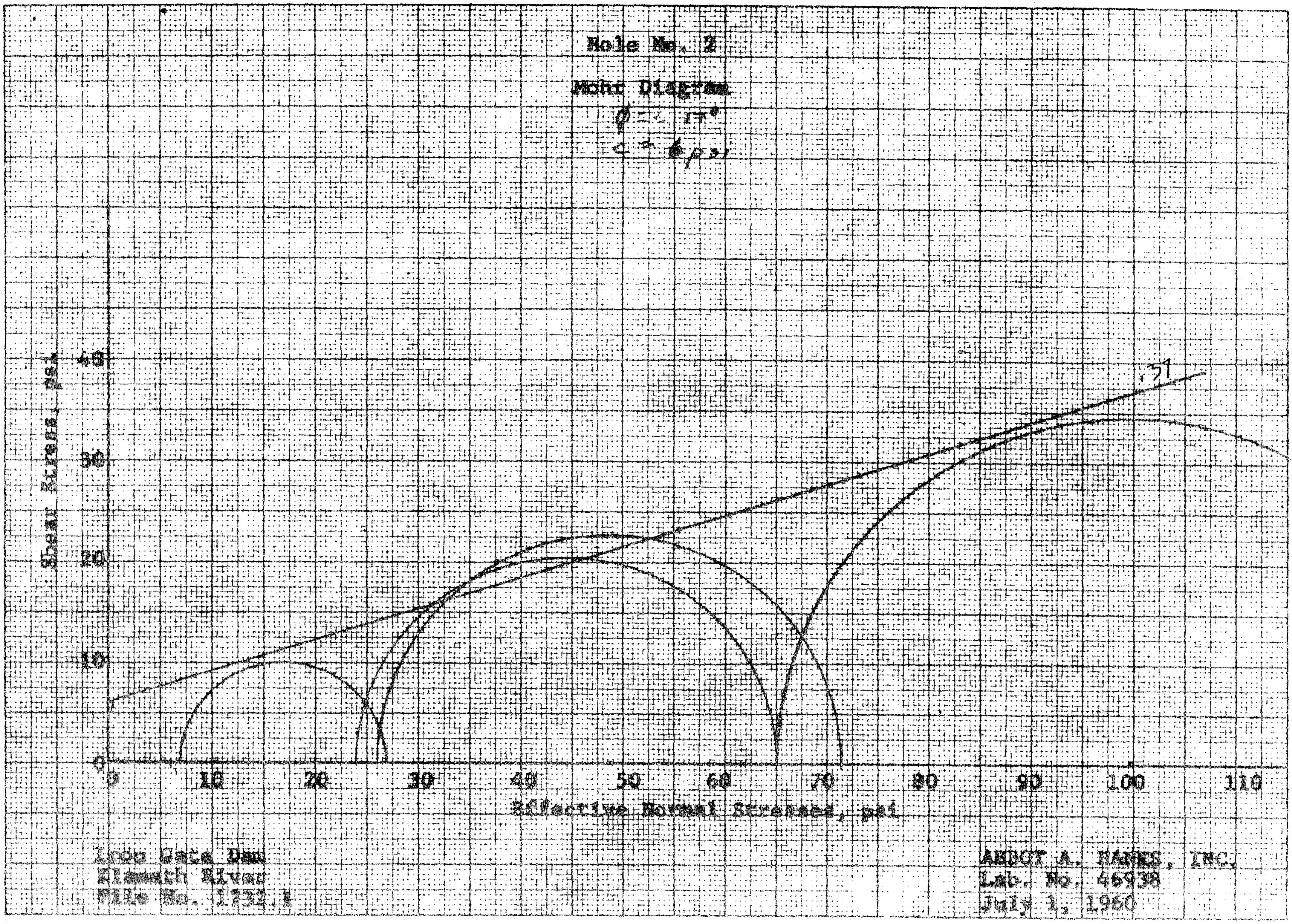
Triaxial Shear Test

Stress-Strain Relationships



Iron Gate Dam
Klamath River
File No. 1732.1

ABBOT A. HANKS, INC.
Lab. No. #6938
July 1, 1960


Hole No. 2
Mohr Diagram
ϕ = 17°
c = 6 psi
Shear Stress, psi
0
10
20
30
40
0
10
20
30
40
50
60
70
80
90
100
110
Effective Normal Stresses, psi
Iron Gate Dam
Klamath River
File No. 1732.1
ABBOT A. HANKS, INC.
Lab. No. 46938
July 1, 1960

BRANCH LABORATORY 1086 MARTIN AVENUE • SANTA CLARA • CHERRY 8-5262
BRANCH OFFICE 10 DE LUCA PLACE • SAN RAFAEL • GLENWOOD 4-8650
CABLE HANX

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ESTABLISHED 1866
1300 SANSOME STREET • SAN FRANCISCO 11, CALIFORNIA • EXBROOK 7-2464

Engineers
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Soils and Foundations
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File No. 1732.1
Lab. No. 46938

June 3, 1960

Mr. W. L. Warren
Assistant Chief Engineer
The California Oregon Power Company
216 West Main Street
Medford, Oregon

Re: Iron Gate Dam
<u>Soil Samples</u>

Dear Mr. Warren:

Enclosed are the findings from tests performed on soil samples marked Hole No. 3.

Very truly yours,

ABBOT A. HANKS, INC.

Donald W Radbruch

Donald W. Radbruch

hms
Encls.
Reports to:
3-The California Oregon Power Company

Iron Gate Dam
Klamath River
File No. 1732.1

Abbot A. Hanks, Inc.
Lab. No. 46938
June 3, 1960

TEST RESULTS

Hole No. 3
Specific Gravity: 2.76

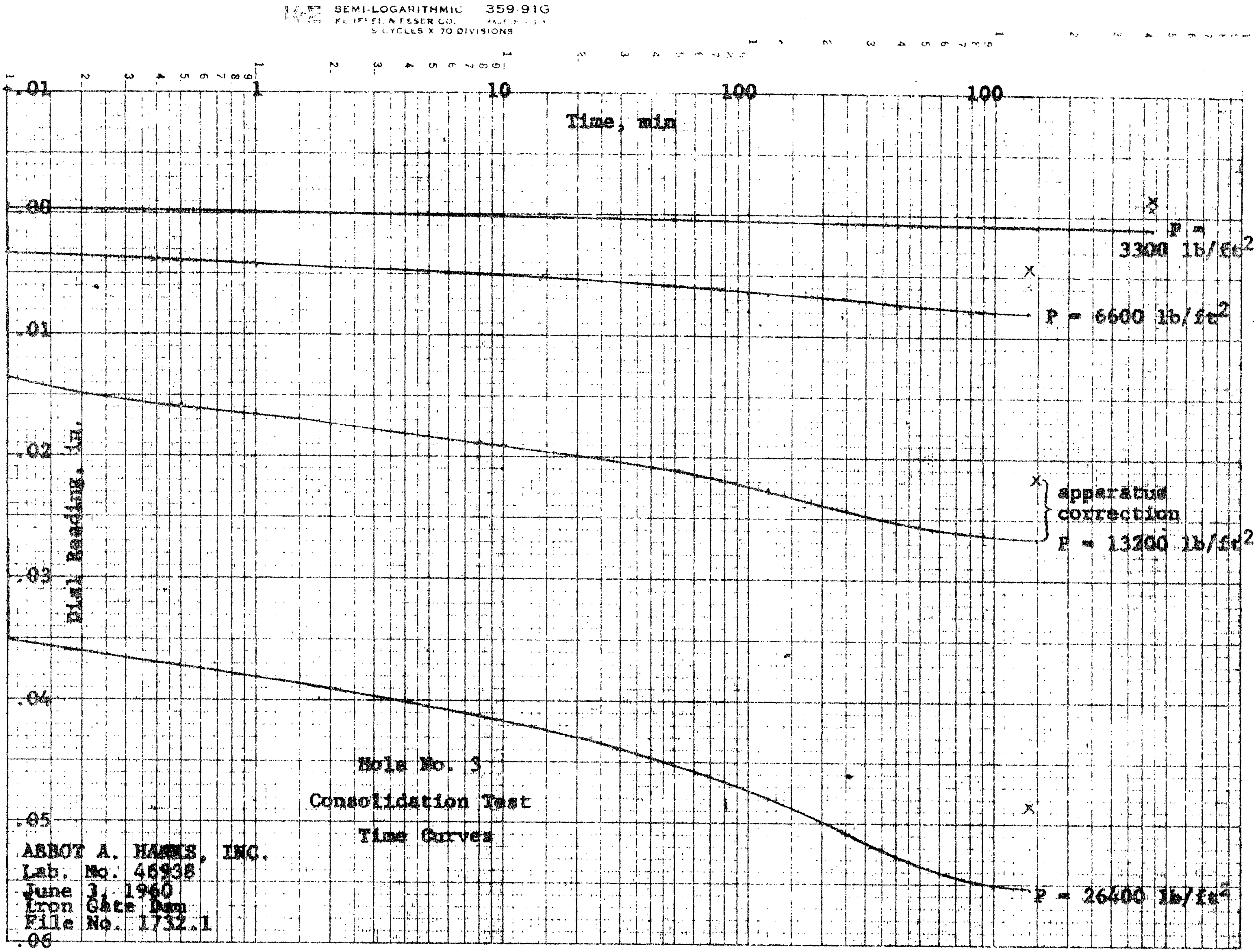
Triaxial Shear Test

	Samples A	Samples B	Samples C
Chamber Pressure, psi	15	50	80
Unit Dry Weight at Compaction, lb/ft^3	104.4	104.5	103.5
Moisture Content at Compaction, %	21.9	22.0	22.1
Unit Dry Weight at Test, lb/ft^3	105.3	107.5	109.2
Moisture Content at Test, lb/ft^3	24.0	22.4	23.5
Degree of Saturation at Test, %	100+	100+	100+
Maximum Deviator Stress, psi	34	59	79
Pore Pressure at Max. Deviator Stress, psi	2	5	2

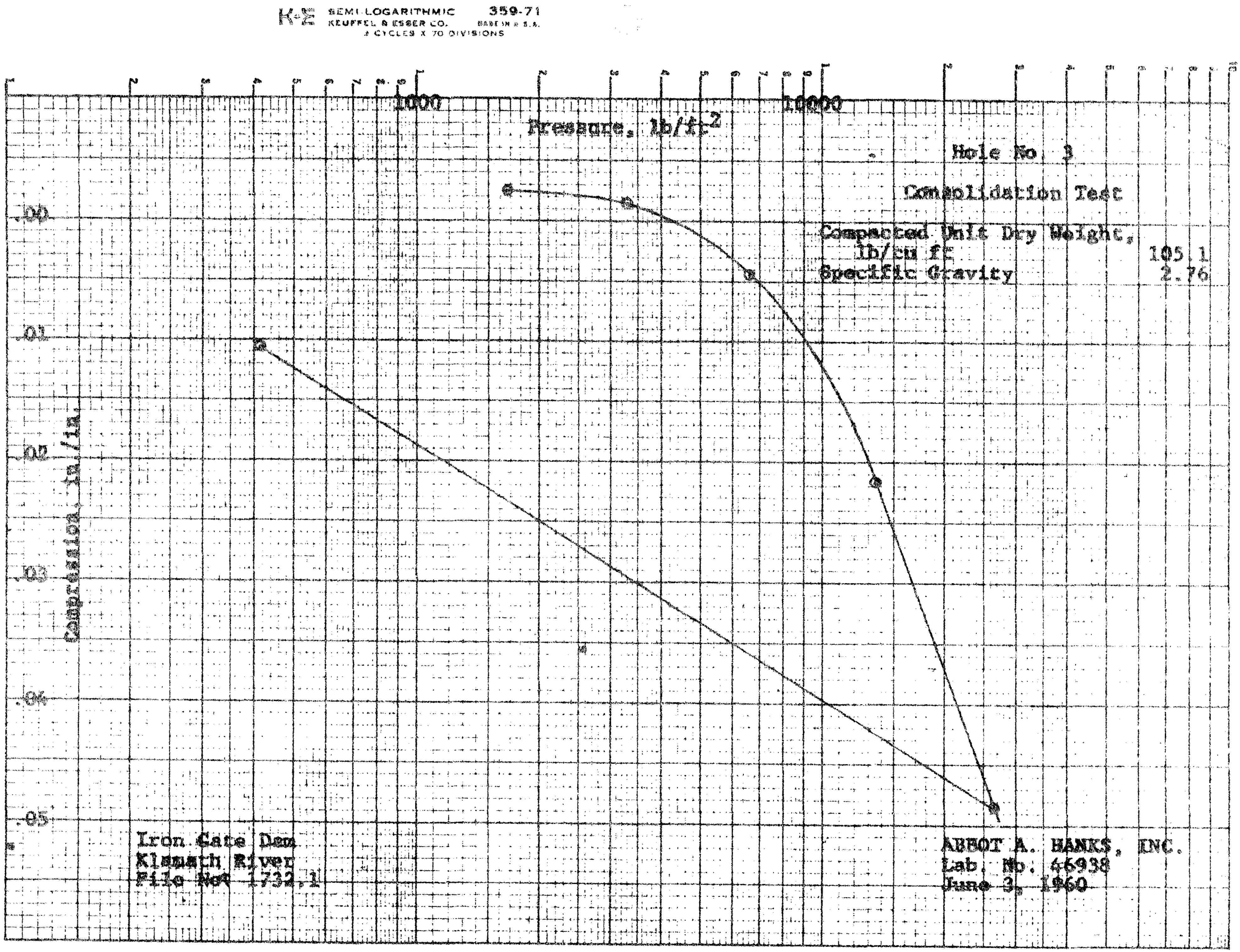
Permeability Test
(Constant Head Test)

Unit Dry Weight at Compaction, lb/ft^3	106.5
Moisture Content at Compaction, %	22.0
Moisture Content at Test, %	23.1
Degree of Saturation at Test, %	100+
Permeability Coefficient, ft per yr	Less than .01
" " , cm/sec	Less than 10^{-8}

~~Report Filter~~
~~Optimum moisture 15.3 15.5~~
~~Max. Dry density 111.6 111.5~~



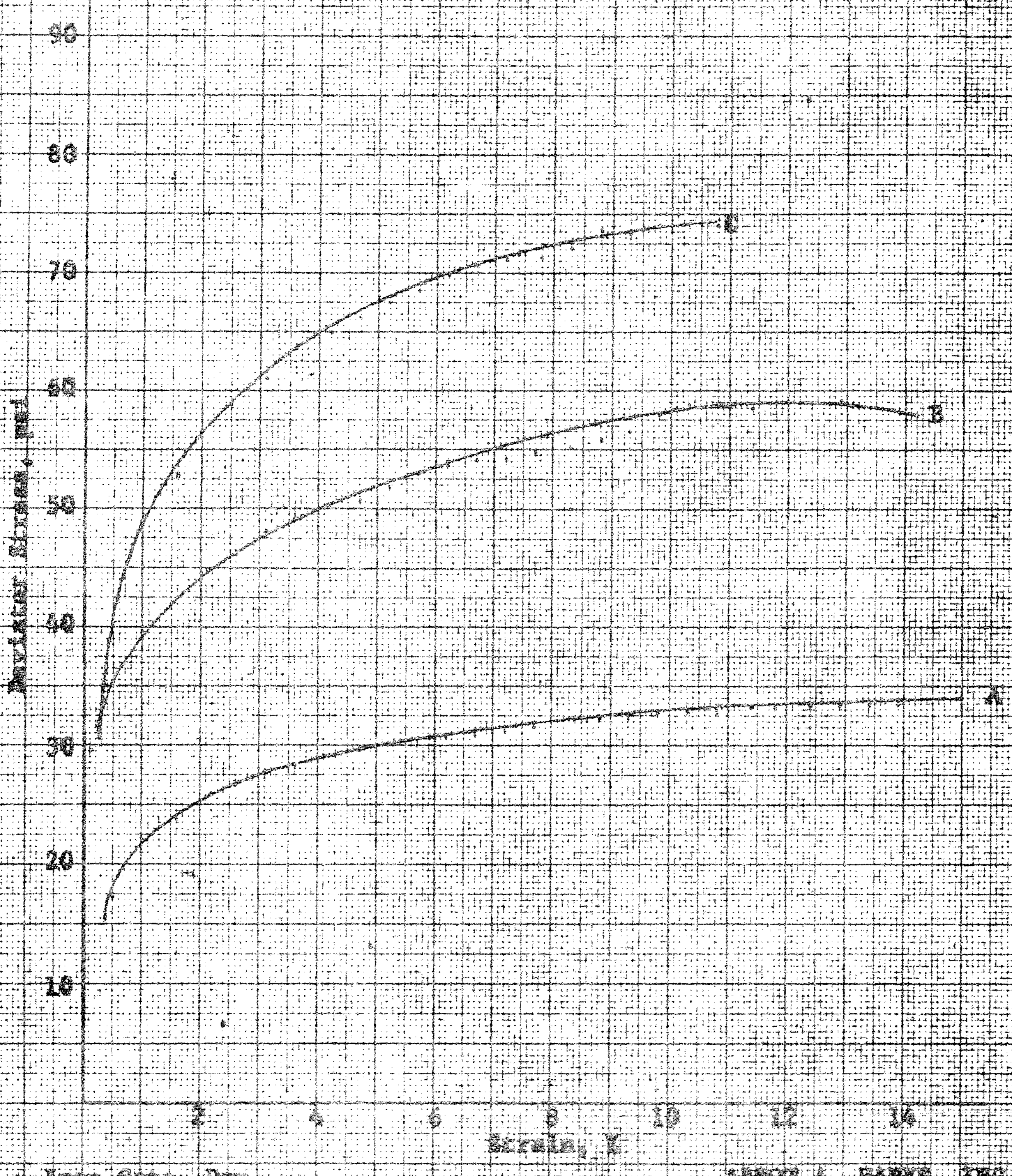
SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO.
5 CYCLES X 70 DIVISIONS
.01
1
10
100
100
Time, min
.00
.01
.02
.03
.04
.05
.06
Dial Reading, in.
P = 3300 lb/ft2
P = 6600 lb/ft2
apparatus correction
P = 13200 lb/ft2
P = 26400 lb/ft2
Hole No. 3
Consolidation Test
Time Curves
ABBOT A. HANES, INC.
Lab. No. 46938
June 3, 1960
Iron Gate Dam
File No. 1732.1


K+E SEMI-LOGARITHMIC 359-71
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 70 DIVISIONS
1000
10000
Pressure, lb/ft^2
Hole No. 3
Consolidation Test
Compacted Unit Dry Weight, lb/cu ft 105.1
Specific Gravity 2.76
Compression, in./in.
.00
.01
.02
.03
.04
.05
Iron Gate Dam
Klamath River
File No. 1732.1
ABBOT A. HANKS, INC.
Lab. No. 46938
June 3, 1960

Hole No. 3

Triaxial Shear Test

Stress-Strain Relationships



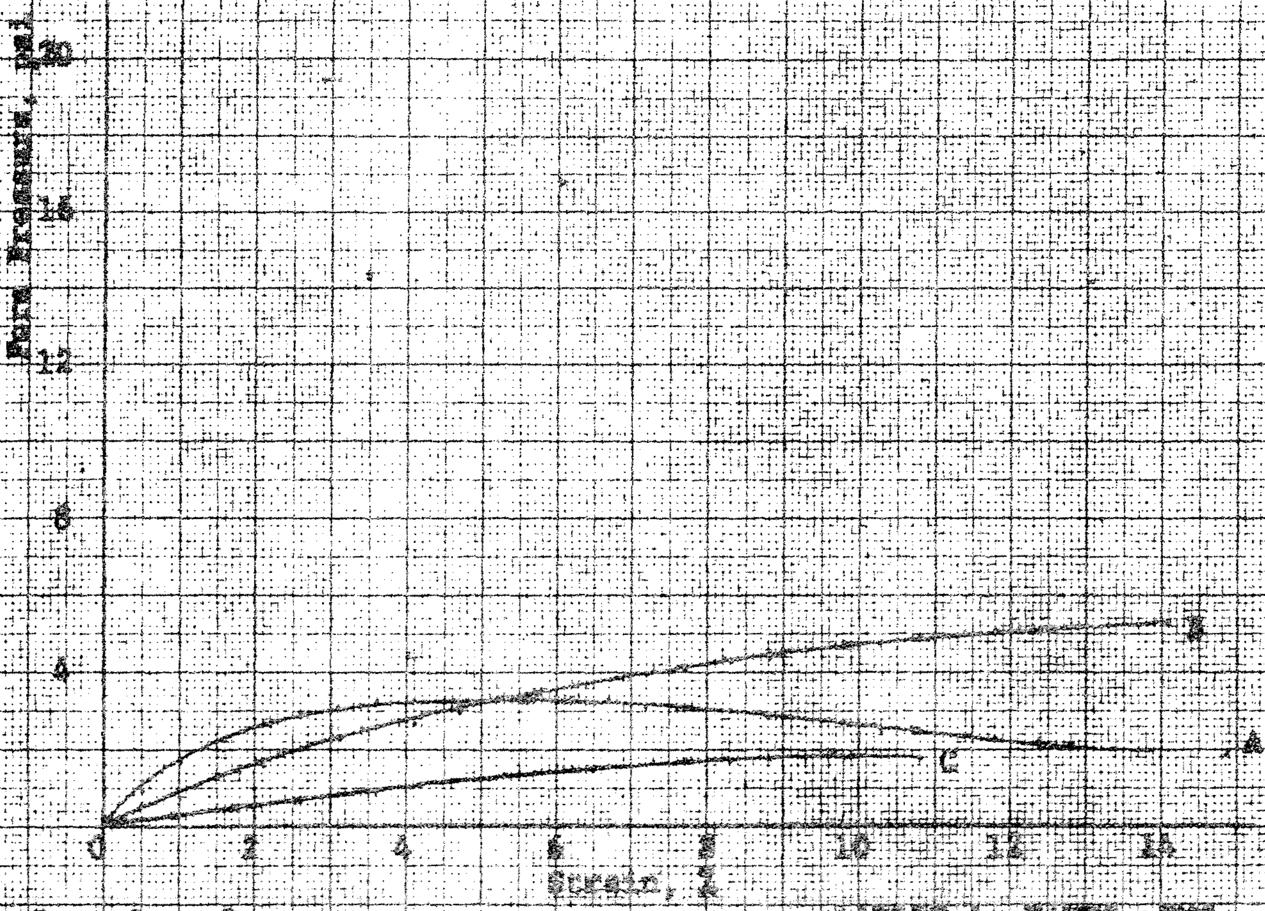
Iron Gate Dam
Klamath River
File No. 1732.1

Abbot A. Hanks, Inc.
Lab. No. 46939
June 3, 1960

Hole No. 3

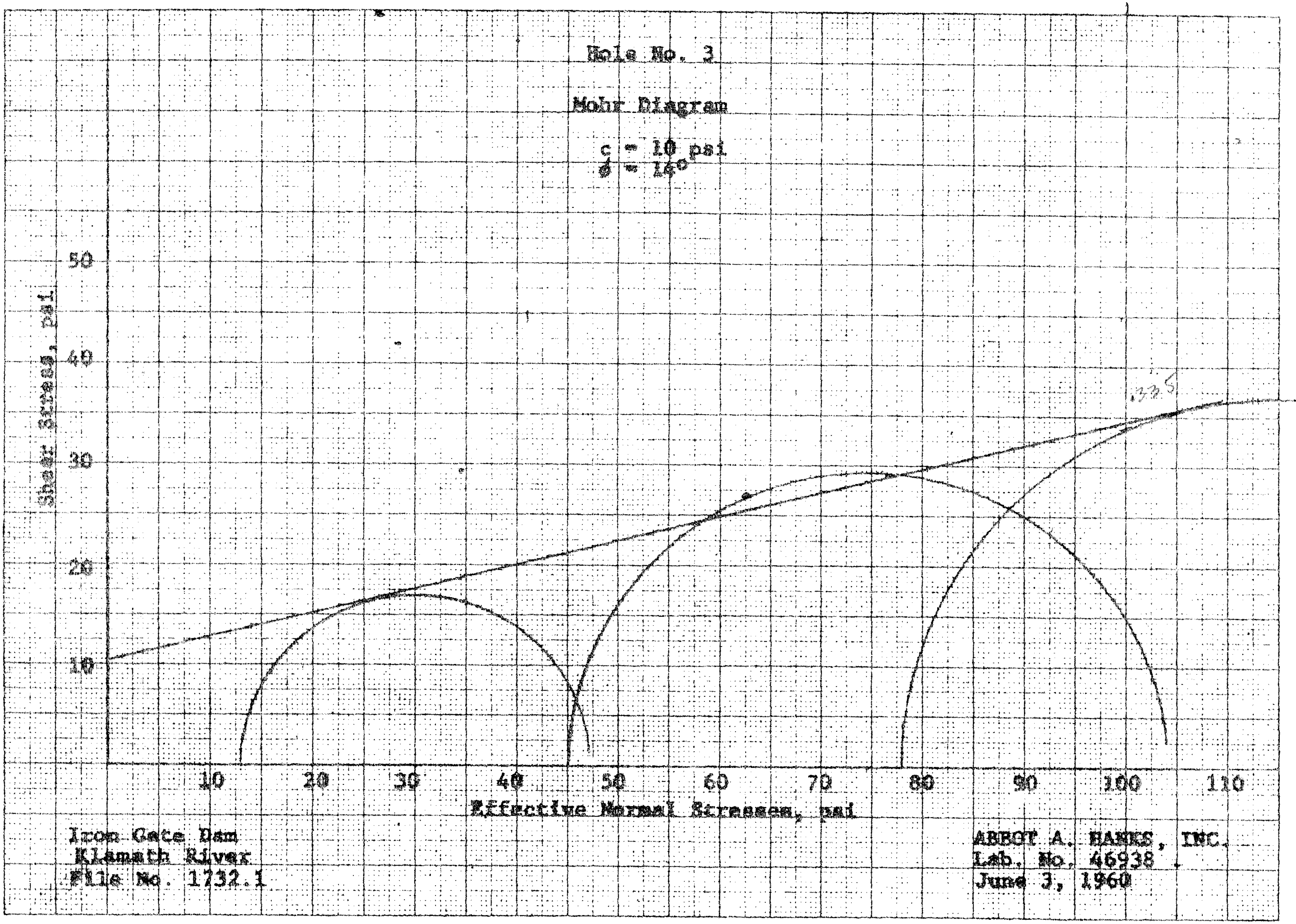
Triaxial Shear Test

Pore Pressure-Strain Relationships



Iron Gate Dam
Klamath River
File No. 1732.1

ABBOT A. HANKS, INC.
Lab. No. [illegible]
June 2, 1960


Hole No. 3
Mohr Diagram
c = 10 psi
ø = 14°
Shear Stress, psi
10
20
30
40
50
10
20
30
40
50
60
70
80
90
100
110
Effective Normal Stresses, psi
.335
Iron Gate Dam
Klamath River
File No. 1732.1
ABBOT A. HANKS, INC.
Lab. No. 46938
June 3, 1960

BRANCH LABORATORY 1056 MARTIN AVENUE • SANTA CLARA • CHERRY 8-5262
BRANCH OFFICE 10 DE LUCA PLACE • SAN RAFAEL • GLENWOOD 4-8650

CABLE HANX

ABBOT A. HANKS, INC.

1300 SANSOME STREET • SAN FRANCISCO 11 CALIFORNIA • EXBROOK 7-2464

Engineers
Assayers
Chemists
Metallurgists
Spectrographers
Soils and Foundations
Consulting Testing Inspecting

File No. 1732.1
Lab. No. 46938

June 9, 1960

Mr. W. L. Warren
Assistant Chief Engineer
The California Oregon Power Company
216 West Main Street
Medford, Oregon

Re: Iron Gate Dam
Soil Samples

Dear Mr. Warren:

Enclosed are the findings from tests performed on soil samples marked Hole No. 4.

You will note that the permeability coefficient of the first sample is 3000 times the permeability coefficient of the second sample. We attribute this large difference to the differences in both density and moisture content at compaction. The second sample, compacted at 16% moisture content, appeared to be somewhat over optimum moisture.

Very truly yours,

ABBOT A. HANKS, INC.

Donald W Radbruch

Donald W. Radbruch

LOL:hms
Encls.
Reports to:
3-The California Oregon Power Company

Iron Gate Dam
Klamath River
File No. 1732.1

Abbot A. Hanks, Inc.
Lab. No. 46938
June 8, 1960

TEST RESULTS

Hole No. 4
Specific Gravity: 2.77

Triaxial Shear Test

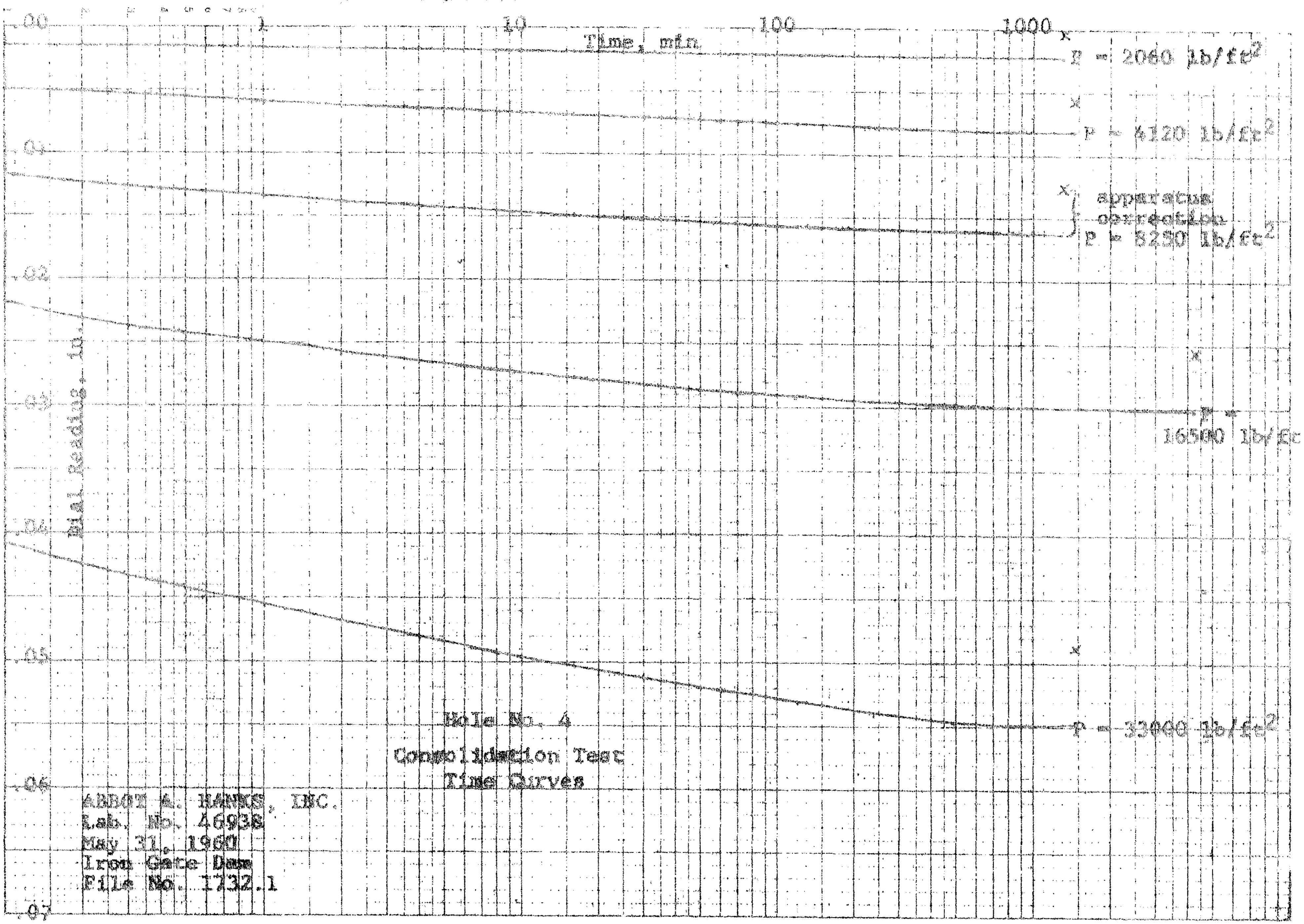
	Sample A	Sample B	Sample C
Chamber Pressure, psi	15	50	80
Unit Dry Weight at Compaction, lb/ft^3	112.8	112.3	116.5
Moisture Content at Compaction, %	13.8	13.6	15.4
Unit Dry Weight at Test, lb/ft^3	112.8	114.2	119.4
Moisture Content at Test, lb/ft^3	16.5	17.6	16.0
Degree of Saturation at Test, %	87	96	100
Maximum Deviator Stress, psi	34	85	152
Pore Pressure at Max. Deviator Stress, psi	3	18	9

Permeability Tests
(Constant Head Tests)

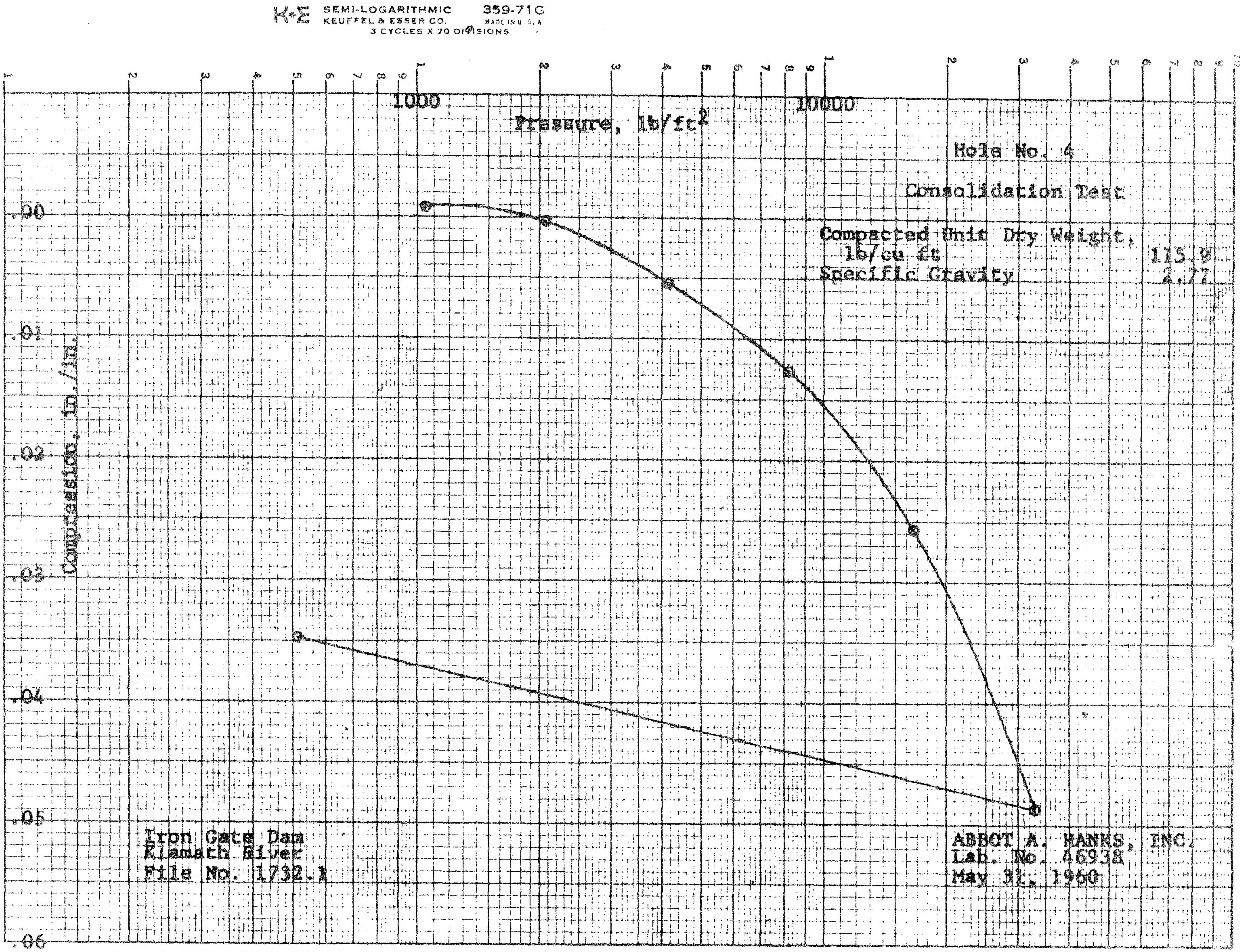
Unit Dry Weight at Compaction, lb/ft^3	113.3
Moisture Content at Compaction, %	14.3
Moisture Content at Test, %	20.4
Degree of Saturation at Test, %	100+
Permeability Coefficient, ft per yr	30-40
" " , cm/sec	$3\text{-}4 \times 10^{-5}$

Unit Dry Weight at Compaction, lb/ft^3	116.2
Moisture Content at Compaction, %	16.0
Moisture Content at Test, %	17.0
Degree of Saturation at Test, %	97
Permeability Coefficient, ft per yr	.01-.04
" " , cm/sec	$1\text{-}4 \times 10^{-8}$

Report Letter
~~Optimum moisture~~ ~~14.5~~ ~~14-15~~
~~max dry density~~ 115.9 ~~115~~



Time, min.
1
10
100
1000
Dial Reading, in.
.00
.01
.02
.03
.04
.05
.06
.07
P = 2060 lb/ft²
P = 4120 lb/ft²
apparatus correction
P = 8250 lb/ft²
P = 16500 lb/ft²
P = 33000 lb/ft²
Hole No. 4
Consolidation Test
Time Curves
ABBOT A. HANKS, INC.
Lab. No. 46938
May 31, 1960
Iron Gate Dam
File No. 1732.1

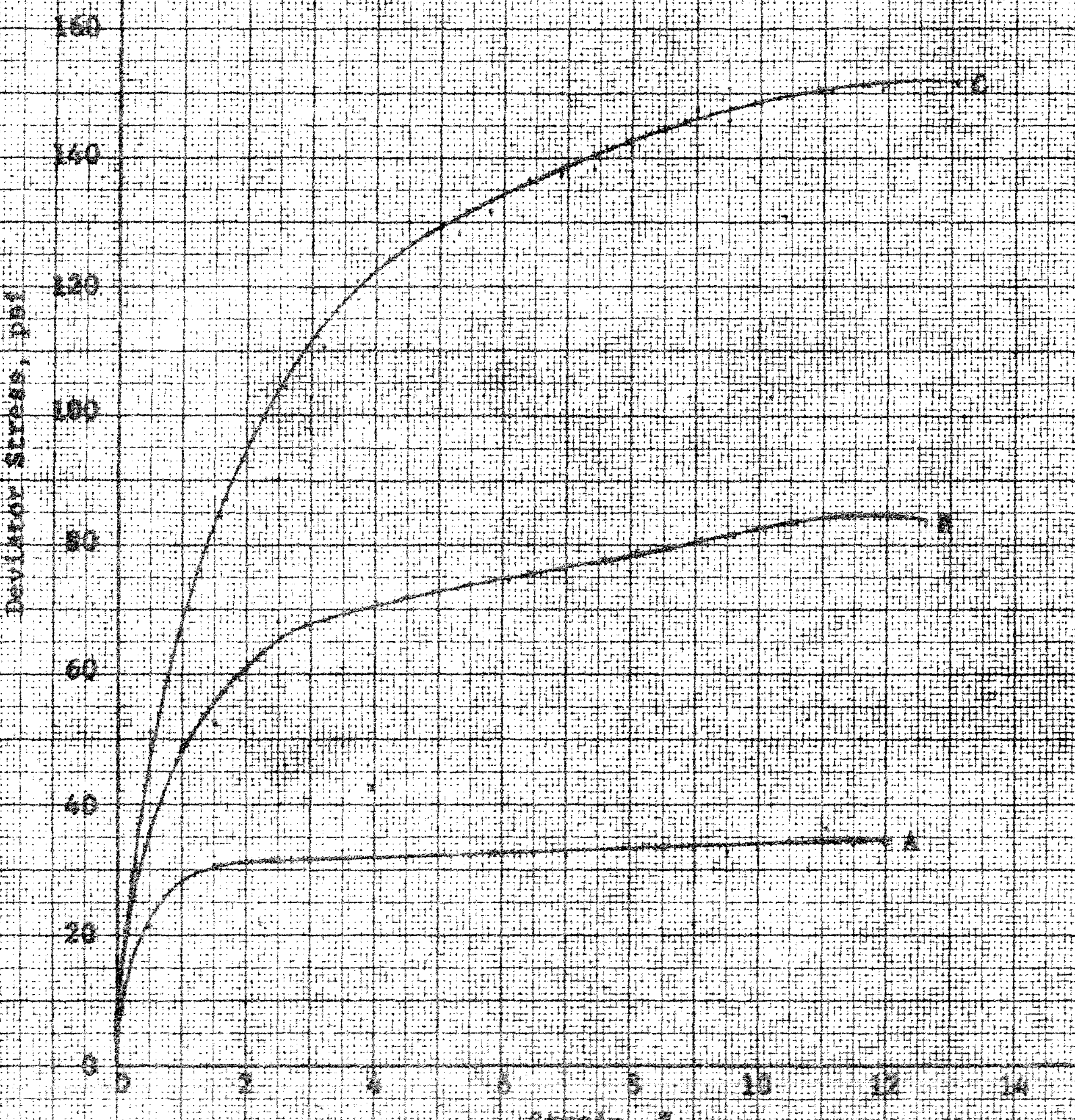


K+E SEMI-LOGARITHMIC 359-71G
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 70 DIVISIONS
1000
10000
Pressure, lb/ft²
Hole No. 4
Consolidation Test
Compacted Unit Dry Weight, lb/cu ft 115.9
Specific Gravity 2.77
Compression, in./in.
.00
.01
.02
.03
.04
.05
.06
Iron Gate Dam
Klamath River
File No. 1732.1
ABBOT A. HANKS, INC.
Lab. No. 46938
May 31, 1960

Hole No. 4

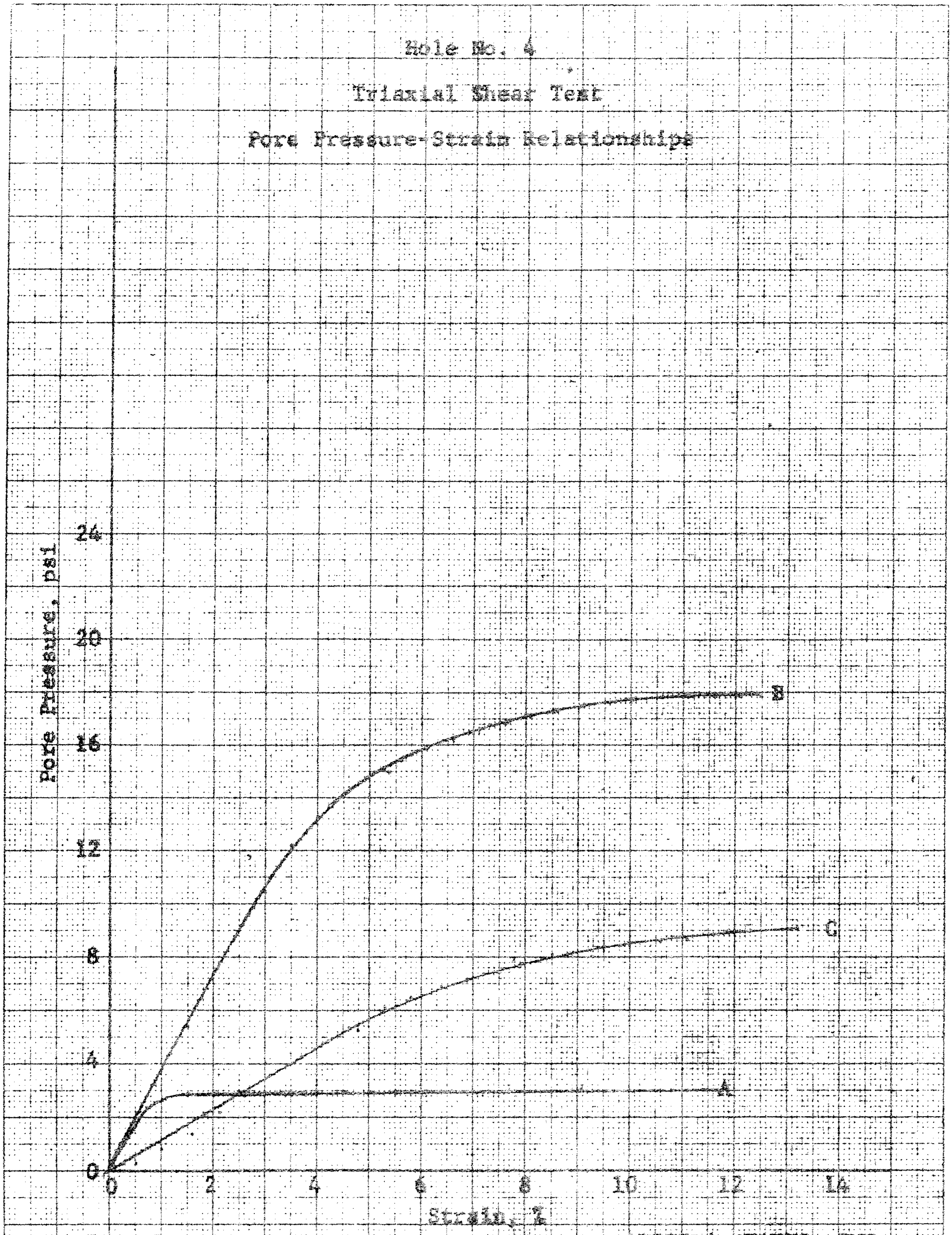
Triaxial Shear Test

Stress-Strain Relationships



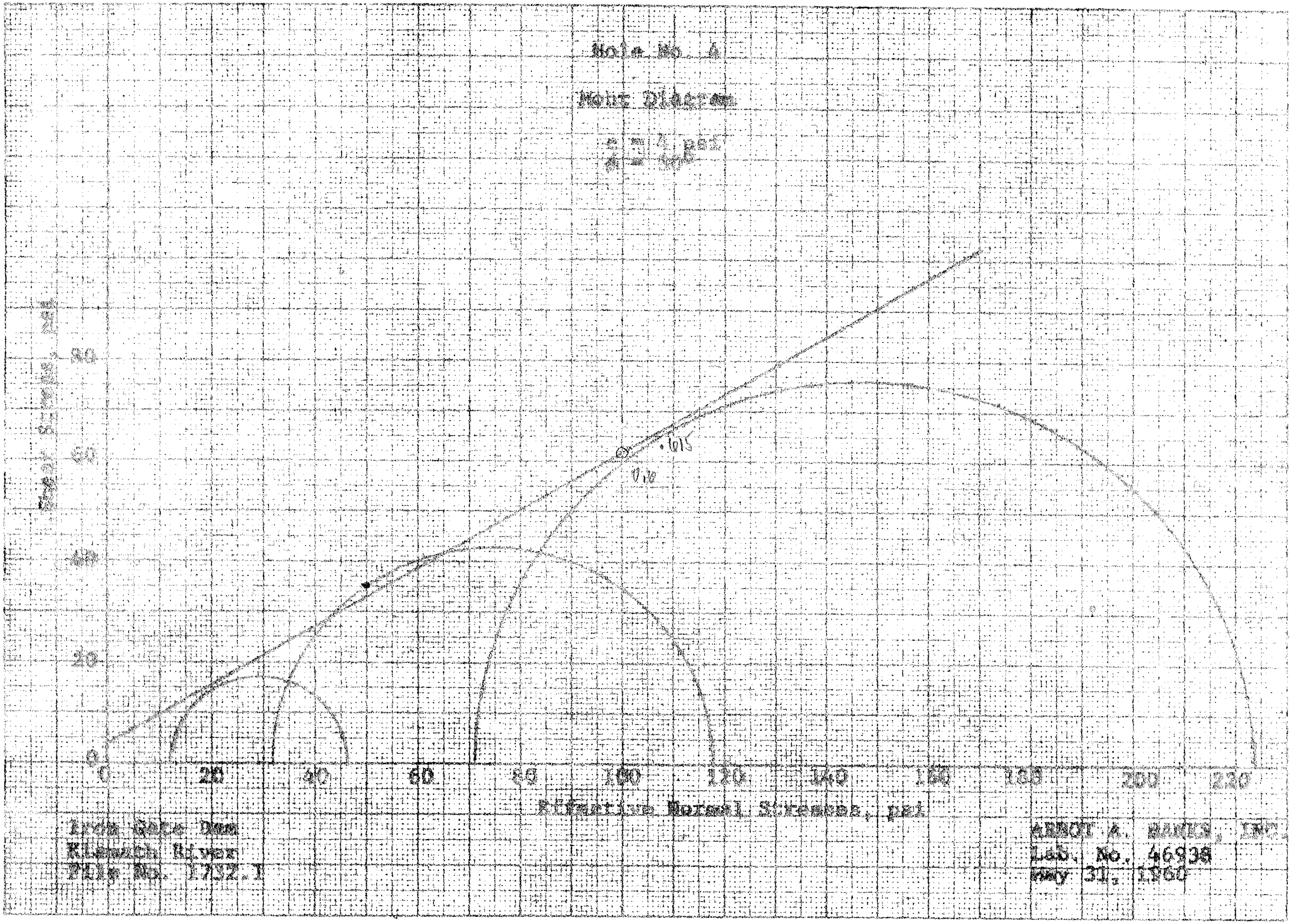
Iron Gate Dam
Klamath River
File No. 1732.1

ABBOT A. HANKS, INC.
Lab. No. 46938
May 21, 1960



Iron Gate Dam
Klamath River
File No. 1732.1

ABBOT A. HANKS, INC.
Lab. No. 46938
May 31, 1960


Hole No. A
Mohr Diagram
c = 4 psi
Shear Stress, psi
0
20
40
60
80
0
20
40
60
80
100
120
140
160
180
200
220
Effective Normal Stresses, psi
0.615
Iron Gate Dam
Klamath River
File No. 1732.1
ABBOT A. HANKS, INC.
Lab. No. 46938
May 31, 1960

BRANCH LABORATORY 1085 MARTIN AVENUE · SANTA CLARA · [illegible]
BRANCH OFFICE 10 DE LUCA PLACE · SAN RAFAEL · GLENWOOD 4 [illegible]
CABLE HANX

ABBOT A. HANKS, INC.
[illegible]
[illegible] SANSOME STREET · SAN FRANCISCO 11 CALIFORNIA · EXBROOK [illegible]

Engineers
Assayers
Chemists
Metallurgists
Spectrographers
Soils and Foundations
Consulting · Testing · Inspecting

File No. 1732.1
Lab. No. 46938

June 9, 1960

Mr. W. L. Warren
Assistant Chief Engineer
The California Oregon Power Company
216 West Main Street
Medford, Oregon

Re: Iron Gate Dam
Soil Samples

Dear Mr. Warren:

Enclosed are the findings from tests performed on soil samples marked Hole No. 7.

Very truly yours,

ABBOT A. HANKS, INC.

Donald W. Radbruch

Donald W. Radbruch

hms
Encls.
Reports to:
3-The California Oregon Power Company

Iron Gate Dam
Klamath River
File No. 1732.1

Abbot A. Hanks, Inc.
Lab. No. 46938
June 9, 1960

TEST RESULTS

Hole No. 7
Specific Gravity: 2.74

Triaxial Shear Test

	Samples			
	A	B	C	D
Chamber Pressure, psi	15	50	80	80
Unit Dry Weight at Compaction, lb/ft^3	109.1	110.0	110.0	109.3
Moisture Content at Compaction, %	17.6	17.3	19.0	19.3
Unit Dry Weight at Test, lb/ft^3	106.7	111.5	114.7	114.8
Moisture Content at Test, lb/ft^3	22.6	19.3	18.7	19.8
Degree of Saturation at Test, %	100+	100	100	100+
Maximum Deviator Stress, psi	22	67	77	79
Pore Pressure at Max. Deviator Stress, psi	6	12	23	17

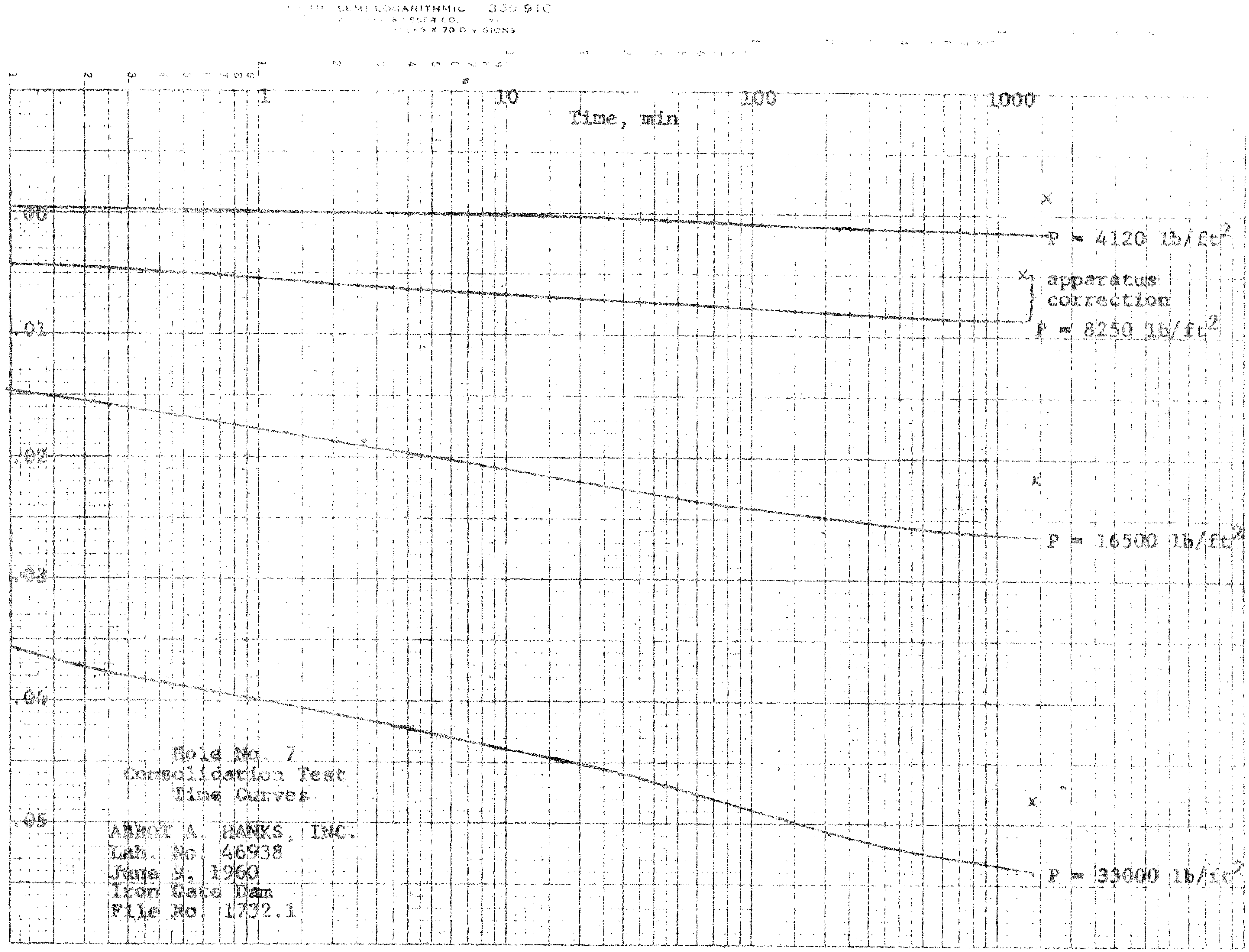
Permeability Test
(Constant Head Test)

Unit Dry Weight at Compaction, lb/ft^3	109.3
Moisture Content at Compaction, %	17.8
Moisture Content at Test, %	19.7
Degree of Saturation at Test, %	96
Permeability Coefficient, ft per yr	Less than .01
" " , cm/sec	Less than 10^{-8}

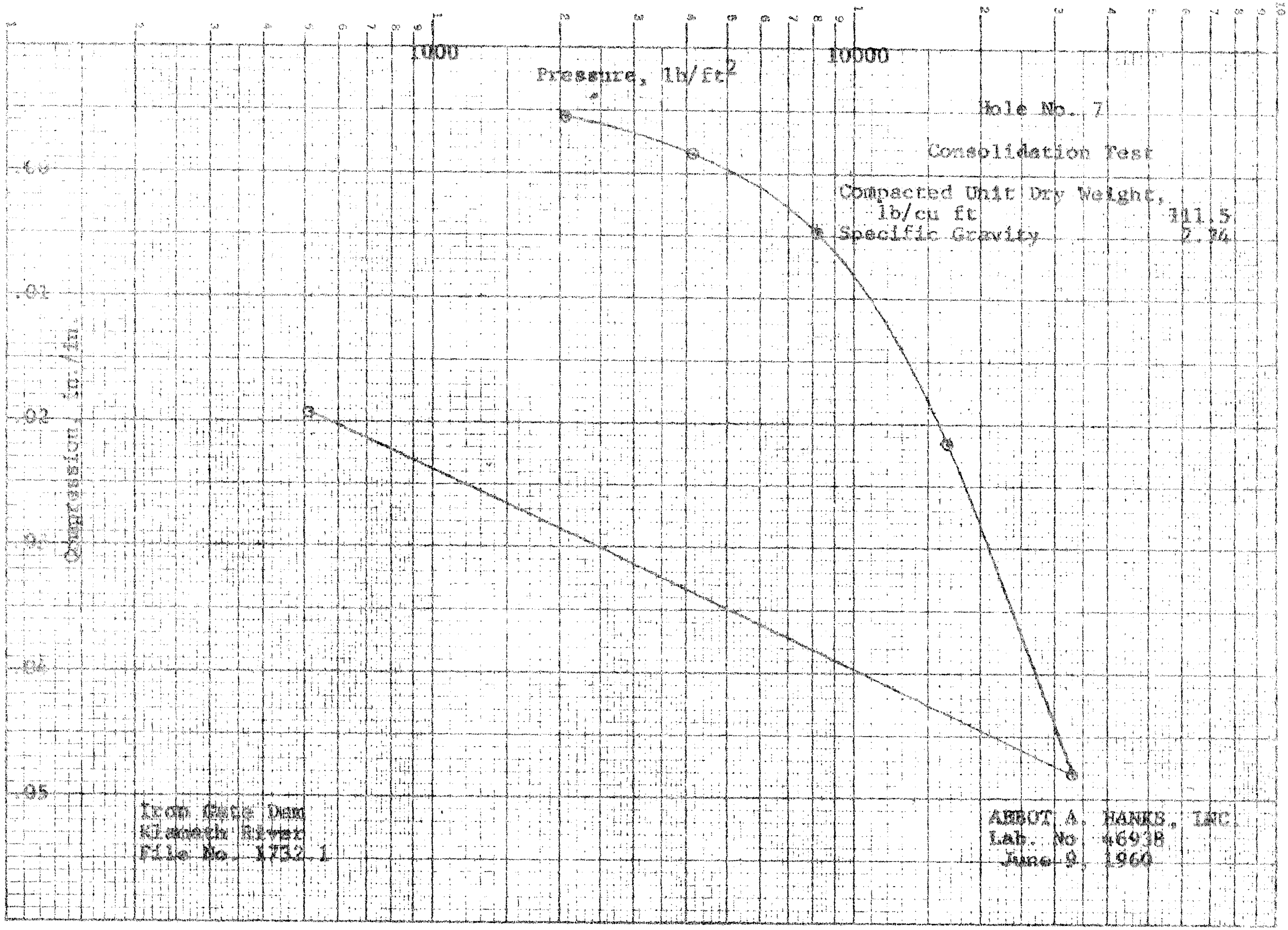
Report ~~Letter~~ ~~a Letter~~

~~Optimum moisture~~ 15.2 15

Max. ~~Dry density~~ 117.6 116.0



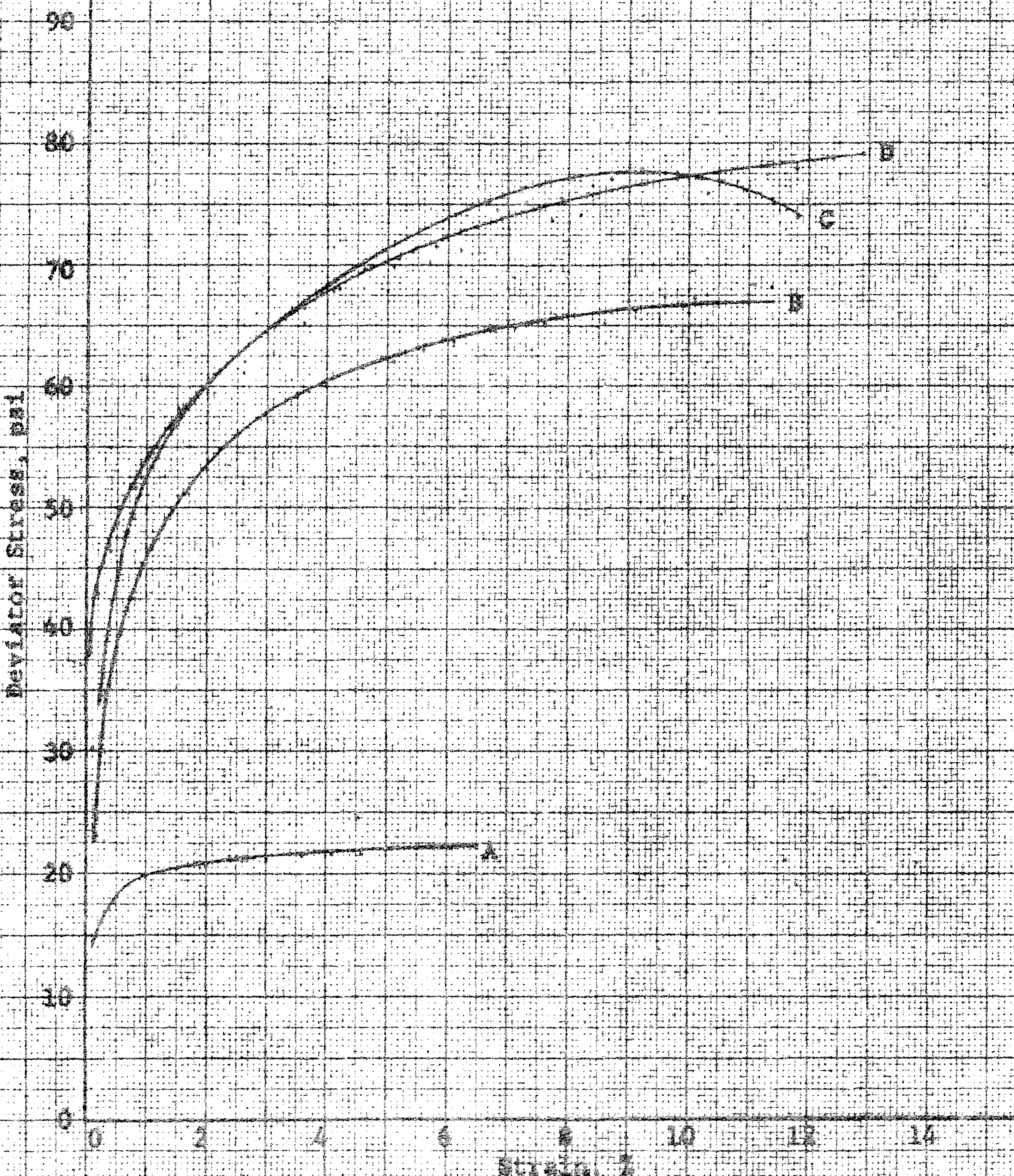
SEMI-LOGARITHMIC 330 91C
1
10
100
1000
Time, min
.00
.01
.02
.03
.04
.05
P = 4120 lb/ft²
apparatus correction
P = 8250 lb/ft²
P = 16500 lb/ft²
P = 33000 lb/ft²
Hole No. 7
Consolidation Test
Time Curves
ABBOT A. HANKS, INC.
Lab. No. 46938
June 9, 1960
Iron Gate Dam
File No. 1732.1


1000
10000
Pressure, lb/ft2
Hole No. 7
Consolidation Test
Compacted Unit Dry Weight, lb/cu ft 111.5
Specific Gravity 2.74
Compression, in./in.
.00
.01
.02
.03
.04
.05
Iron Gate Dam
Klamath River
File No. 1732.1
ABBOT A. HANKS, INC.
Lab. No. 46938
June 9, 1960

Hole No. 7

Triaxial Shear Test

Stress-Strain Relationships



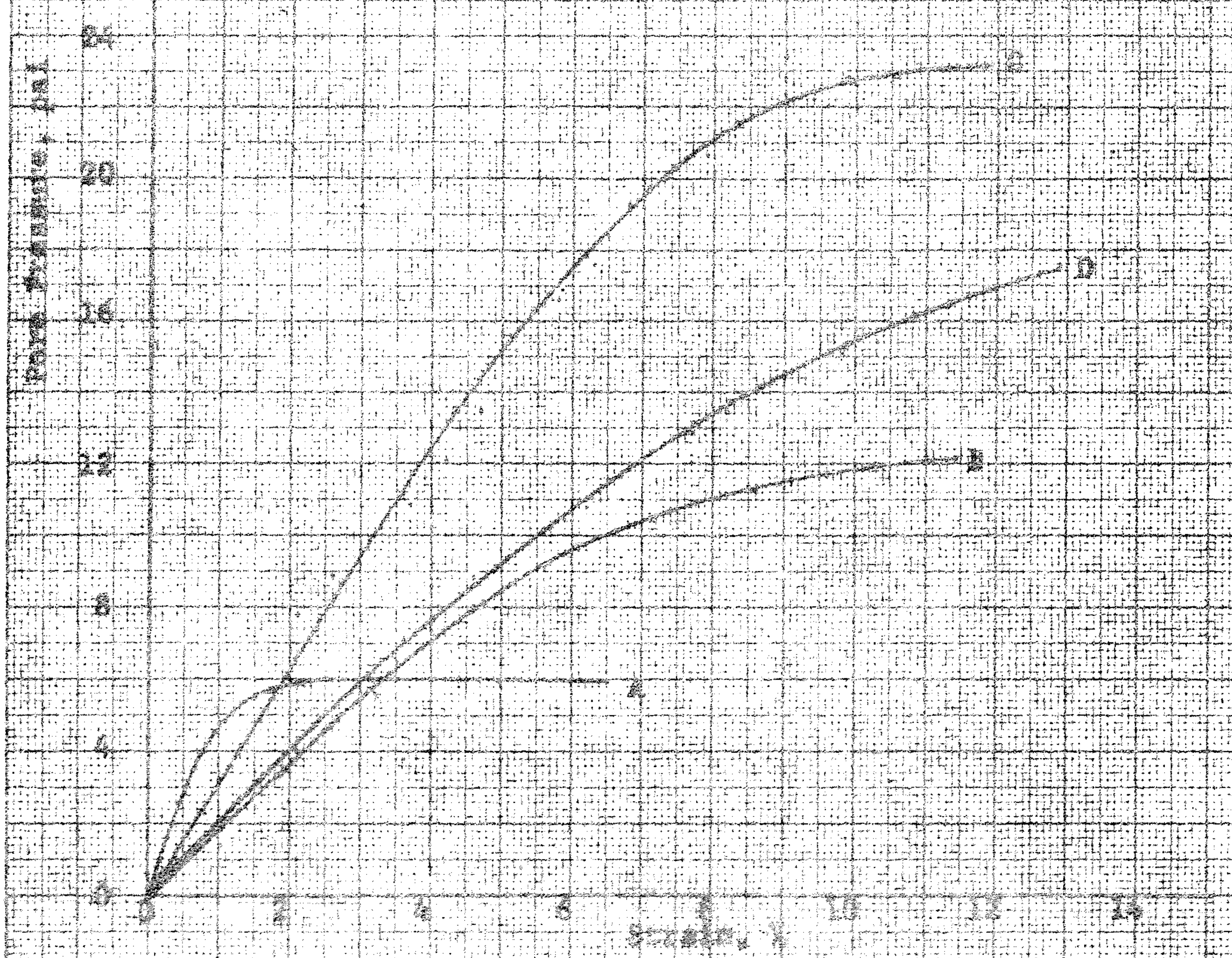
Iron Gate Dam
Klamath River
File No. 1732.1

ABBOT A. HANKS, INC.
Lab. No. 46836
June 9, 1960

Hole No. 7

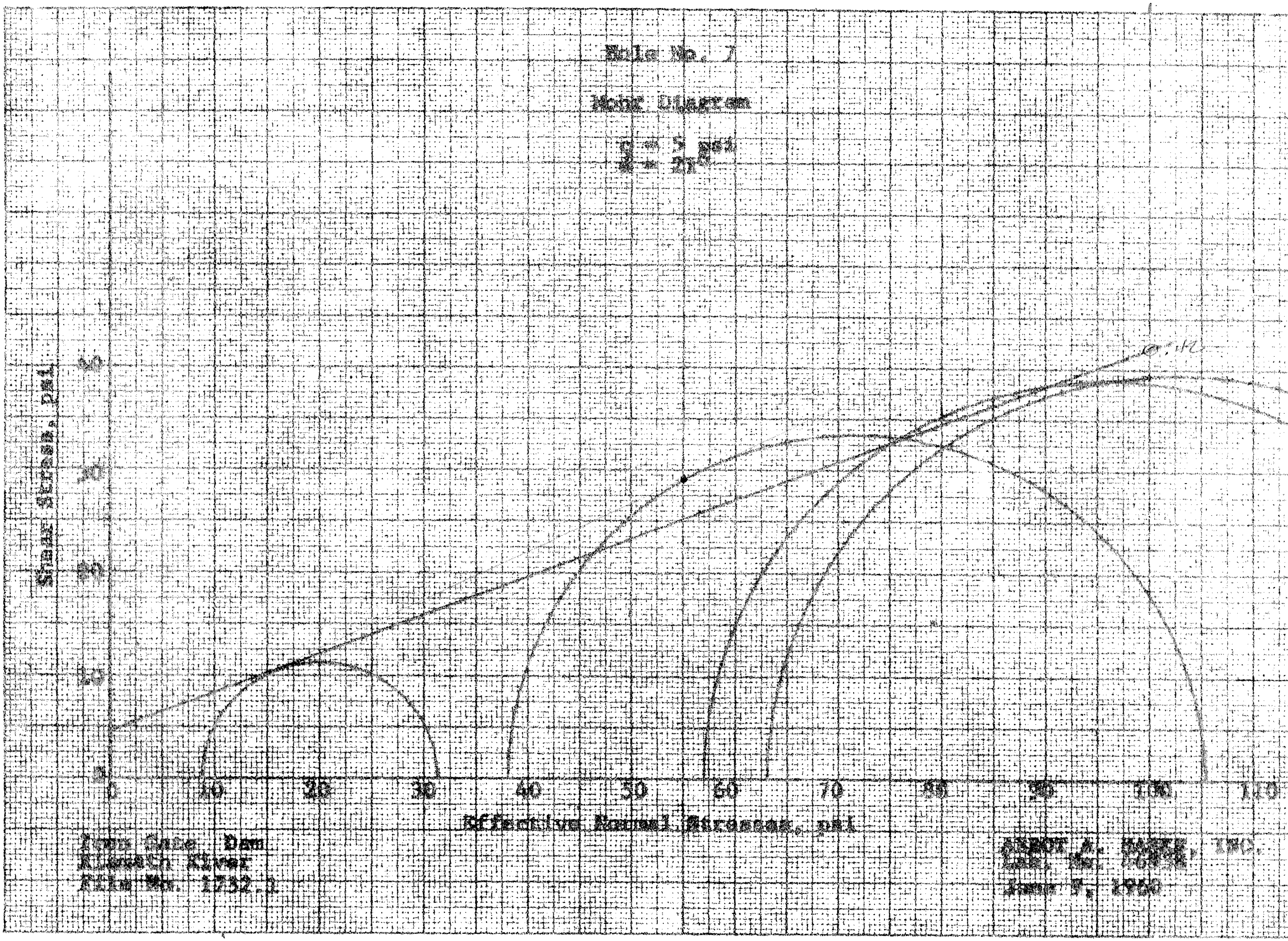
Triaxial Shear Test

Pore Pressure-Strain Relationships



Iron Gate Dam
Klamath River
File No. 1732.[illegible]

ABBOT A. HANKS, INC.
Lab. No. [illegible]
June 9, 1960


Hole No. 7
Mohr Diagram
c = 5 psi
Shear Stress, psi
0
10
20
30
40
50
60
70
80
90
100
110
Effective Normal Stresses, psi
Iron Gate Dam
Klamath River
File No. 1732.2

BRANCH LABORATORY 1085 MARTIN AVENUE • SANTA CLARA • CHERRY ...
BRANCH OFFICE 10 DE LUCA PLACE • SAN RAFAEL • GLENWOOD 4 ...

ABBOT A. HANKS, INC.

1300 SANSOME STREET • SAN FRANCISCO 11, CALIFORNIA • EXBROOK ...

Engineers
Assayers
Chemists
Metallurgists
Spectrographers
Soils and Foundations
Consulting Testing Inspecting

CABLE HANKS

File No. 1732.1
Lab. No. 46938

May 24, 1960

Mr. W. L. Warren
Assistant Chief Engineer
The California Oregon Power Company
216 West Main Street
Medford, Oregon

Re: Iron Gate Dam
Soil Samples

Dear Mr. Warren:

Enclosed are the findings from tests performed on soil samples marked Hole No. 8.

Very truly yours,

ABBOT A. HANKS, INC.

Donald W Radbruch

Donald W. Radbruch

hms
Encls.
Reports to:
3-The California Oregon Power Company

Iron Gate Dam
Klamath River
File No. 1732.1

Abbot A. Hanks, Inc.
Lab. No. 46938
May 18, 1960

TEST RESULTS

Hole No. 8
Specific Gravity: 2.75

Triaxial Shear Test

	Sample A	Sample B	Sample C
Chamber Pressure, psi	15	50	80
Unit Dry Weight at Compaction, lb/ft^3	98.6	99.7	98.9
Moisture Content at Compaction, %	19.9	19.9	20.1
Unit Dry Weight at Test, lb/ft^3	95.4	100.6	102.9
Moisture Content at Test, lb/ft^3	28.4	26.1	25.0
Degree of Saturation at Test, %	98	100+	100+
Maximum Deviator Stress, psi	21	48	66
Pore Pressure at Max. Deviator Stress, psi	5	13	30

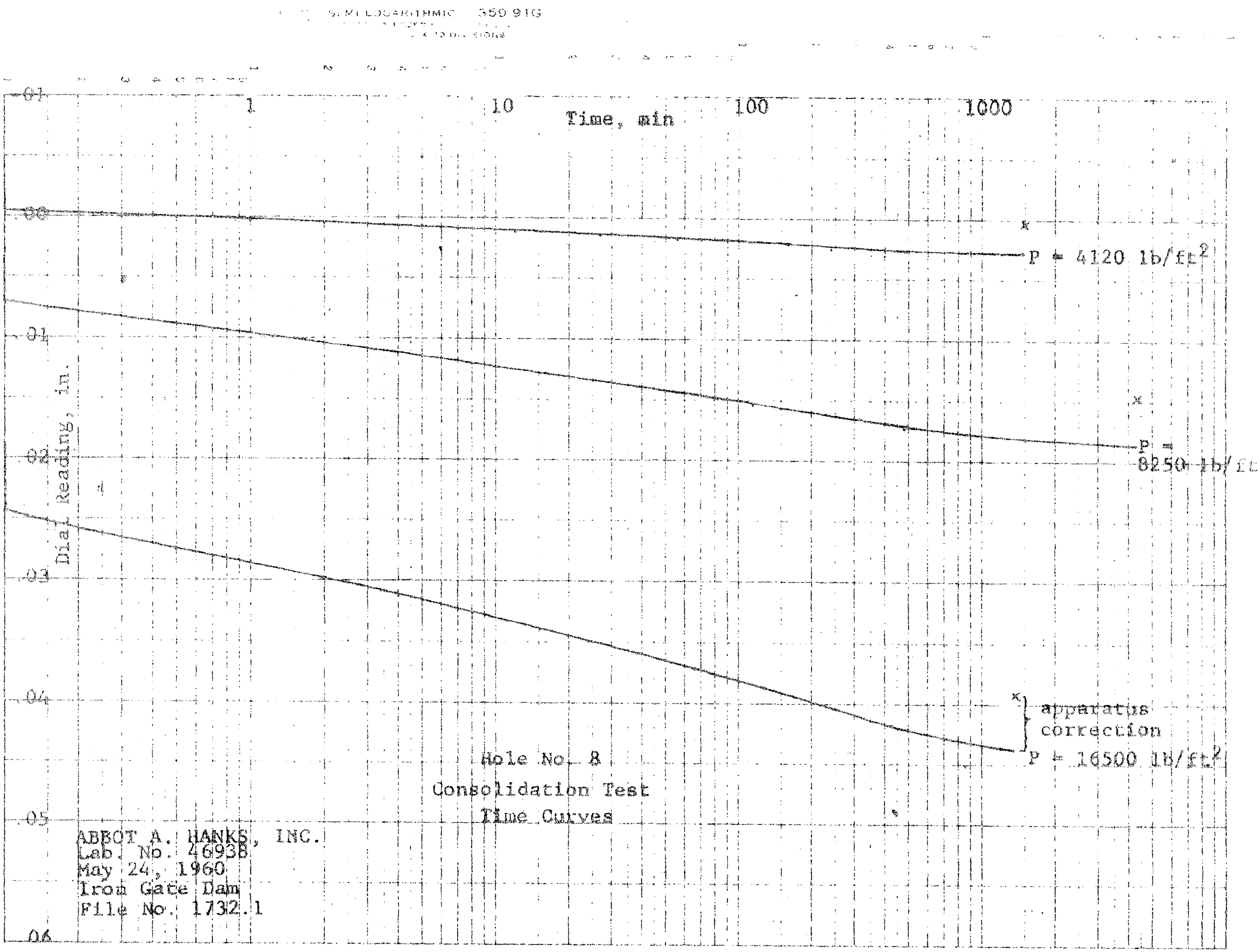
Permeability Test
(Constant Head Test)

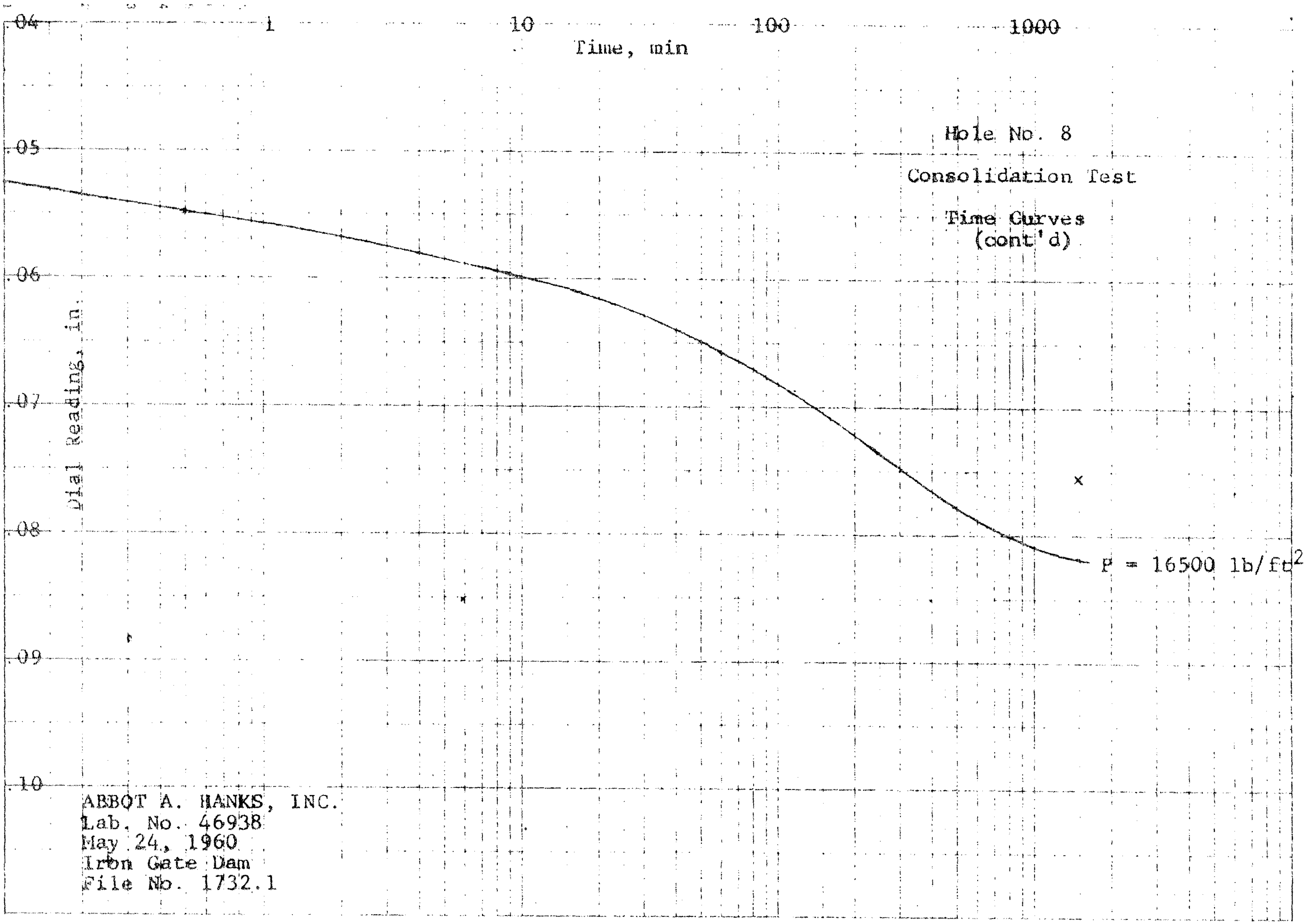
Unit Dry Weight at Compaction, lb/ft^3	100.8
Moisture Content at Compaction, %	21.1
Moisture Content at Test, %	25.4
Degree of Saturation at Test, %	100
Permeability Coefficient, ft per yr	Less than .01
" " , cm/sec	Less than 10-8

~~Report~~ letter

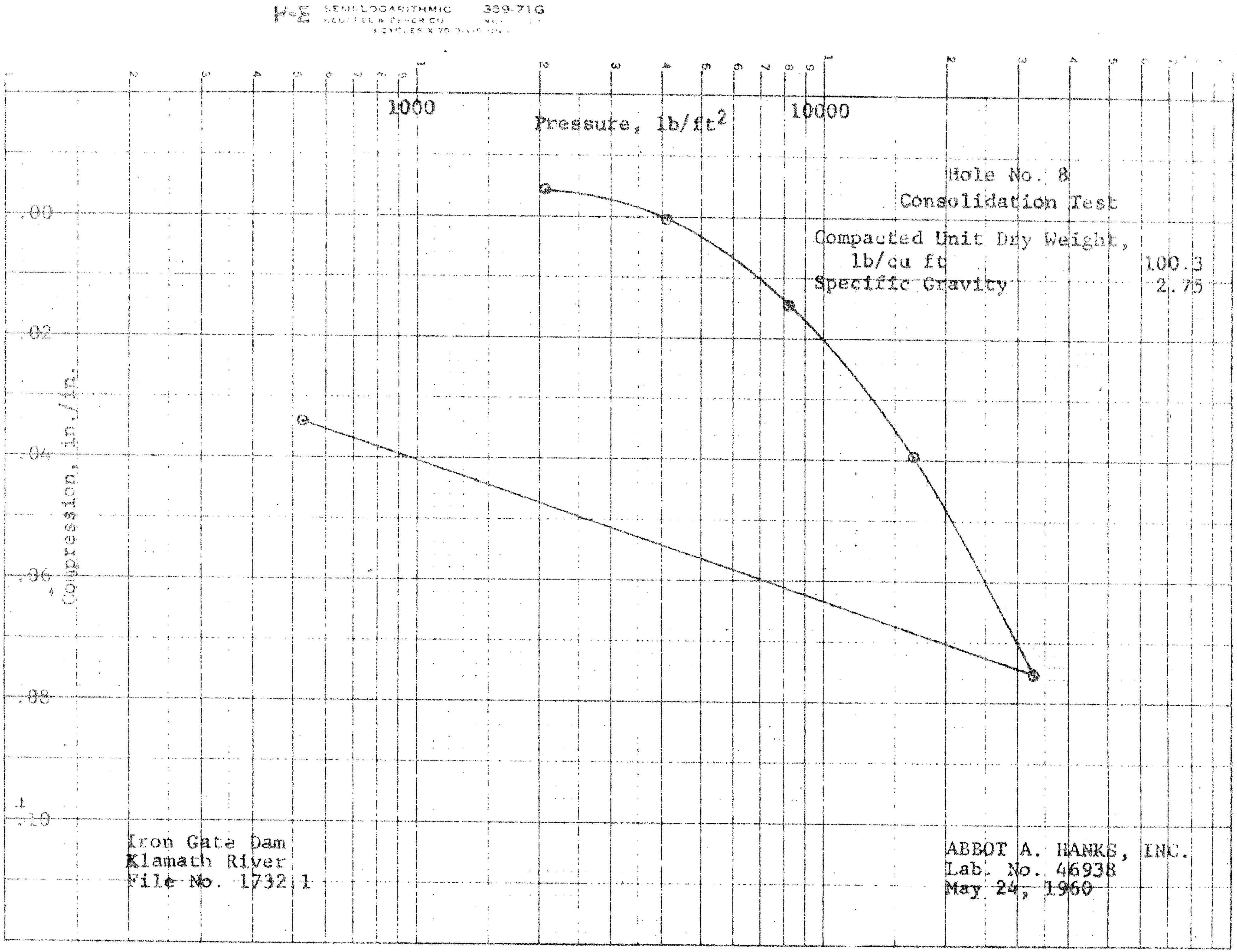
~~optimum moisture~~ ~~17.2~~ ~~17.5~~

~~Max. dry density~~ ~~107.8~~ ~~100.0~~


SEMI-LOGARITHMIC 359 91G
Time, min
1
10
100
1000
Dial Reading, in.
.00
.01
.02
.03
.04
.05
.06
P = 4120 lb/ft²
P = 8250 lb/ft
apparatus correction
P = 16500 lb/ft²
Hole No. 8
Consolidation Test
Time Curves
ABBOT A. HANKS, INC.
Lab. No. 46938
May 24, 1960
Iron Gate Dam
File No. 1732.1



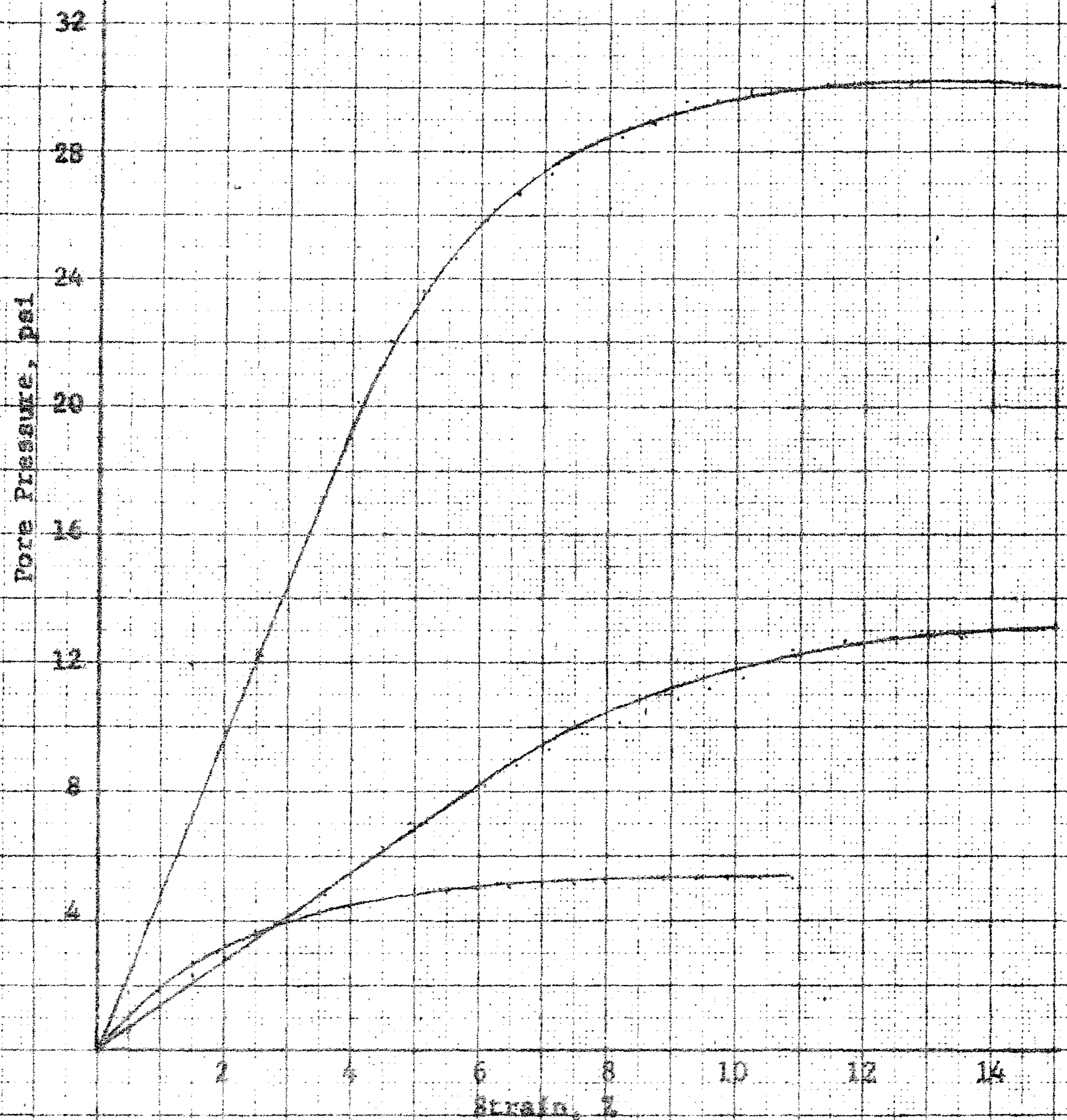
.04
.05
.06
.07
.08
.09
.10
1
10
100
1000
Time, min
Dial Reading, in.
Hole No. 8
Consolidation Test
Time Curves
(cont'd)
P = 16500 lb/ft²
ABBOT A. HANKS, INC.
Lab. No. 46938
May 24, 1960
Iron Gate Dam
File No. 1732.1


K&E SEMI-LOGARITHMIC 359-71G
KEUFFEL & ESSER CO.
3 CYCLES X 70 DIVISIONS
1000
10000
Pressure, lb/ft^2
Compression, in./in.
.00
.02
.04
.06
.08
.10
Hole No. 8
Consolidation Test
Compacted Unit Dry Weight, lb/cu ft 100.3
Specific Gravity 2.75
Iron Gate Dam
Klamath River
File No. 1732.1
ABBOT A. HANKS, INC.
Lab. No. 46938
May 24, 1960

Hole No. 8

Triaxial Shear Test

Pore Pressure-Strain Relationships



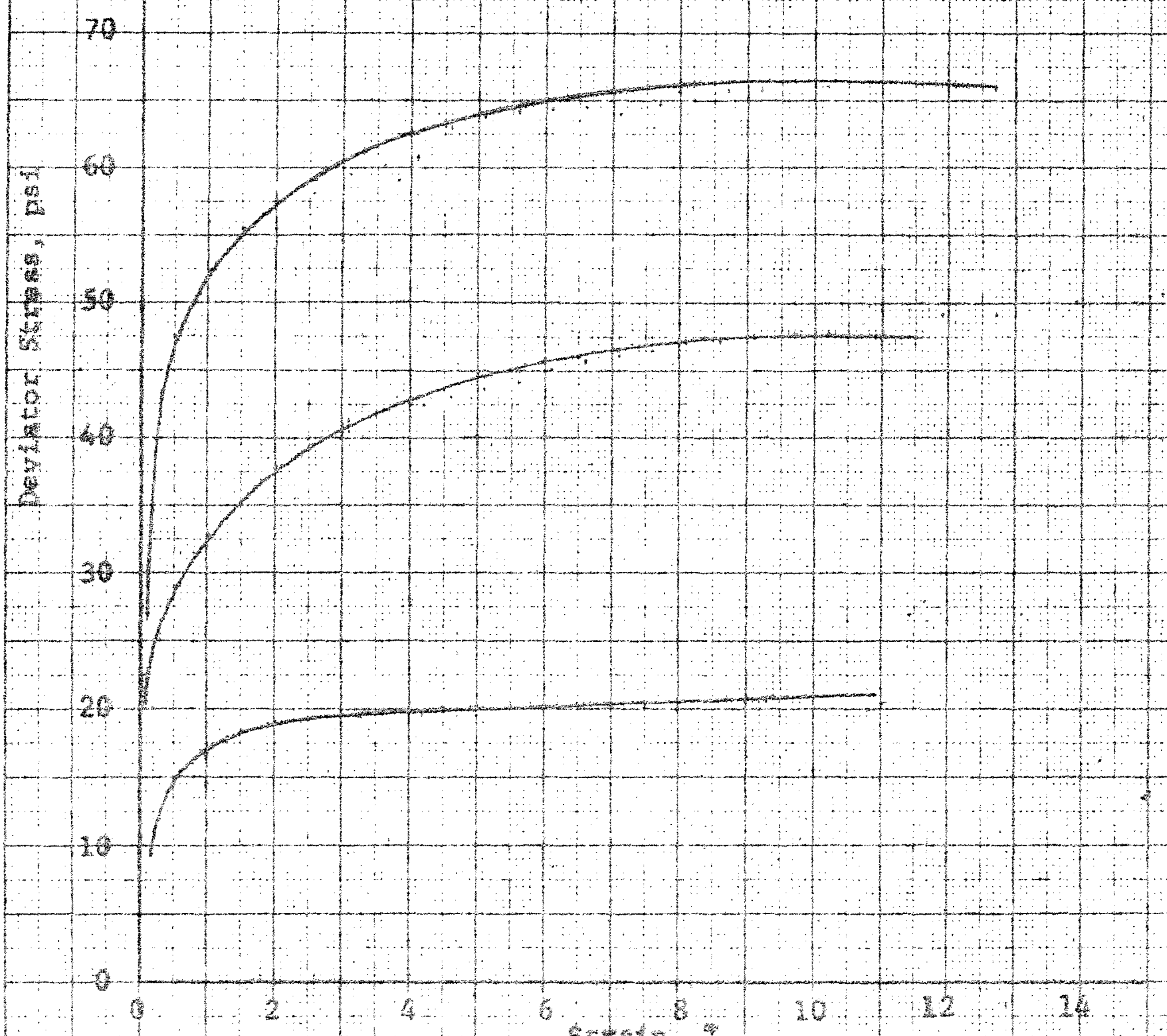
Iron Gate Dam
Klamath River
File No. 1732.1

ABBOT A. HANKS, INC.
Lab. No. 46938
May 18, 1960

Hole No. 8

Triaxial Shear Test

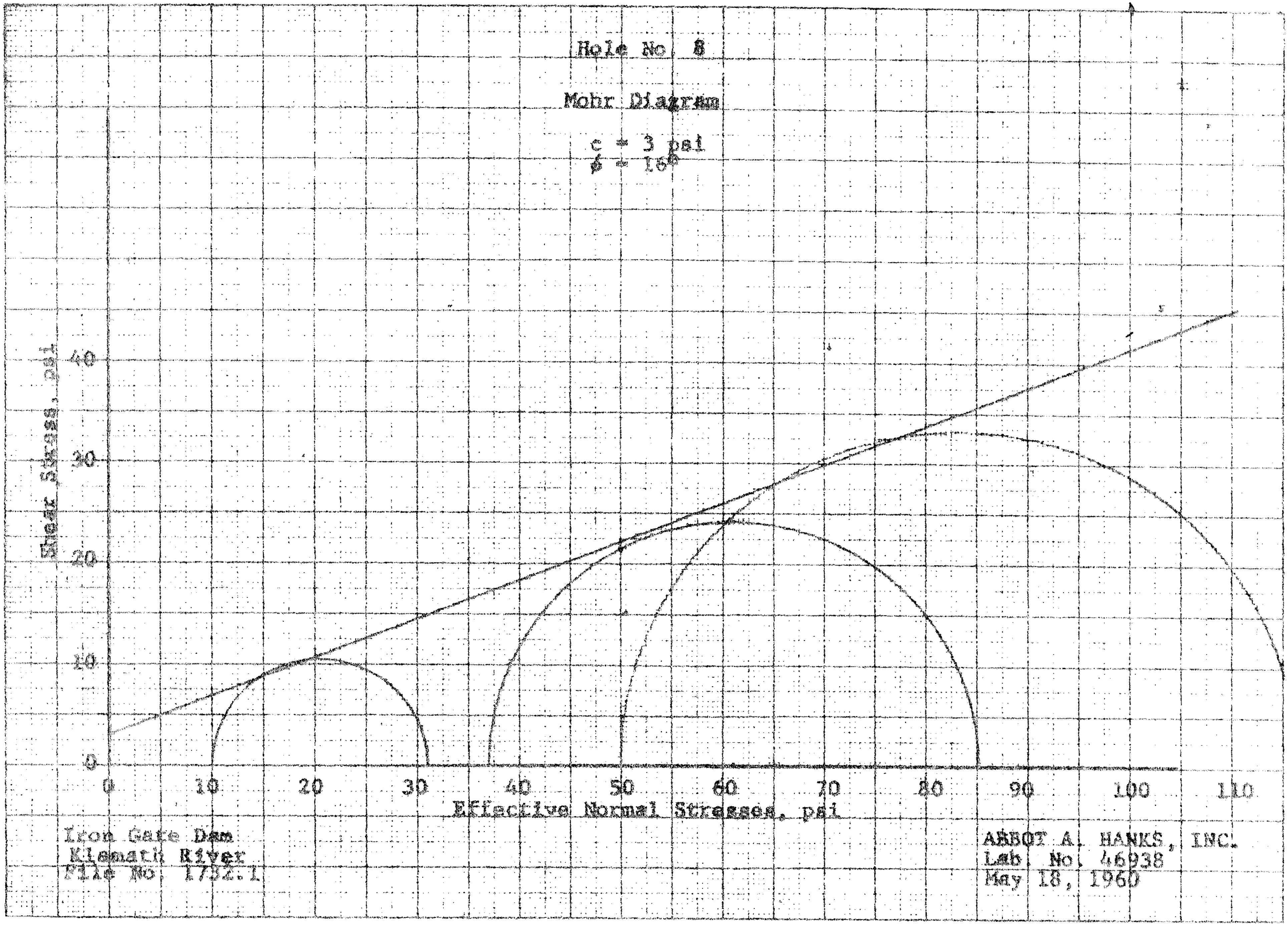
Stress-Strain Relationships



Iron Gate Dam
Klamath River
File No. 1732.1

ABBOT A. HANKS, INC.
Lab. No. 46938
May 18, 1960

10 X 10 TO THE CM. 359-14G
KEUFFEL & ESSER CO.


Hole No. 8
Mohr Diagram
c = 3 psi
ϕ = 16°
Shear Stress, psi
0
10
20
30
40
0
10
20
30
40
50
60
70
80
90
100
110
Effective Normal Stresses, psi
Iron Gate Dam
Klamath River
File No. 1732.1
ABBOT A. HANKS, INC.
Lab. No. 46938
May 18, 1960

BRANCH LABORATORY 1086 MARTIN AVENUE • SANTA CLARA • CHERRY 8 5262
BRANCH OFFICE 10 DE LUCA PLACE • SAN RAFAEL • GLENWOOD 4 8650
CABLE HANX

ABBOT A. HANKS, INC.

ESTABLISHED 1866

1300 SANSOME STREET • SAN FRANCISCO 11, CALIFORNIA • EXBROOK 7-2464

Engineers
Assayers
Chemists
Metallurgists
Spectrographers
Soils and Foundations
Consulting · Testing · Inspecting

File No. 1732.1
Lab. No. 46938

May 19, 1960

Mr. W. L. Warren
Assistant Chief Engineer
The California Oregon Power Company
216 West Main Street
Medford, Oregon

Re: Iron Gate Dam
Soil Samples

Dear Sir:

Enclosed are the findings from tests performed on soil samples marked Hole No. 11.

Very truly yours,

ABBOT A. HANKS, INC.

Donald W Radbruch

Donald W. Radbruch

hms
Encls.
Reports to:
3-The California Oregon Power Company

Iron Gate Dam
Klamath River
File No. 1732.1

Abbot A. Hanks, Inc.
Lab. No. 46938
May 19, 1960

TEST RESULTS

Hole No. 11
Specific Gravity: 2.75

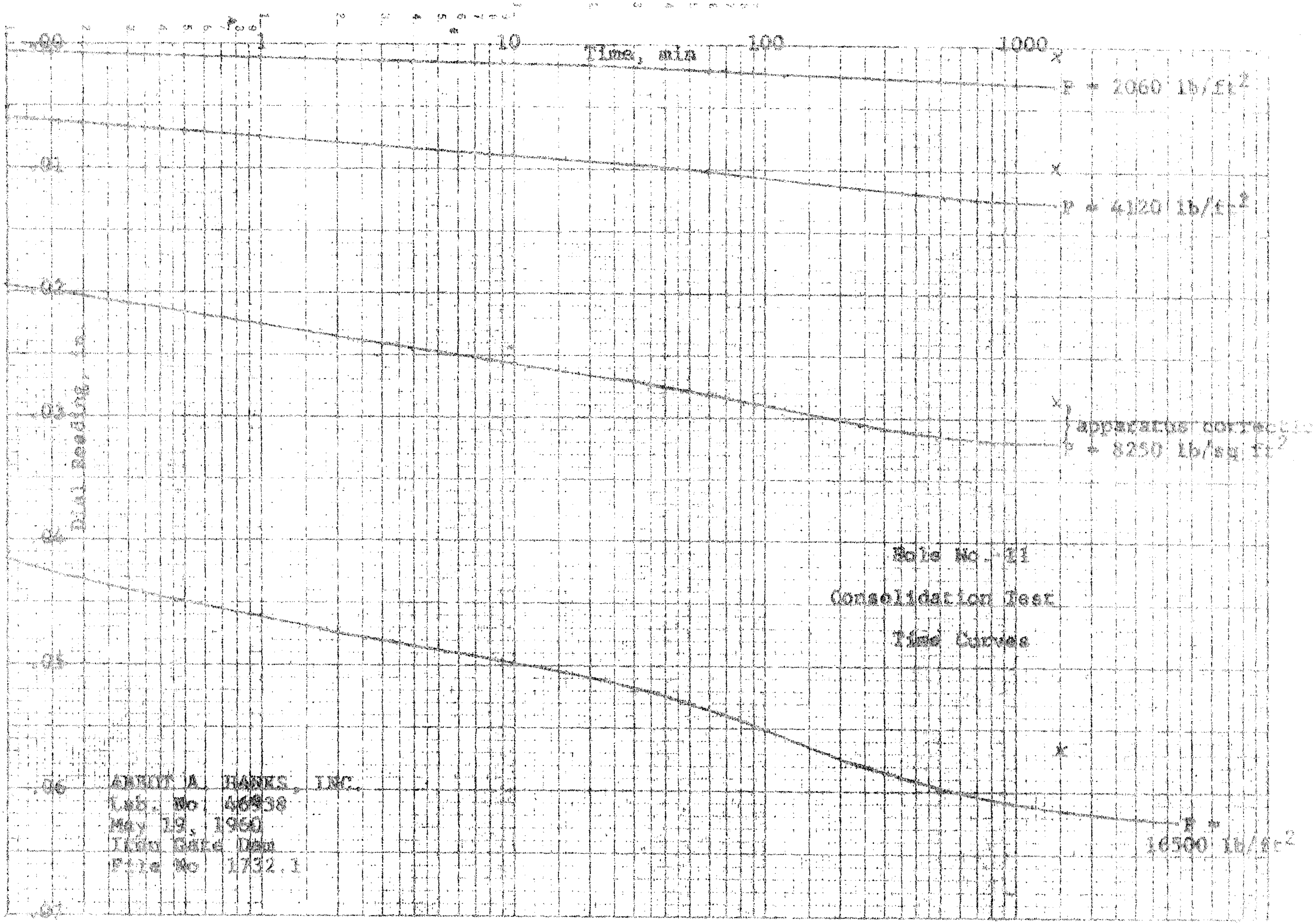
Triaxial Shear Test

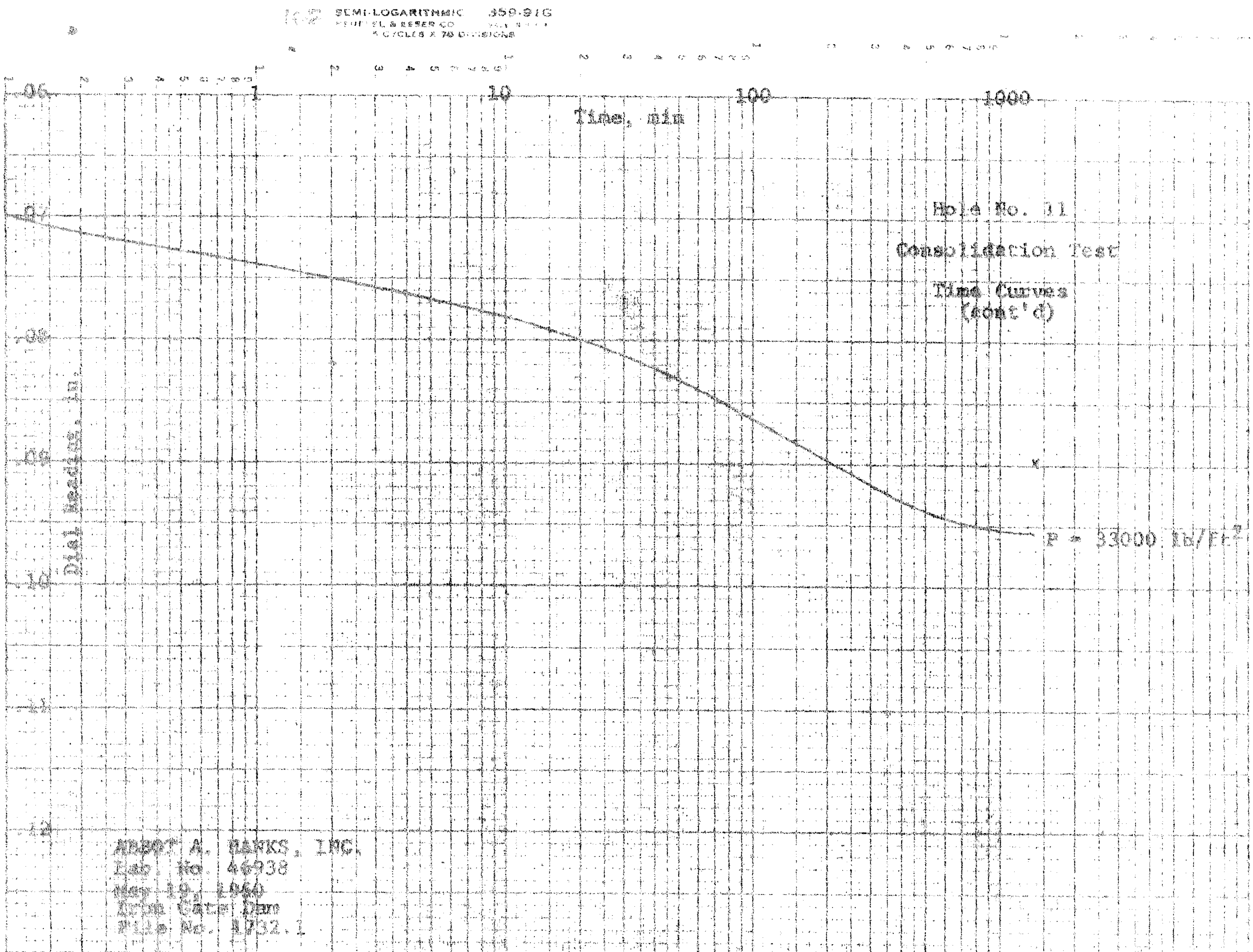
	Sample A	Sample B	Sample C
Chamber Pressure, psi	15	50	80
Unit Dry Weight at Compaction, lb/ft^3	101.5	101.7	102.1
Moisture Content at Compaction, %	22.2	21.7	22.0
Unit Dry Weight at Test, lb/ft^3	102.3	105.1	107.6
Moisture Content at Test, lb/ft^3	25.0	22.9	21.7
Degree of Saturation at Test, %	100	100	100
Maximum Deviator Stress, psi	21	55	73
Pore Pressure at Max. Deviator Stress, psi	5	7	22

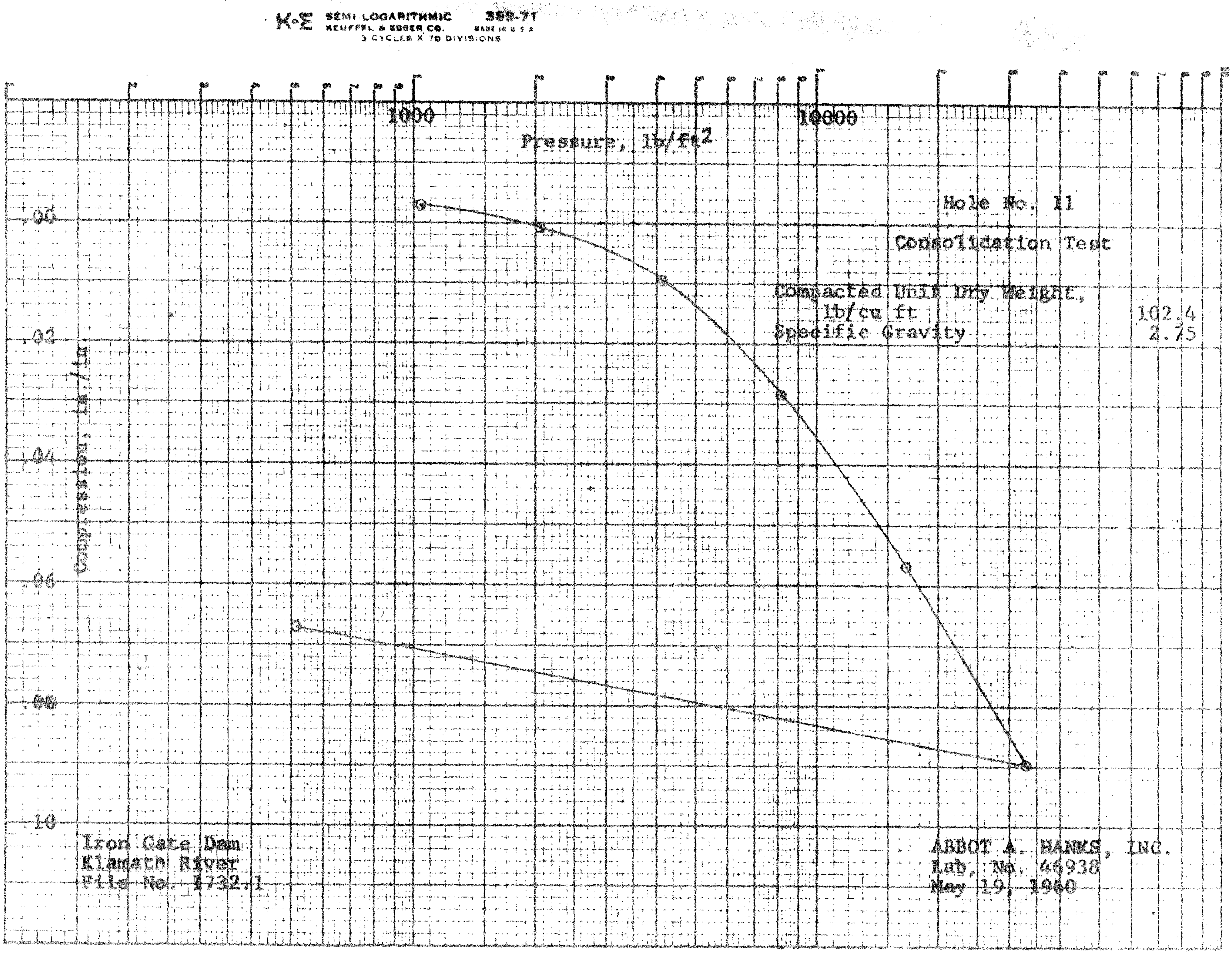
Permeability Test
(Constant Head Test)

Dry Density at Compaction, lb/ft^3	101.0
Moisture Content at Compaction, %	22.4
Permeability Coefficient, ft per yr	Less than .01
" " , cm/sec	Less than 10^{-8}

SEMI-LOGARITHMIC 359-91C
KEUFFEL & ESSER CO.
3 CYCLES X 70 DIVISIONS



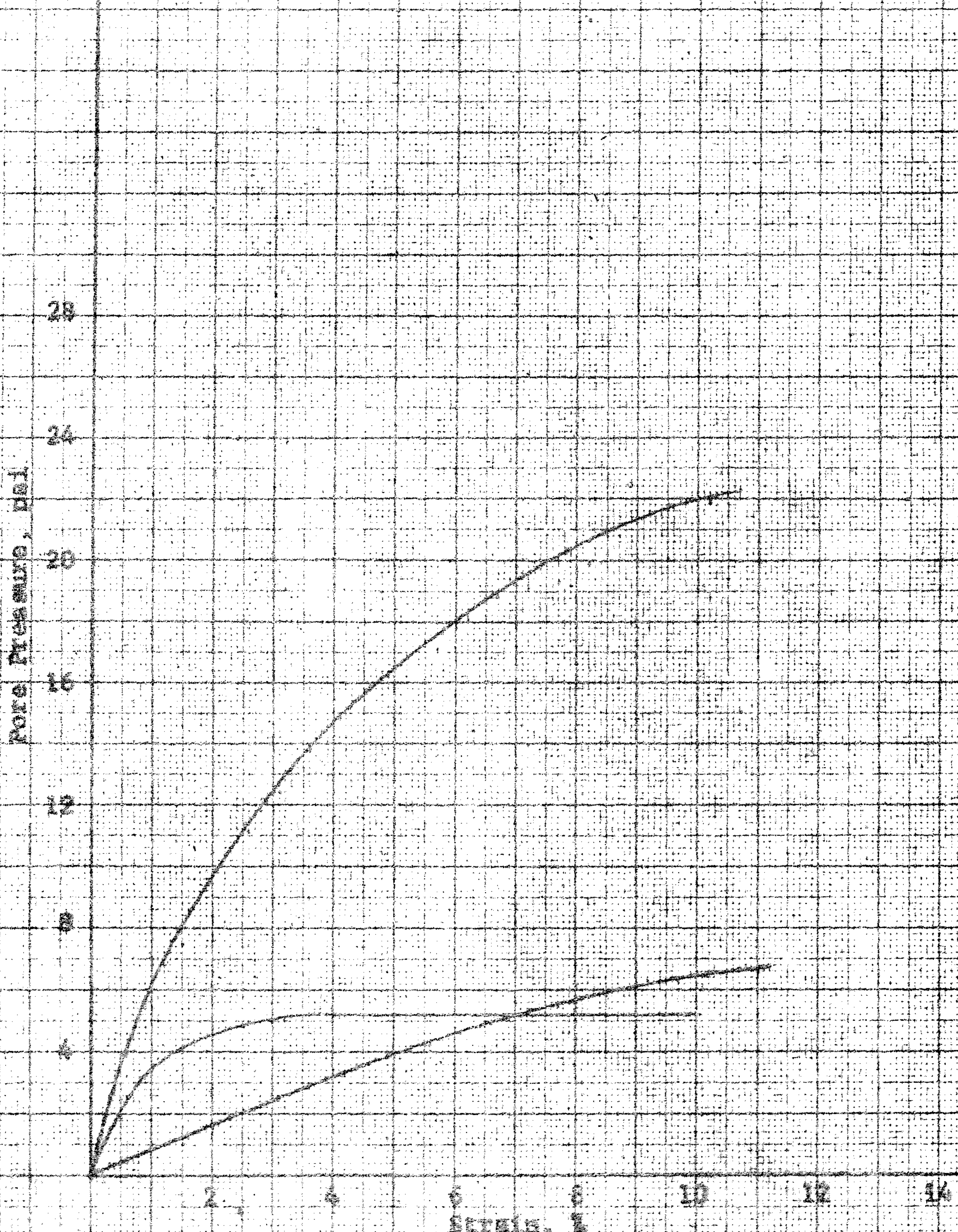

SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO.
Time, min
Dial Reading, in.
Hole No. 11
Consolidation Test
Time Curves
(cont'd)
P = 33000 lb/Ft^2
Lab. No. 46938
File No. 1732.1


K-E SEMI-LOGARITHMIC 359-71
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 70 DIVISIONS
1000
10000
Pressure, lb/ft2
Compression, in./in.
.00
.02
.04
.06
.08
.10
Hole No. 11
Consolidation Test
Compacted Unit Dry Weight, lb/cu ft 102.4
Specific Gravity 2.75
Iron Gate Dam
Klamath River
File No. 1732.1
ABBOT A. HANKS, INC.
Lab. No. 46938
May 19, 1960

Hole No. 11

Triaxial Shear Test

Pore Pressure-Strain Relationships



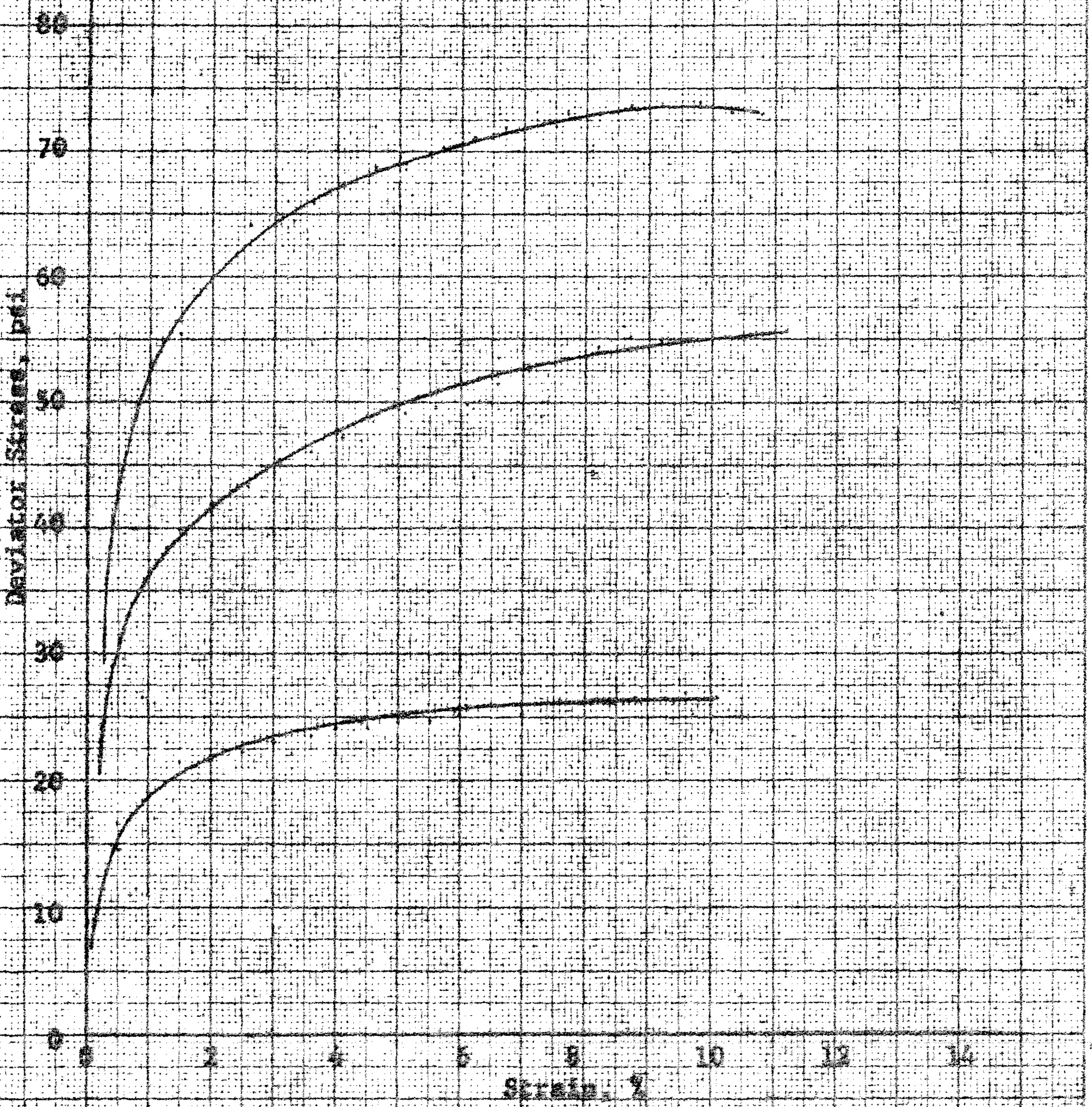
Iron Gate Dam
Klamath River
File No. 1732.1

ABBOT A. HANKS, INC.
Lab. No. 46936
May 19, 1960

Hole No. 11

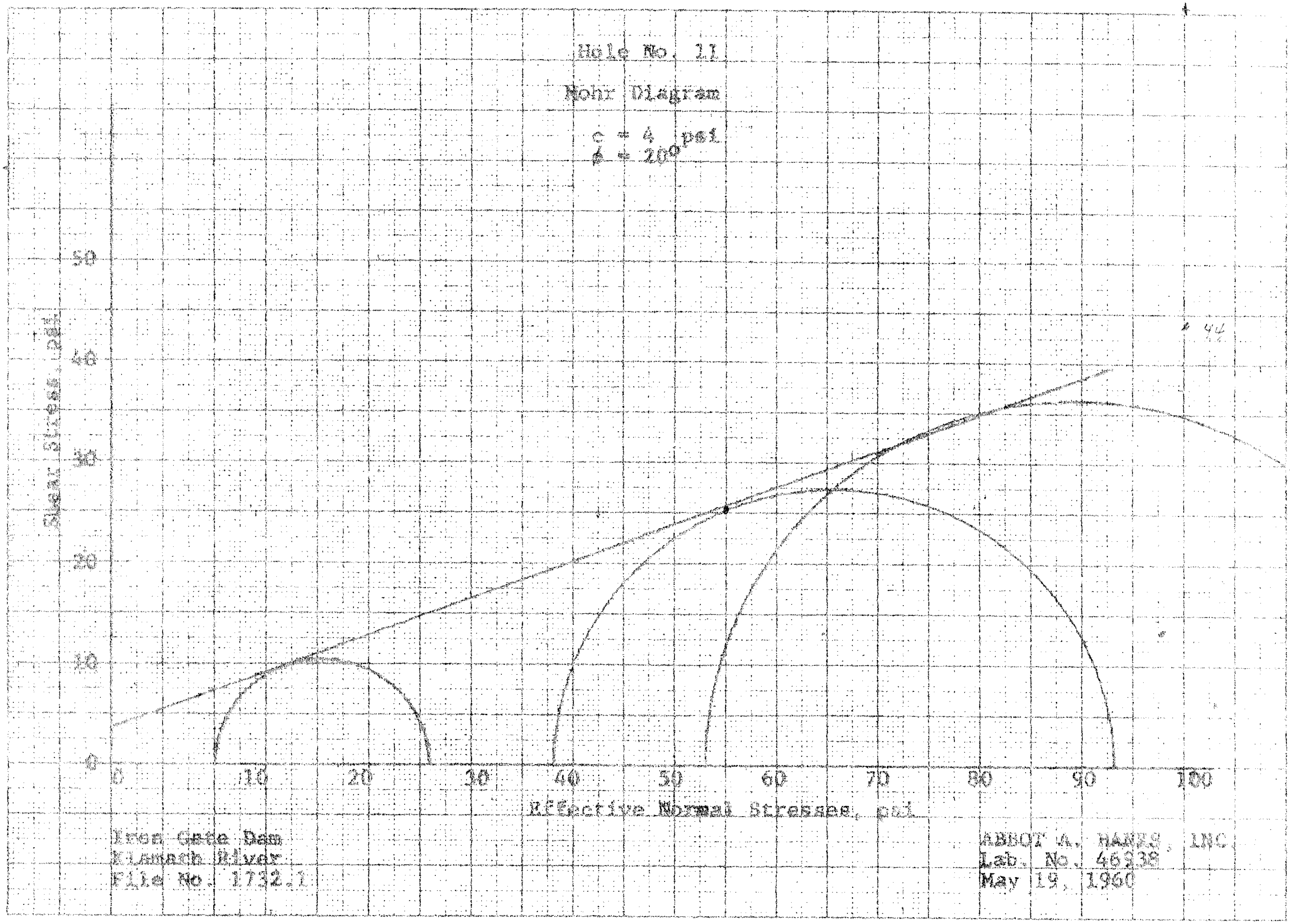
Triaxial Shear Test

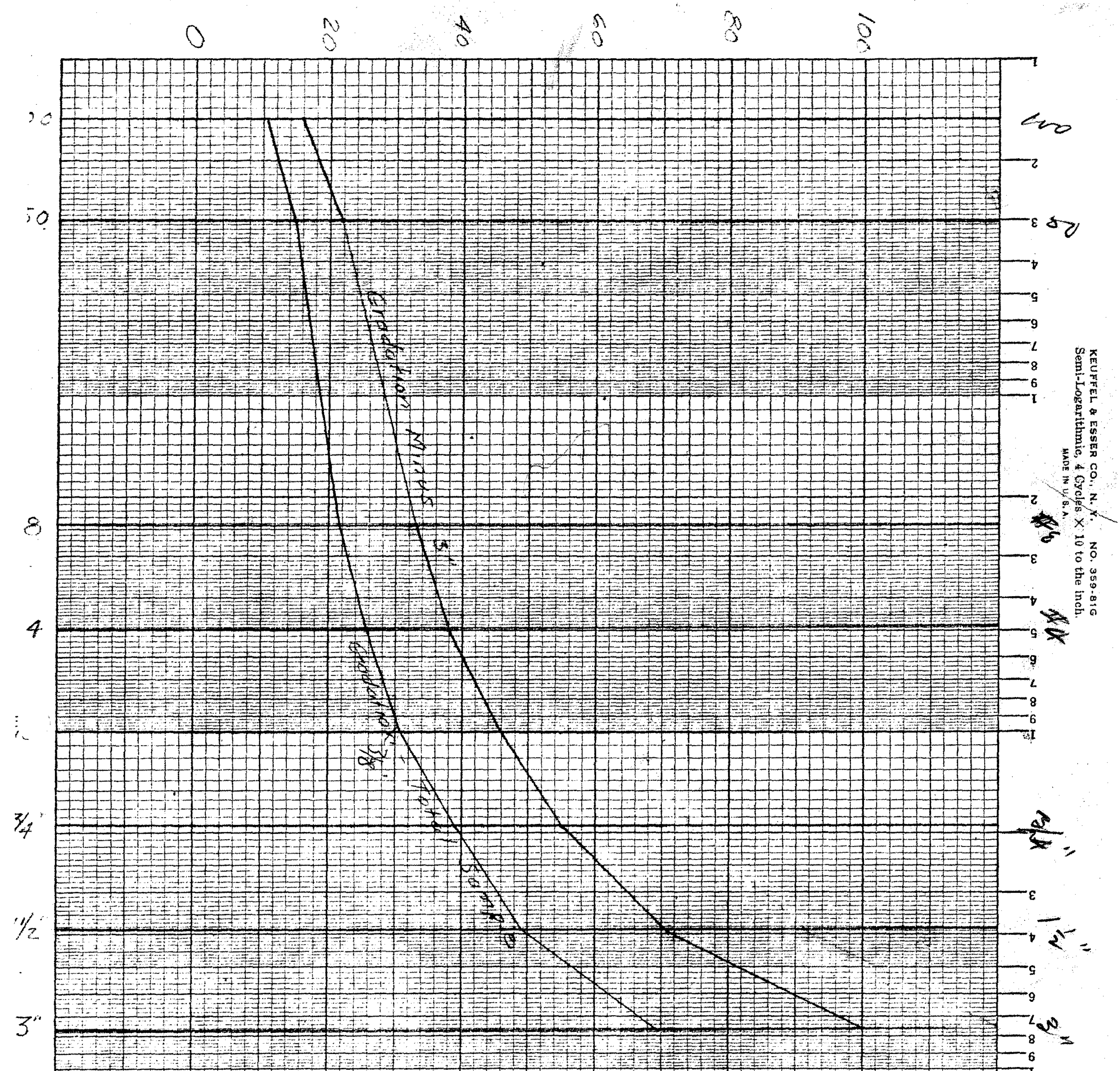
Stress-Strain Relationships



Iron Gate Dam
Klamath River
File No. 1732.1

ABBOT A. HANKS, INC.
Lab. No. 46938
May 18, 1960


Hole No. 11
Mohr Diagram
c = 4 psi
φ = 20°
Shear Stress, psi
0
10
20
30
40
50
0
10
20
30
40
50
60
70
80
90
100
Effective Normal Stresses, psi
44
Iron Gate Dam
Klamath River
File No. 1732.1
ABBOT A. HANKS, INC
Lab. No. 46938
May 19, 1960



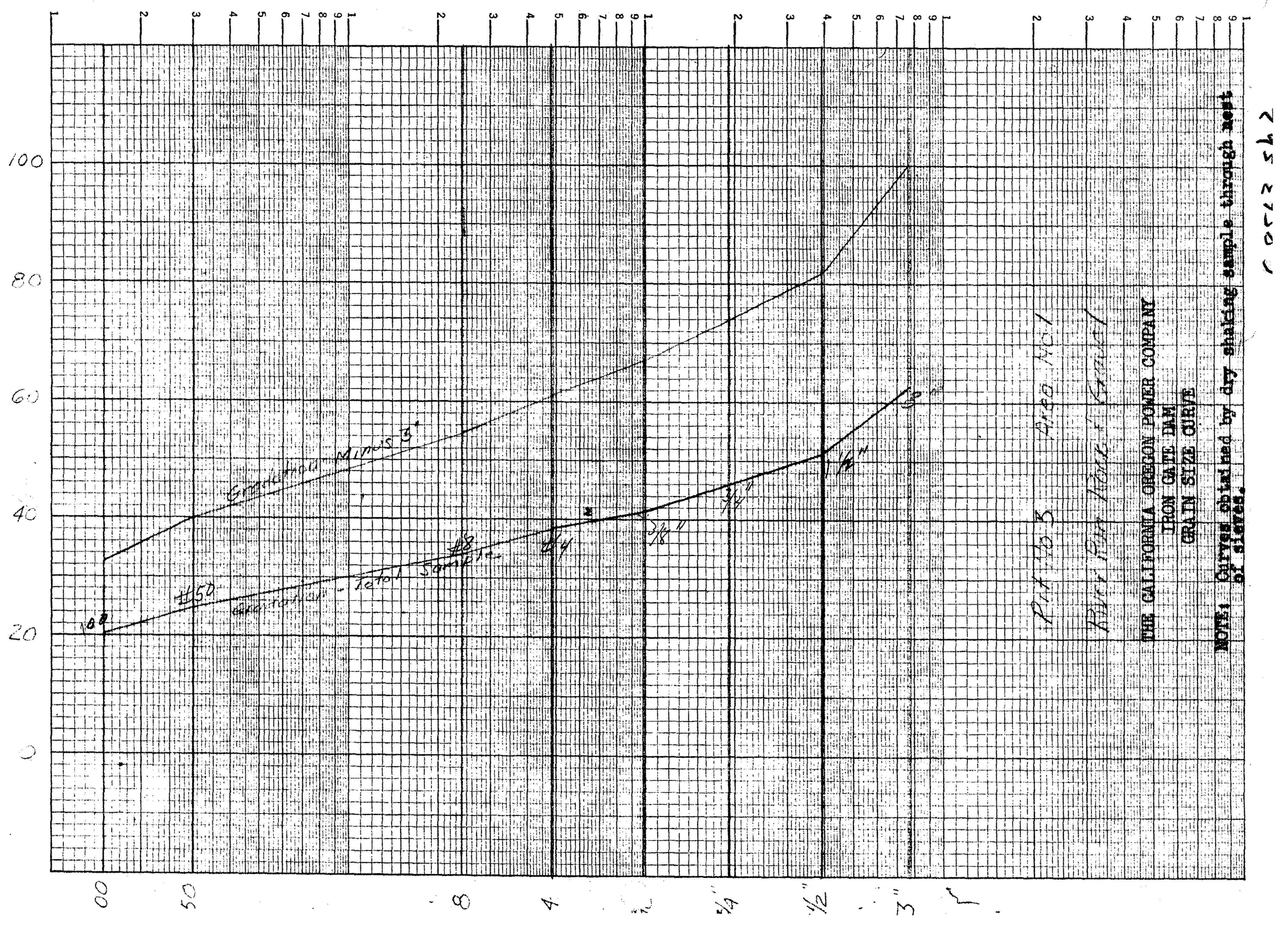
Pit 2 Area 1

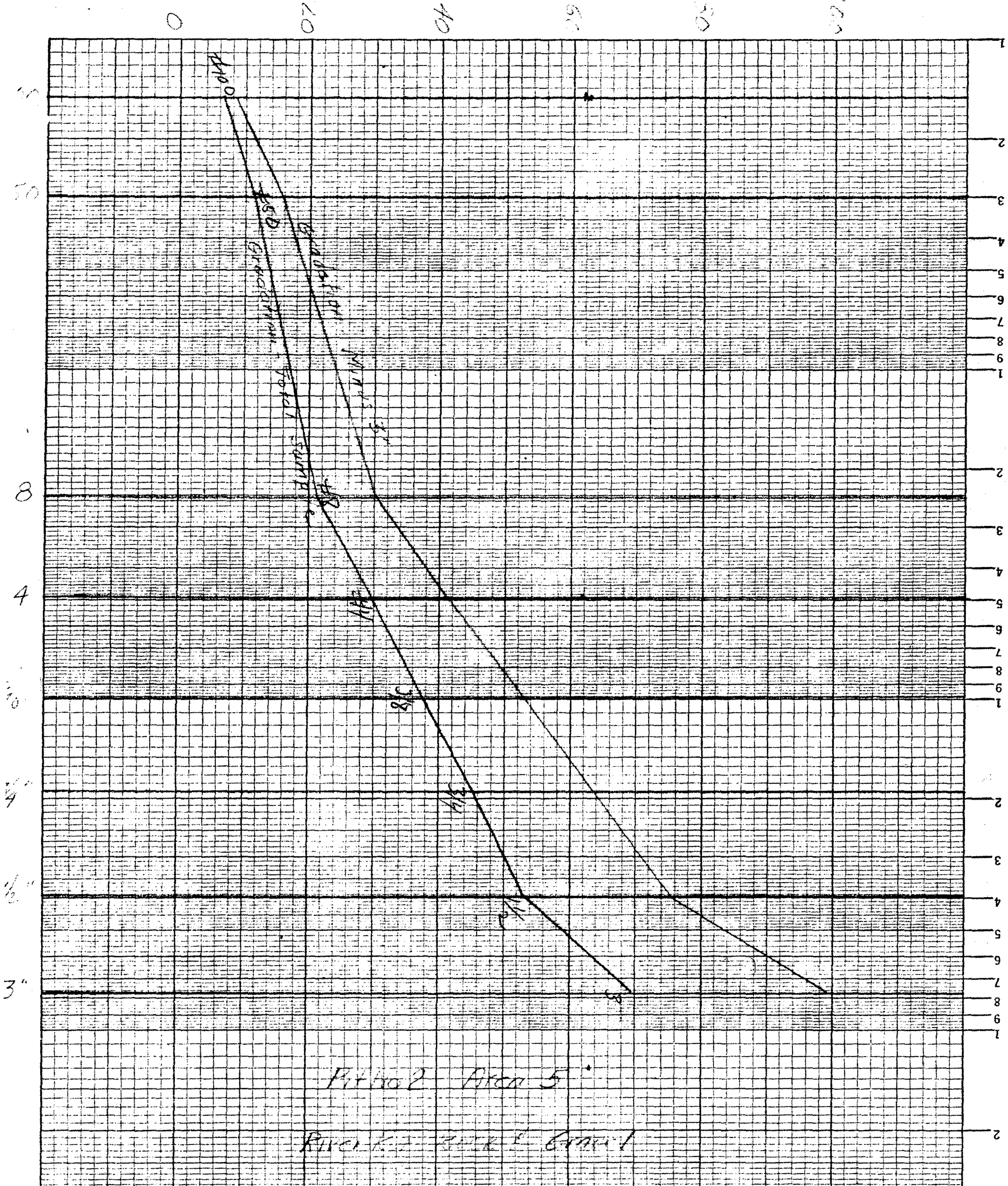
River Run Rock & Gravel

THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE

NOTE: Curves obtained by dry shaking sample through nest of sieves.

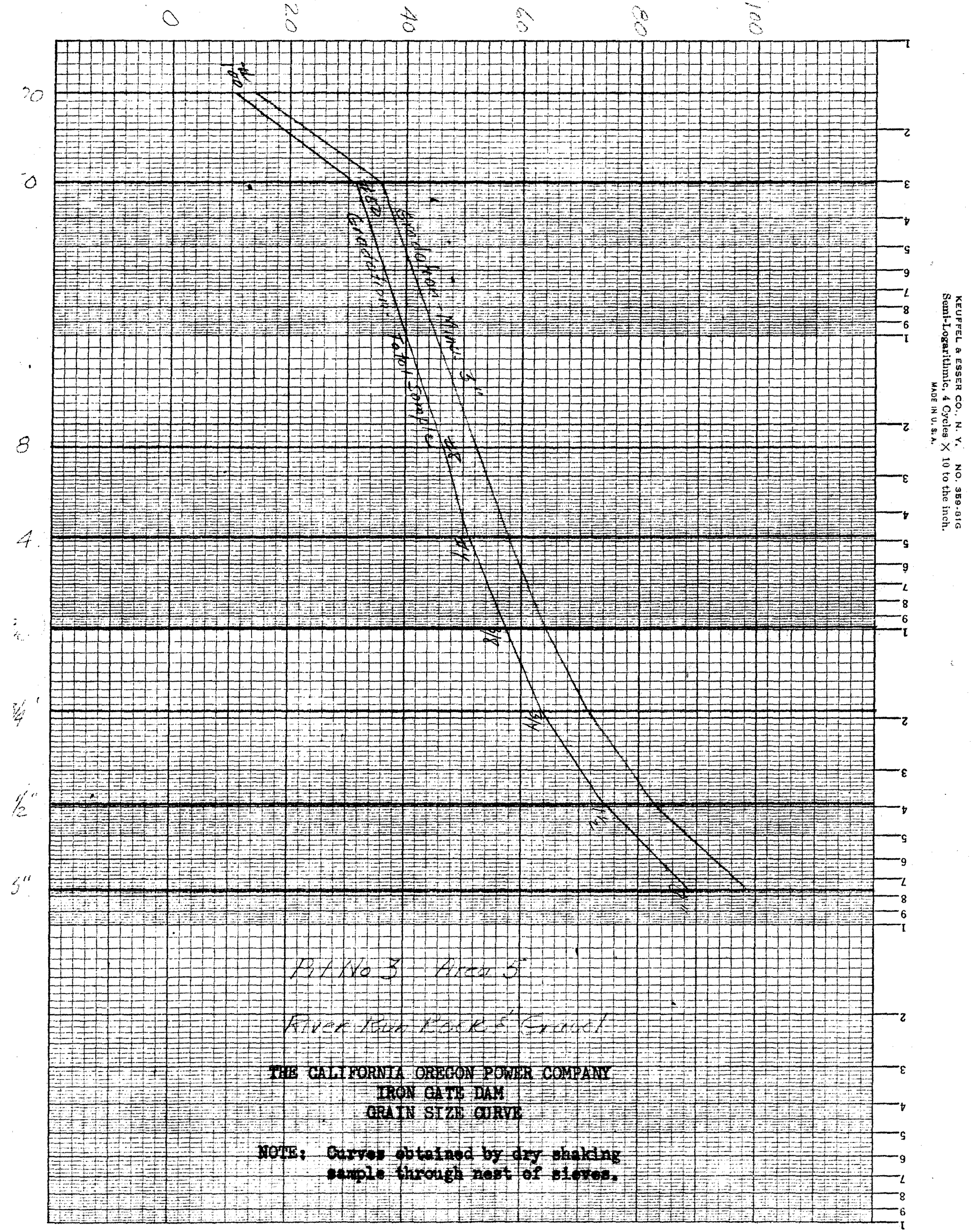
KEUFFEL & ESSER CO., N. Y. NO. 359-81G
Semi-Logarithmic, 4 Cycles × 10 to the inch.
MADE IN U. S. A.



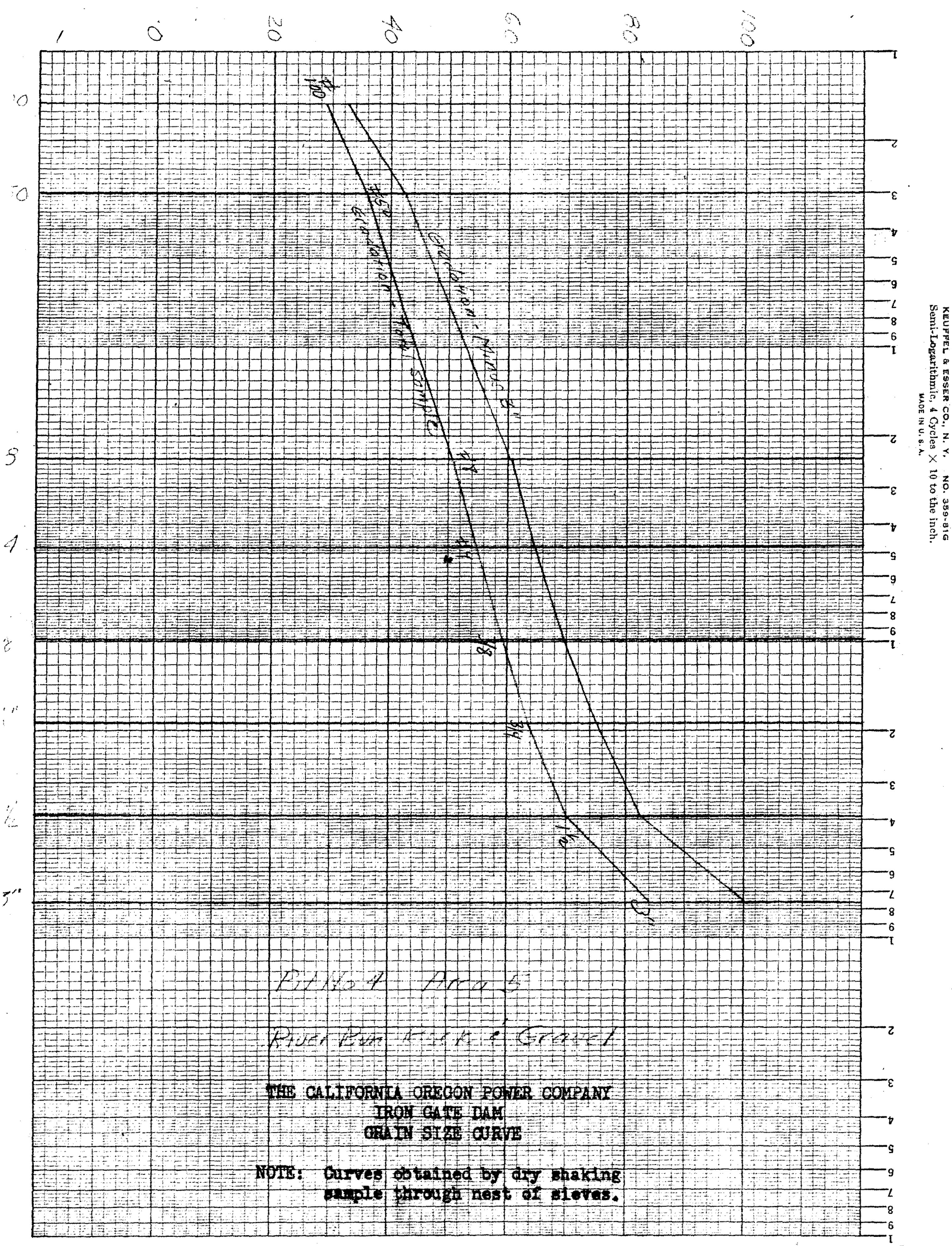


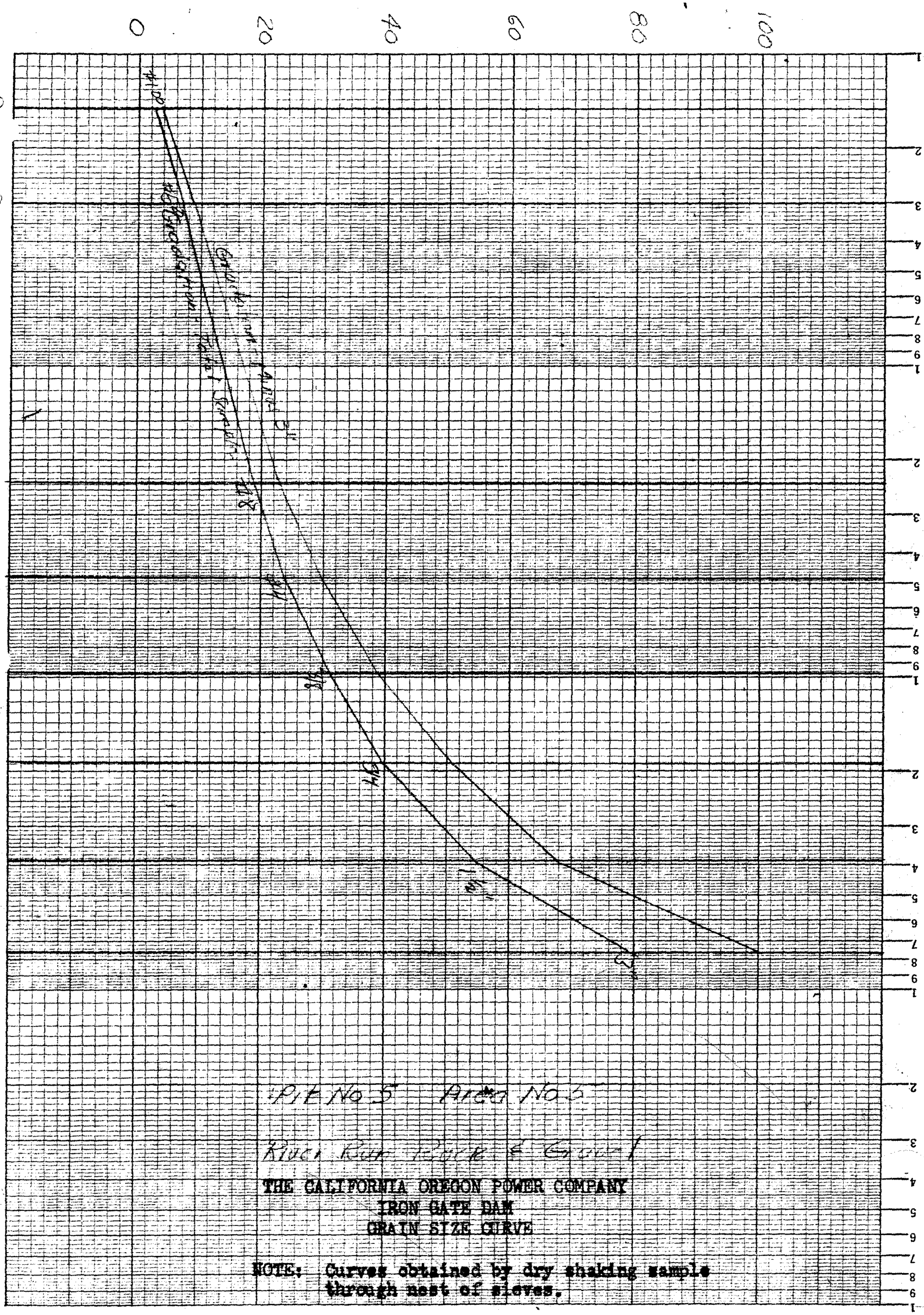
THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE

NOTE: Curves obtained by dry shaking sample through nest of sieves.



Pit No 3 Area 5
River Run Rock & Gravel
THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE
NOTE: Curves obtained by dry shaking sample through nest of sieves.
Gradation Total Sample
Gradation Minus 3"
KEUFFEL & ESSER CO., N. Y. NO. 359-81G
Semi-Logarithmic, 4 Cycles X 10 to the inch.
MADE IN U.S.A.

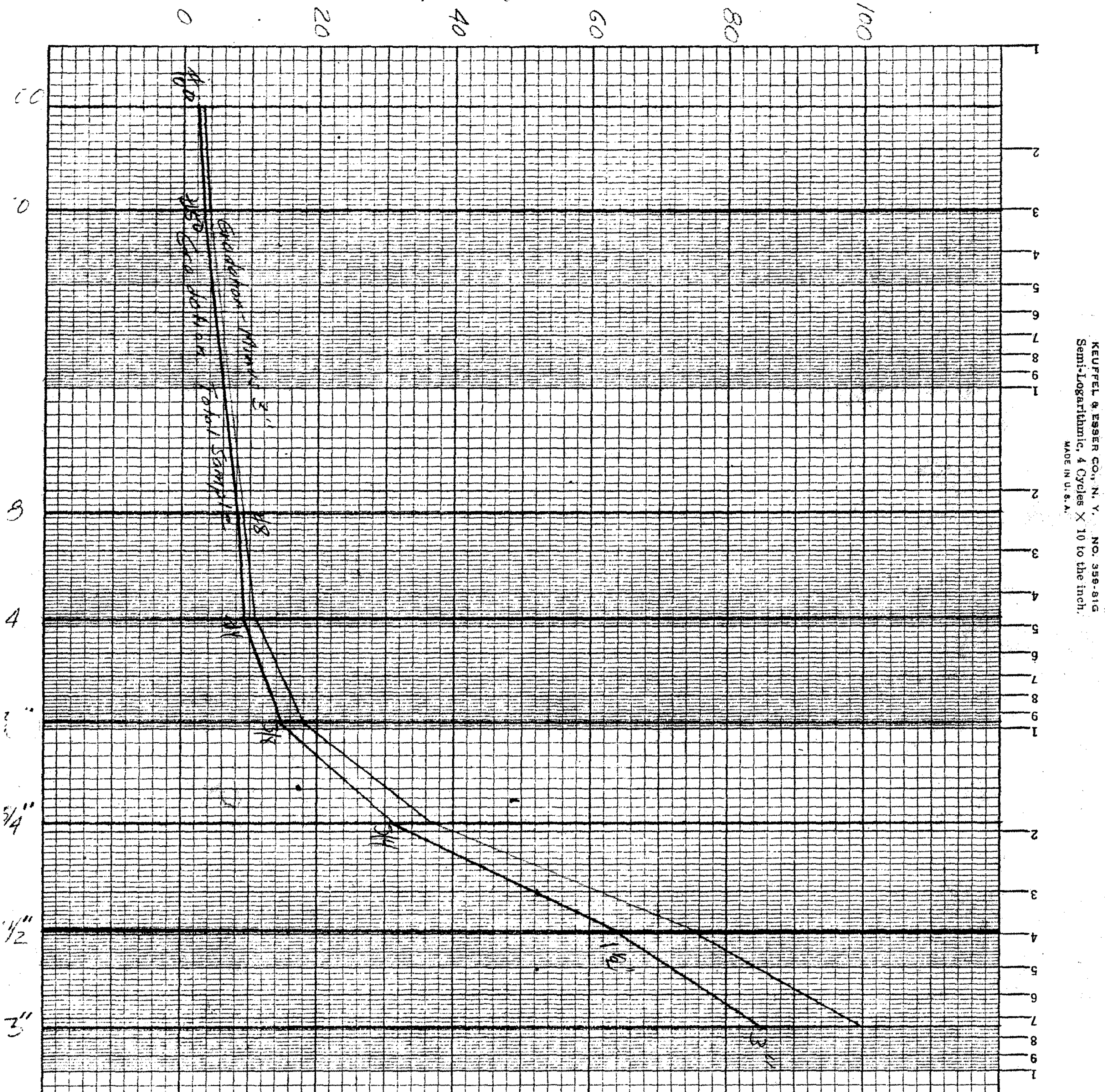

0
20
40
60
80
100
Gradation - Total sample
Gradation - Minus 3"
3"
1 1/2
3/4
THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE
NOTE: Curves obtained by dry shaking sample through nest of sieves.
River Run Rock & Gravel
KEUFFEL & ESSER CO., N. Y. NO. 359-81G
Semi-Logarithmic, 4 Cycles × 10 to the inch.
MADE IN U.S.A.



THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE

NOTE: Curves obtained by dry shaking sample through nest of sieves.

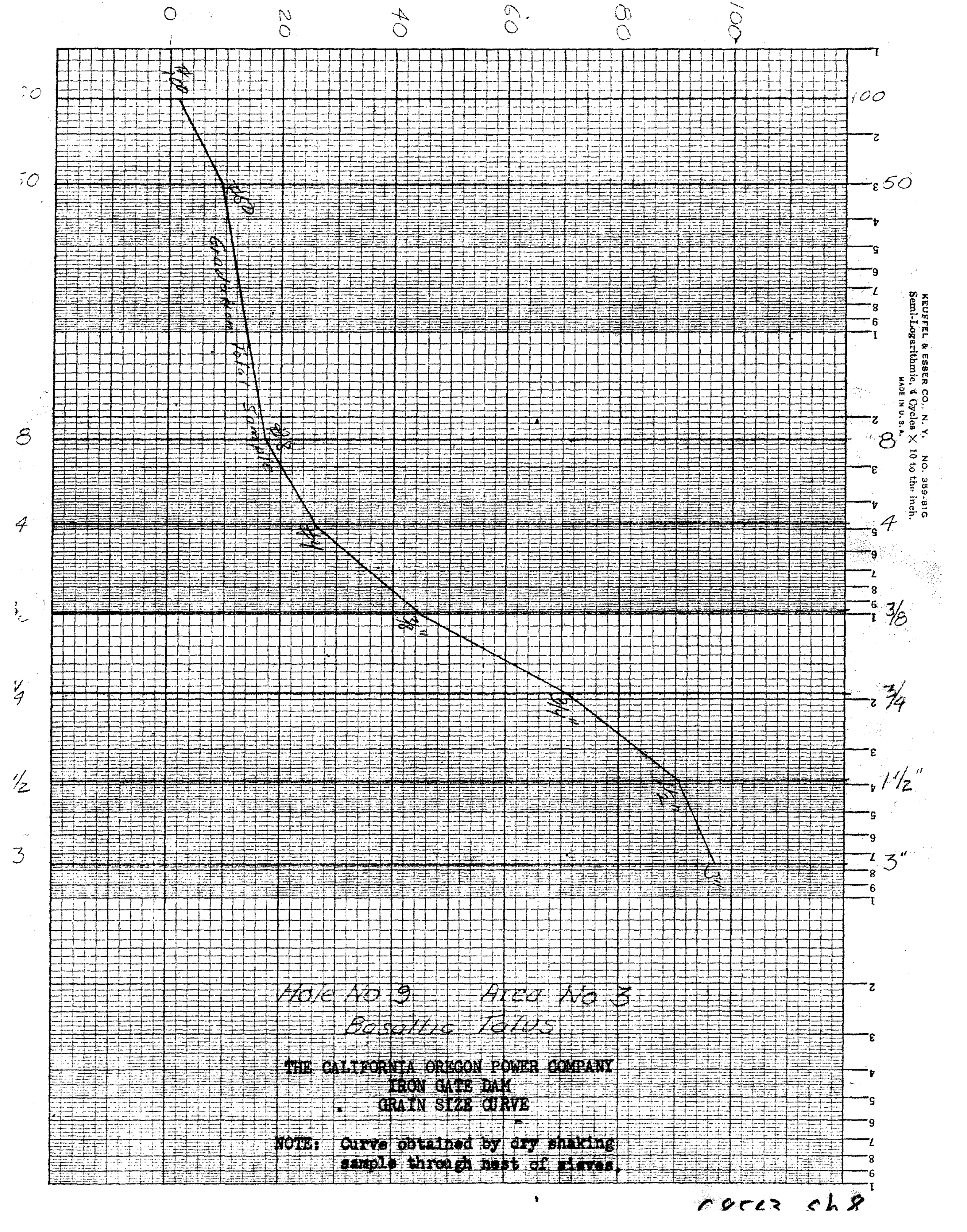
C8563 Sh 6

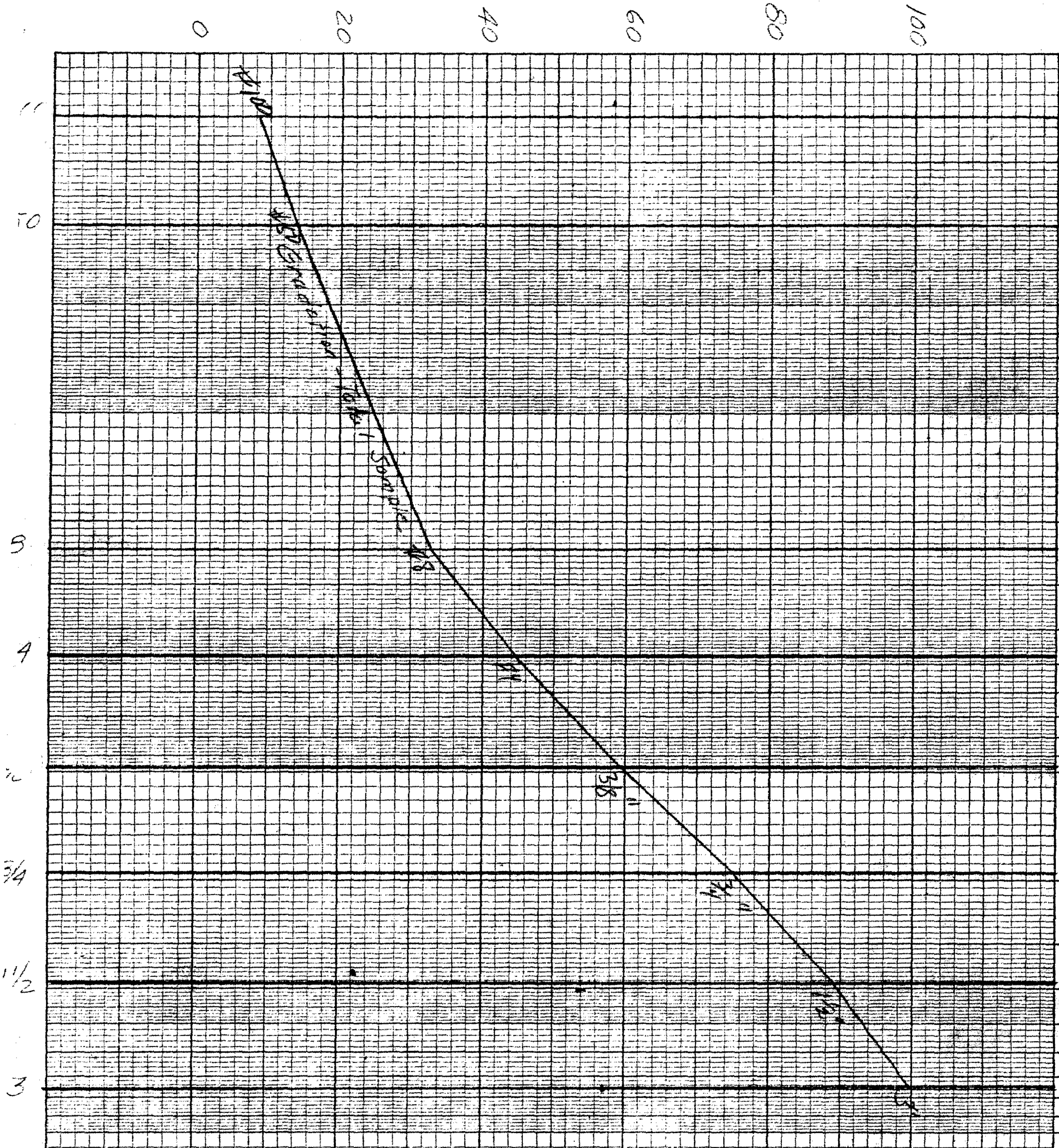


Pit 1 Dodson Area
Basaltic Talus

THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE

NOTE: Curves obtained by dry shaking sample through nest of sieves.


0
20
40
60
80
100
Gradation Total Sample
Hole No 9 Area No 3
Basaltic Talus
THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE
NOTE: Curve obtained by dry shaking
sample through nest of sieves.
KEUFFEL & ESSER CO., N. Y. NO. 359-81G
Semi-Logarithmic, 4 Cycles X 10 to the inch.
MADE IN U.S.A.
100
50
8
4
3/8
3/4
1½"
3"

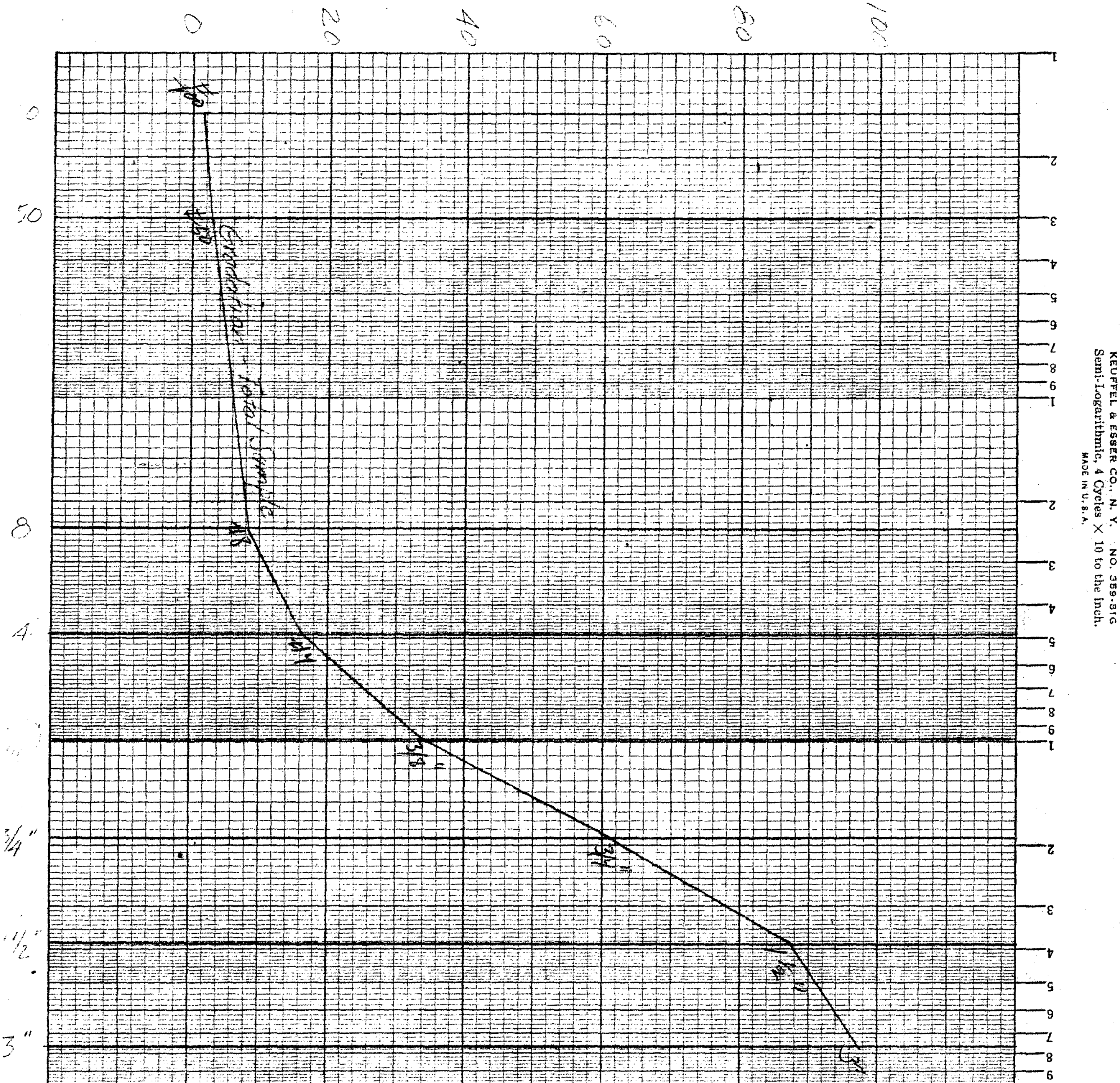


Hole 11 Area 3

Basaltic Talus

THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE

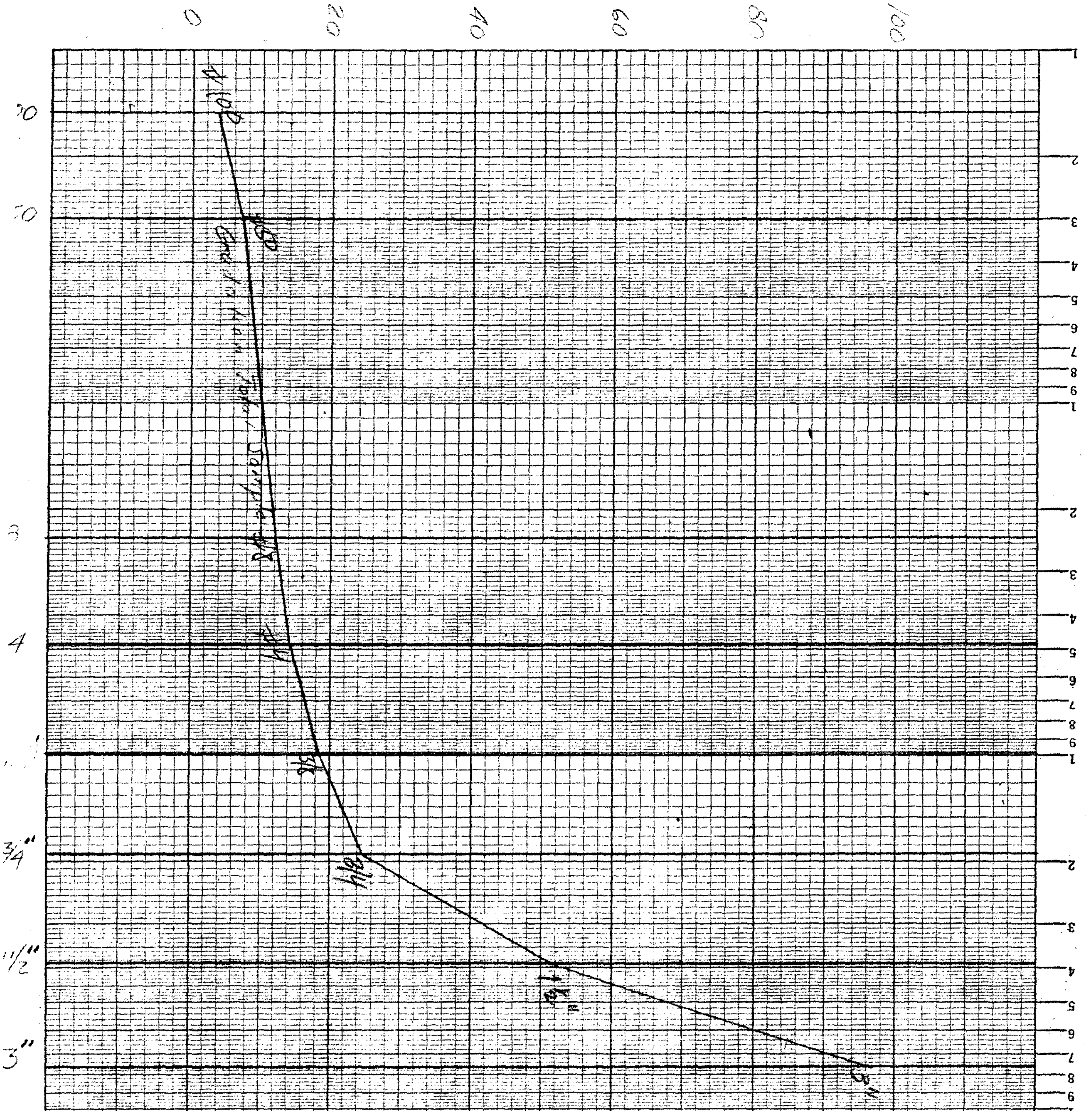
NOTE: Curve obtained by dry shaking sample through nest of sieves.



Pit 1 - Bogus Area
Basaltic Talus

THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE

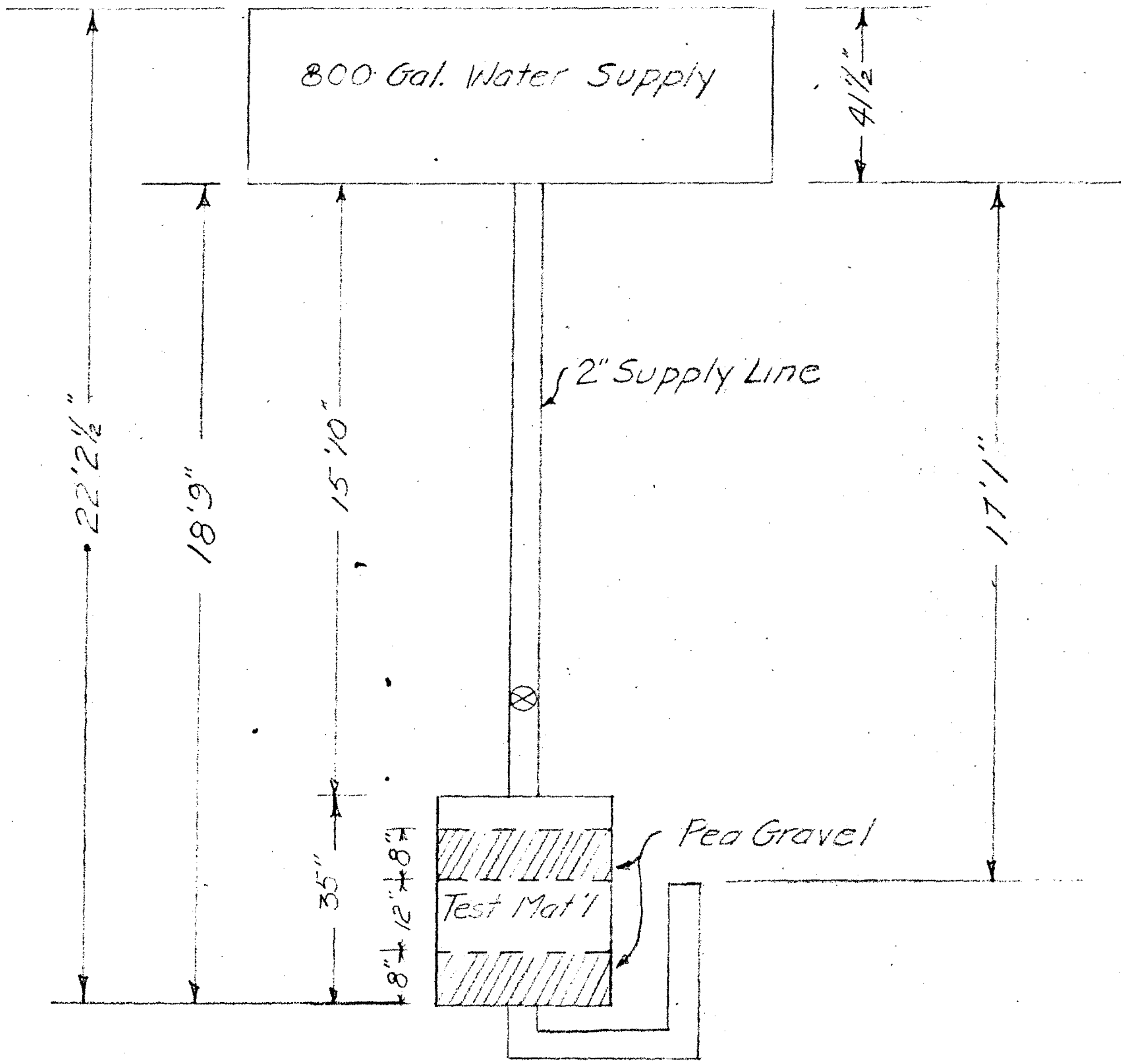
NOTE: Curve obtained by dry shaking sample through nest of sieves.



Pit 1 Summit Area
Basaltic Talus

THE CALIFORNIA OREGON POWER COMPANY
IRON GATE DAM
GRAIN SIZE CURVE

NOTE: Curves obtained by dry shaking sample through nest of sieves.



Permeability Test Method

No Scale

Iron Gate Project

DRAWN BY			J. O.	
TRACED BY			J. O. REQ.	
CHECKED BY			MAP NO.	
APPROVED BY	SEC.	TWP.	RANGE	AREA
SCALE	SCHOOL DIST.	ROAD DIST.	RURAL ☐	URBAN ☐
DATE 7-20-60	THE CALIFORNIA OREGON POWER COMPANY		C 8560	

BRANCH LABORATORY 1086 MARTIN AVENUE • SANTA CLARA • CHERRY 8-5262
BRANCH OFFICE 61 JORDAN STREET • SAN RAFAEL • GLENWOOD 4-8650

CABLE HANX

ABBOT A. HANKS, INC.

ESTABLISHED 1866

1300 SANSOME STREET • SAN FRANCISCO 11, CALIFORNIA • EXBROOK 7-2464

Engineers
Assayers
Chemists
Metallurgists
Spectrographers
Soils and Foundations
Consulting · Testing · Inspecting

File No. 1732.2
Lab. No. 52348

August 8, 1961

The California Oregon Power Company
Iron Gate Project
Post Office Box 201
Hornbrook, California

Re: Iron Gate Dam - P. O. #39636
Soil Tests, Sample 16+00 300' L

Gentlemen:

Based on tests of four specimens compacted in the range of 81 to 82 lb per cu ft, it appears that the intergranular strength factors of the above sample in a consolidated shear test with pore pressures measured are as follows:

Friction angle	11½ - 15½ degrees
Cohesion	450 - 800 lb/sq ft.

This soil is a highly plastic, impervious clay. Consolidation was extremely slow, requiring 10 days to complete the consolidation and saturation of each 2 in. diameter by 4 in. length specimen. An extremely long seasoning period was also necessary to attain uniformity of moisture content prior to compaction of specimens at the specified moisture content.

We are proceeding with tests of Sample 12+00 400' L, and will submit details of all tests upon completion.

Very truly yours,

ABBOT A. HANKS, INC.

L. O. Long

LOL:hms
Reports to:
3-Iron Gate Project, Hornbrook, Calif.
1-The California Oregon Power Company, Medford, Ore.

BRANCH LABORATORY: 1086 MARTIN AVENUE • SANTA CLARA • CHERRY 8-5262
BRANCH OFFICE: 61 JORDAN STREET • SAN RAFAEL • GLENWOOD 4-8650

CABLE: HANX

ABBOT A. HANKS, INC.
ESTABLISHED 1866
1300 SANSOME STREET • SAN FRANCISCO 11, CALIFORNIA • EXBROOK 7-2464

Engineers
Assayers
Chemists
Metallurgists
Spectrographers
Soils and Foundations
Consulting · Testing · Inspecting

File No. 1732.2
Lab. No. 52348, 52871

October 20, 1961

Mr. M. L. Warren
Assistant Chief Engineer
The California Oregon Power Co.
216 Main Street
Medford, Oregon

Re: Iron Gate Project Samples

Dear Mr. Warren:

Attached are the findings from triaxial shear tests performed on soil samples marked "12+00, 400'L", and "16+00, 300'L".. The triaxial tests were performed in the same manner as described in our letter of June 29, 1960.

Complete saturation was not attained in the tests because, when confined under the higher lateral pressures, the specimens were virtually impermeable, and complete saturation could not be attained even by application of a high vacuum on the top of the specimens and a small positive pressure on the base.

You will note that we did not submit data for a specimen of sample 16+00, 300'L at 80 psi chamber pressure. The data for this specimen was not consistent with the remainder of the test data, and it appears likely that there was leakage of the membrane during the test. If you feel that a repetition of the test at 80 psi would serve a useful purpose, we should be pleased to repeat the test.

We should be pleased to discuss any questions in connection with these tests.

Very truly yours,

ABBOT A. HANKS, INC.

L. O. Long

L. O. Long

LOL:hms
Encls.
Reports to:
3-The California Oregon Power Co.

Iron Gate Project
The California Oregon Power Company
File No. 1732.2

Abbot A.Hanks, Inc.
Lab. No. 52348
October 17, 1961

TABLE NO. I

Sample: 16 + 00 300'L.
Soil Type: Dark yellow-brown clay.

Sample	A	B	C	D
Chamber Pressure, psi	15.5	15	50	50
Unit Dry Weight at Compaction, lb/ft^3	81.3	81.2	82.7	82.5
Moisture Content at Compaction, %	25.0	24.6	24.2	23.7
Unit Dry Weight at Test, lb/ft^3	76.8	74.7	84.7	84.7
Moisture Content at Test, %	42.3	36.8	--	35.3
Degree of Saturation at Test, %	94	80	--	97
Maximum Deviator Stress, psi	15	18	43	35
Pore Pressure at Maximum Deviator Stress, psi	6	4	1	2

Iron Gate Project
The California Oregon Power Company
File No. 1732.2

Abbot A. Hanks, Inc.
Lab. No. 52871
October 17, 1961

TABLE NO. II

Sample: 12 + 00, 400'L.
Soil Type: Very dusky red clay.

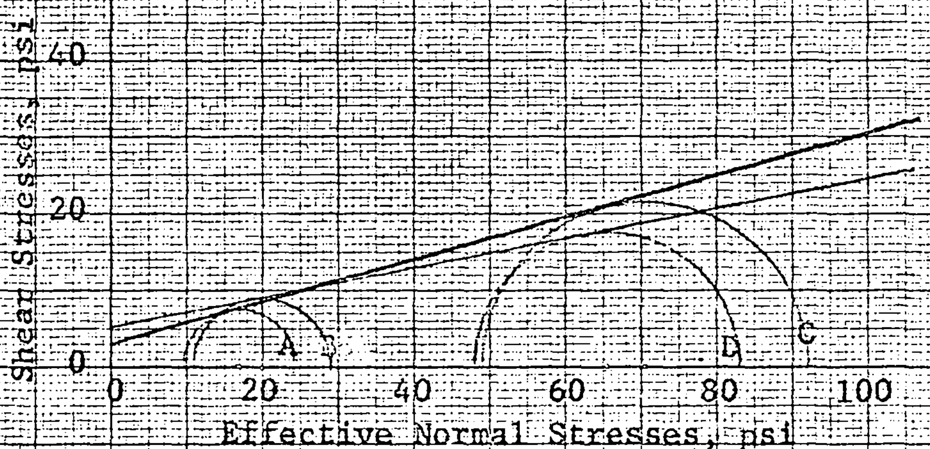
Sample	A	B	C
Chamber Pressure, psi	15	50	80
Unit Dry Weight at Compaction, lb/ft^3	88.6	86.7	86.9
Moisture Content at Compaction, %	24.5	23.5	24.5
Unit Dry Weight at Test, lb/ft^3	81.6	89.2	91.0
Moisture Content at Test, %	36.3	30.7	27.2
Degree of Saturation at Test, %	89	94	86
Maximum Deviator Stress, psi	16	48	81
Pore Pressure at Maximum Deviator Stress, psi	1	4	1

hms

Sample 16+00, 300'L

MOHR DIAGRAM

c = 3-5½ psi
ϕ = 11-15°



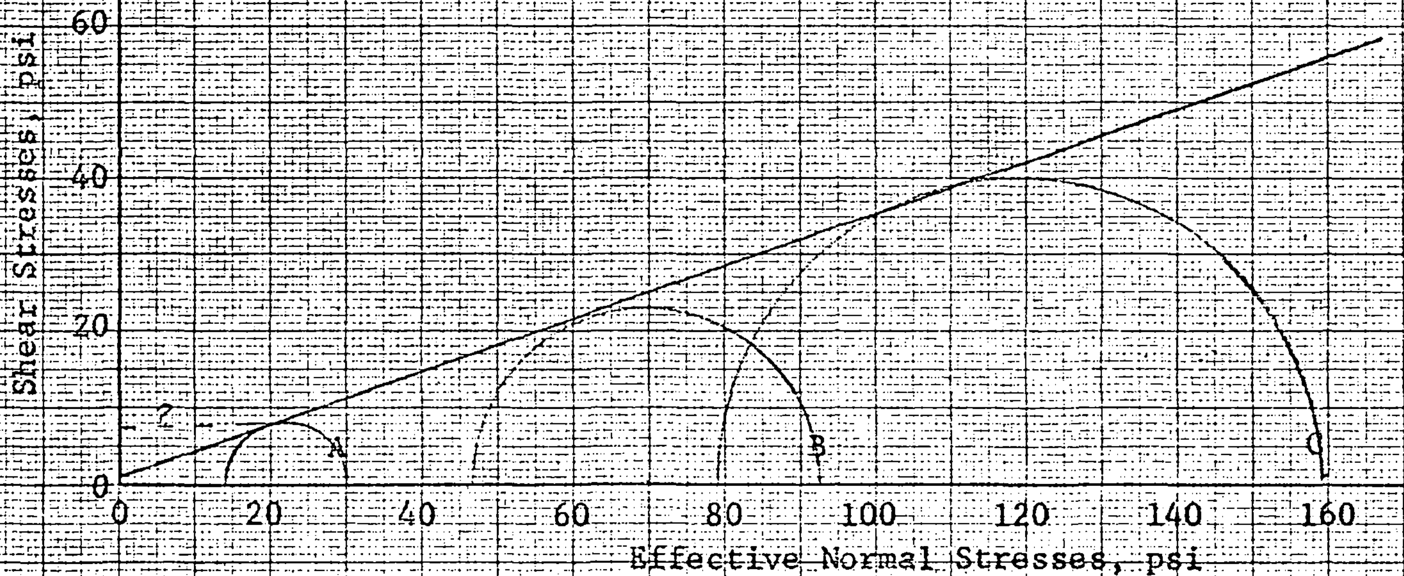
Iron Gate Dam
File No. 1732.2

ABBOT A. HANKS, INC.
Lab. No. 52348

Sample 12+00, 400'L

MOHR DIAGRAM

c = 1 psi
$\phi = 20^{\circ}$



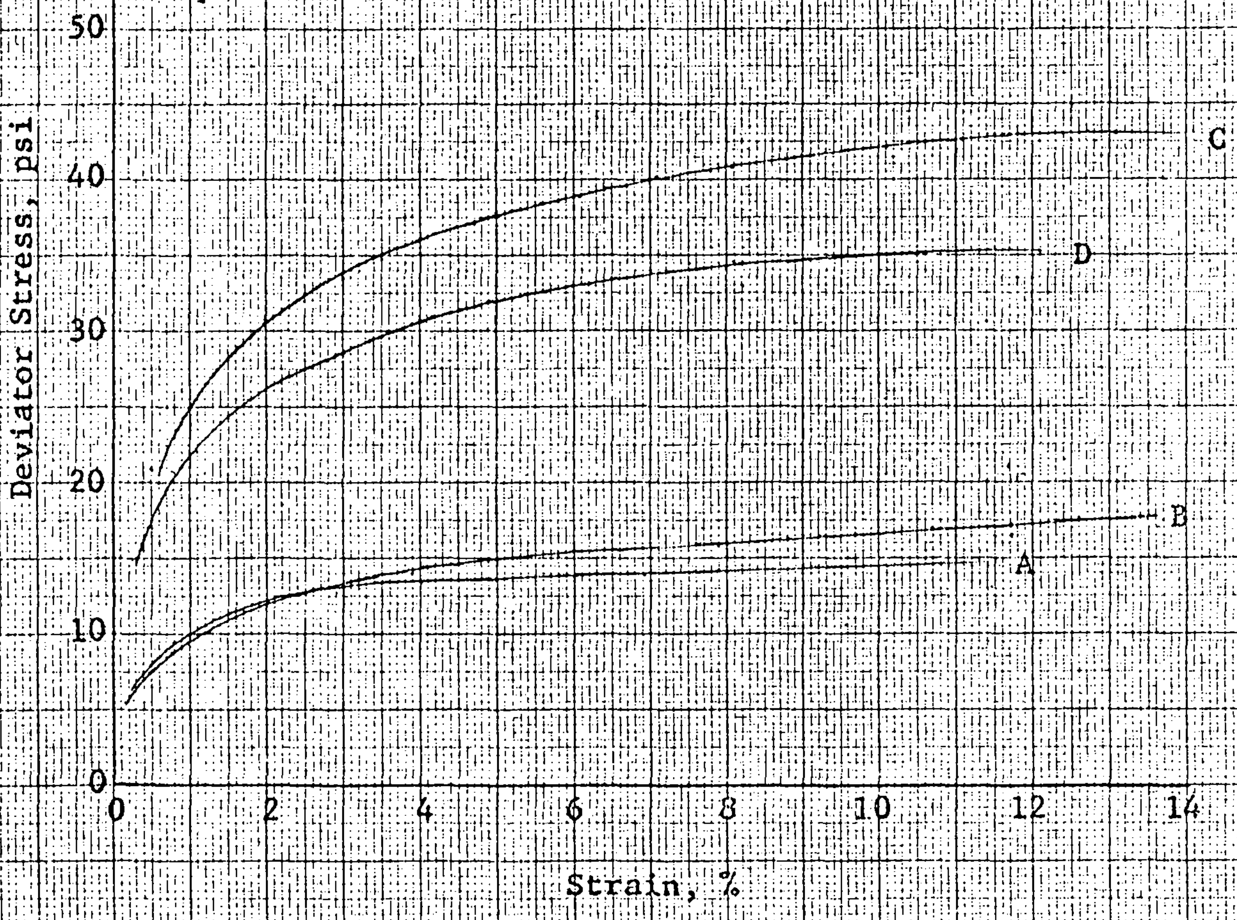
Iron Gate Dam
File No. 1732.2

ABBOT A. HANKS, INC.
Lab. No. 52871

Sample 16+00, 300'L

TRIAXIAL SHEAR TEST

Stress-Strain Relationships



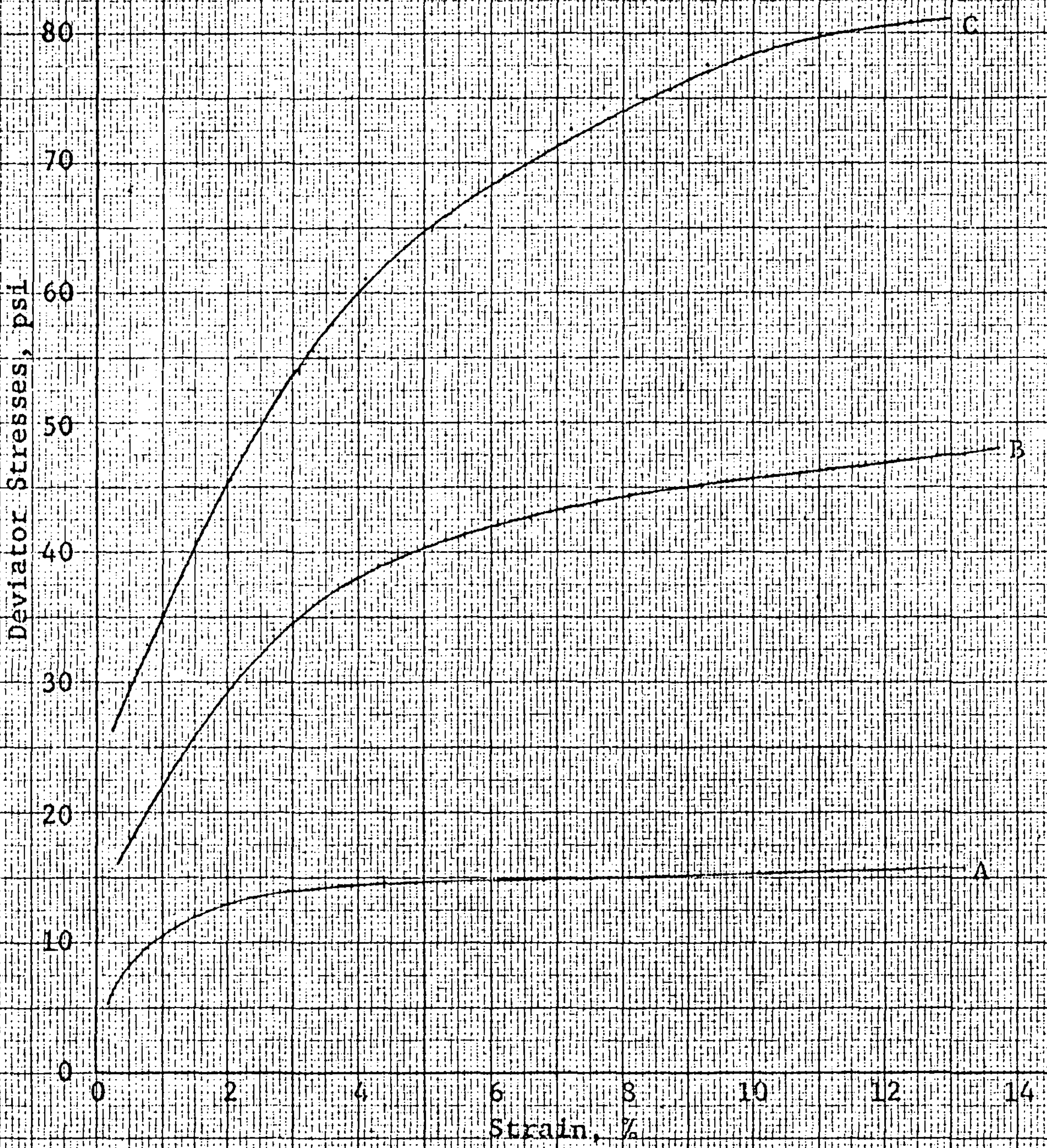
Iron Gate Dam
File No. 1732.2

ABBOT A. HANKS, INC.
Lab. No. 52348

Sample 12+00, 400'L

TRIAXIAL SHEAR TEST

Stress-Strain Relationships



Iron Gate Dam
File No. 1732.2

ABBOT A. HANKS, INC.
Lab. No. 52871

Attachment B Falling Head Permeability Tests

Undrained, consolidated triaxial shear tests with pore pressure measurements, consolidation tests, and constant head permeability tests were performed on representative samples of material for each hole by Abbot A. Hanks Laboratory in San Francisco. Before each test the material was compacted to near optimum moisture and maximum dry density. The results of these tests are shown in Abbot A. Hanks report as Plate IV. For convenient reference, the permeability coefficient, the angle of internal friction and cohesion for the material from each hole are tabulated below:

HOLE NO.	COHESION p.s.i.	psf	ANGLE OF INTERNAL FRICTION	PERMEABILITY FT/YEAR Less than	COEFFICIENT CM/SEC Less than
1.	9	1300	10°	.01	10-8
2.	6	860	17°	-	-
3.	10	1440	14°	.01	10-8
4.	4	580	30°	.01 - .04	1-4 x 10-8
7.	5	720	21°	.01	10-8
8.	3	430	16°	.01	10-8
11.	4	580	20°	.01	10-8

844 psf 7) 128 (18° av.

The quantities of the impervious materials available in Areas "A" and "5", are estimated to be 264,000 cubic yards. The quantities in Area "1" are estimated to be 57,000 dubic yards. However, most of Area "1" will be inundated by backwater from the construction of the cofferdam so, in order to utilize this material, it will be necessary that it be stockpiled, which does not seem practical.

2. Pervious Shell Materials

Two types of pervious materials were investigated:

A. Gravels in the flood plain of the river in Areas "1" and "5"

B. Talus deposits of basaltic rock in Area "3", Bogus Creek Area, Summit Area and Dodson Area.

Sample Area "1"	% Passing #100 Sieve	% Moisture	Dry Density Lbs/cu ft	Wet Density Lbs/cu ft	Permeability Coefficient Ft/Day
Pit 2, 1-14' Depth	15	8	119.5	129.2	11.1
Pit 3, 3-12' "	21	7	128.5	138.2	17.6
Area "5"					
Pit 2, 2-16' Depth	9	9	129.5	141.5	12.6
Pit 3, 2-12' "	14	9	137.5	151.0	.59
Pit 4, 4-20' "	33	11	105.0	118.0	8.94
Pit 5, 4-16' "	3	9	125.0	137.0	3.95

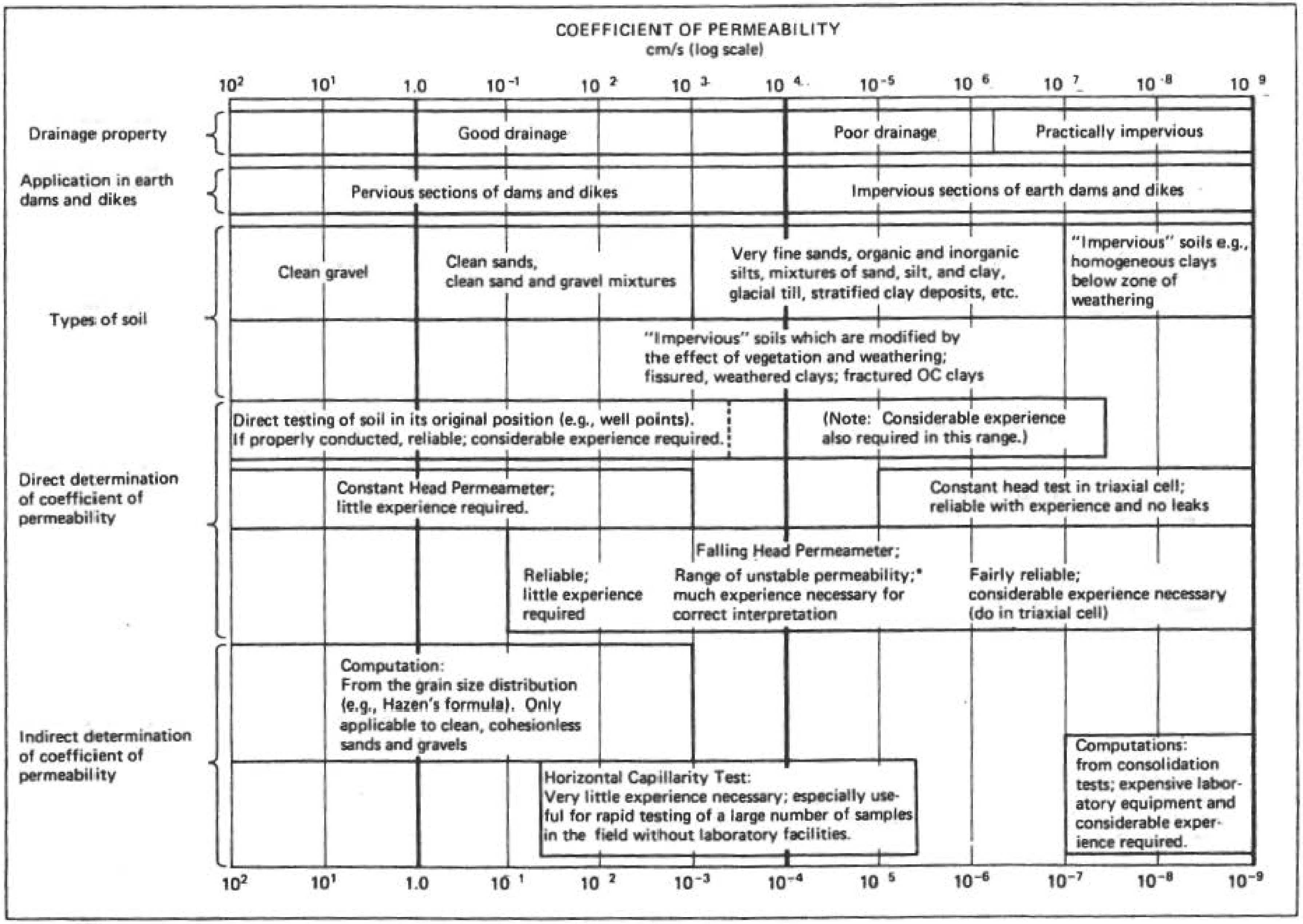
The estimated quantity of gravel materials in Area "1" is 90,000 cubic yards, which can be obtained without stockpiling the impervious material overlining the gravels, and in Area "5", is 381,000 cubic yards, making a total of 471,000 cubic yards.

Talus deposits.

The talus material was tested in a manner similar to that described in the section headed "Gravels". No settlement was noted after the permeability test on any of the samples of talus material. The results of the grain size distribution tests are shown on Drawing C-8563, Sheets 7 through 11, and attached hereto as Plate V. The results of the permeability tests are tabulated below:

Sample Area "3"	% Passing #100 Sieve	% Moisture	Dry Density Lbs/cu ft	Wet Density Lbs/cu ft	Permeability Coefficient Ft/Day
Hole 9, 0-12' Depth	7	8	125.2	135.5	21.2
Hole 11,0-6' "	9	13	116.5	134.0	5.45
Dodson Area					
Pit 1, 0-10' Depth	2	7	118.5	127.2	19.2
Bogus Area					
Pit 1, 10' Depth	8	8	113.3	124.0	10.5
Pit 1, 0-9' "	2	9	112.2	122.5	25.9
Summit Area					
Pit 1, 0-7' Depth	4	9	117.5	128.5	9.65

Attachment C Typical Permeability Ranges



*Due to migration of fines, channels, and air in voids.

Attachment D Direct Shear Test Results

Direct shear tests were performed on each sample by Pittsburgh Laboratories. Results were unobtainable on Type 3 and Type 4 because of shear ring binding and mechanical interlocking of coarse sand particles. It is felt however that the shearing resistance of Types 3 and 4 is very similar to Types 2 and 3 and therefore may be used in design. The shear resistance of Types 1 and 2 are as follows:

Type No.	1	2	Avg.
Cohesion (Tons/sq/ft/)	.37	1.64	1.00
Angle of Internal Friction (Ø)	34.4°	19.4°	26.9°

A stability analysis was made using approximate methods, the above average test values and the section shown on Plate V. This analysis indicates that a factor of safety of approximately 2.25 will be obtained.

The volume of the material available as determined from the drill holes is as follows:

Types 1, 2 and 3	-	96,000 cubic yards
" 4	- - - - - - -	55,000 " "

Field observation indicates that additional material is available on the borders of the areas drilled which is similar to the material tested.

CONCLUSIONS:

It is concluded that the earthen embankment of Big Bend Dam may be constructed of the materials which have been analyzed in this report to the approximate typical section as shown on Plate V, and to specifications attached hereto entitled "Earthwork Specifications for Big Bend Dam" and labelled "Appendix 1".

The impervious core of the embankment, Zone 1, should be constructed of the materials classified in this report as Types 1, 2 and 3. The moisture content of these materials is about 25% and the maximum dry density between 85 and 95 lbs per cubic foot. The "yardstick" for construction should be set for this section at 25% moisture and 90 lbs per cubic foot. As construction progress is made, the "yardstick" may be varied to more closely conform to field results.

Zone 2 of the embankment, the semi-pervious section, should be constructed of the material classified as Type 4. The optimum moisture content of this material is about 18% with a dry density, including the gravel, of 128 lbs per cubic foot. Again, as field results are obtained, this "yardstick" may be varied.

Attachment E Compaction Test Results

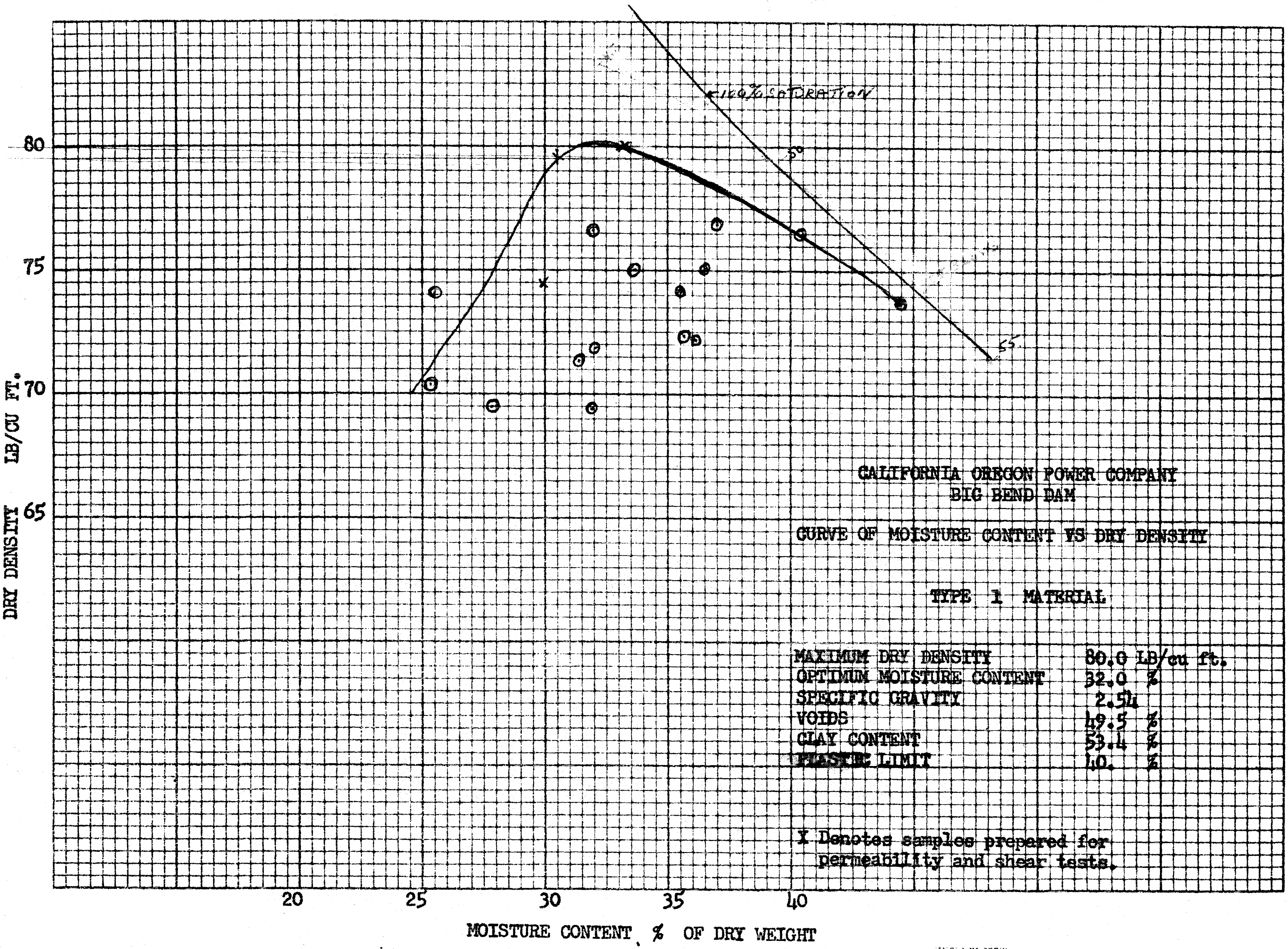
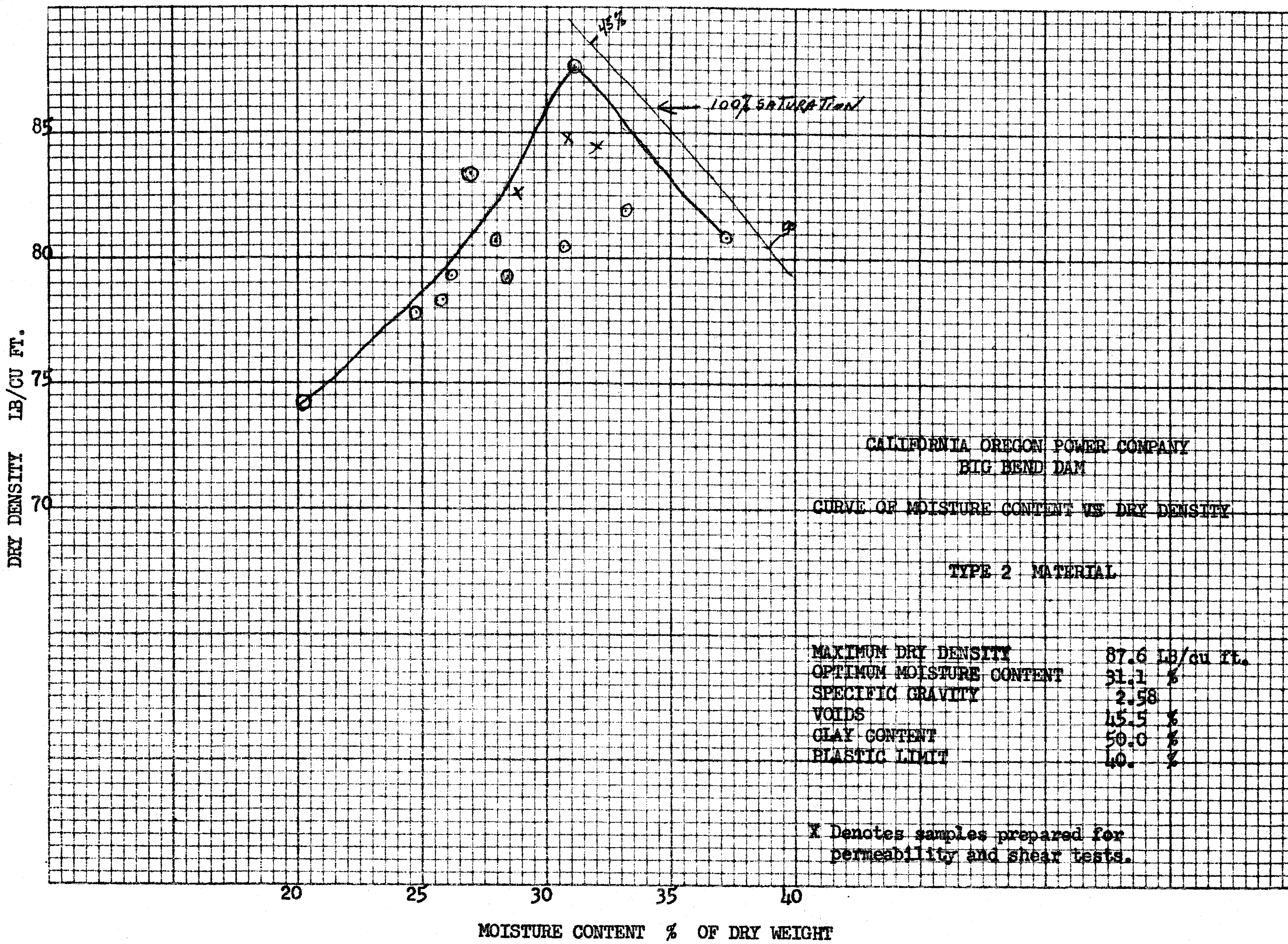


PLATE III - Sheet No. 1



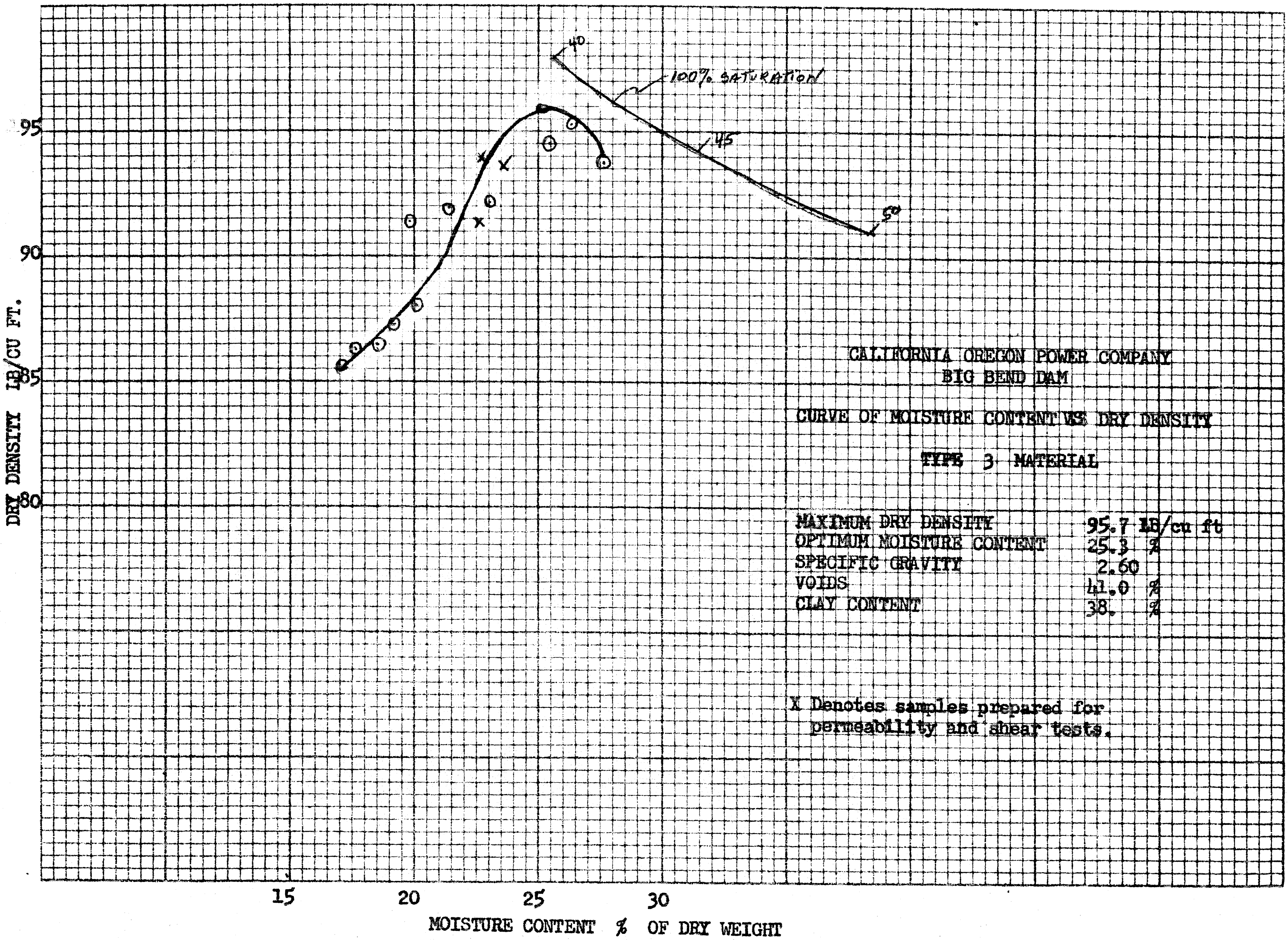
CALIFORNIA OREGON POWER COMPANY
BIG BEND DAM

CURVE OF MOISTURE CONTENT VS DRY DENSITY

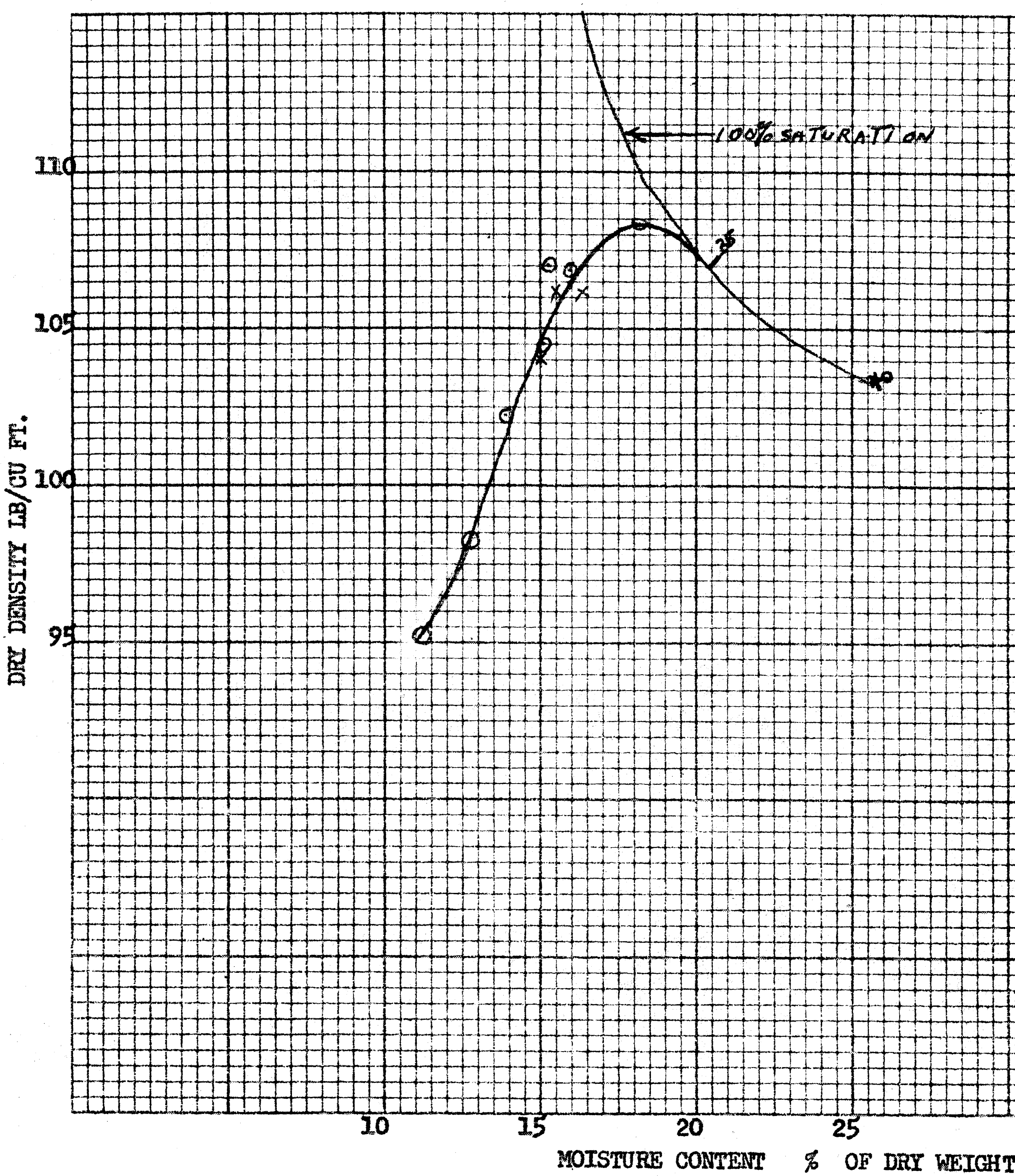
TYPE 2 MATERIAL

MAXIMUM DRY DENSITY	87.6 LB/cu ft.
OPTIMUM MOISTURE CONTENT	31.1 %
SPECIFIC GRAVITY	2.58
VOIDS	45.5 %
CLAY CONTENT	50.0 %
PLASTIC LIMIT	40. %

X Denotes samples prepared for permeability and shear tests.



DRY DENSITY LB/CU FT.
95
90
85
80
15
20
25
30
MOISTURE CONTENT % OF DRY WEIGHT
40
100% SATURATION
45
50
CALIFORNIA OREGON POWER COMPANY
BIG BEND DAM
CURVE OF MOISTURE CONTENT VS DRY DENSITY
TYPE 3 MATERIAL
MAXIMUM DRY DENSITY 95.7 LB/cu ft
OPTIMUM MOISTURE CONTENT 25.3 %
SPECIFIC GRAVITY 2.60
VOIDS 41.0 %
CLAY CONTENT 38. %
X Denotes samples prepared for permeability and shear tests.



CALIFORNIA OREGON POWER COMPANY
BIG BEND DAM

CURVE OF MOISTURE CONTENT VS DRY DENSITY

TYPE 4 MATERIAL

MAXIMUM DRY DENSITY	108.2 lb/cu ft.
OPTIMUM MOISTURE CONTENT	18.0 %
SPECIFIC GRAVITY	2.63
VOIDS	34.0 %
CLAY CONTENT	18. %

X Denotes samples prepared for permeability and shear tests.

Attachment F Permeability Test Results

	In Place Moisture	Clay Content (Percent)	Specific Gravity of Particles	% Finer than #4 Sieve
Avg.	19.7	35	2.64	51
Max.	26.9	48	2.72	63
Min.	14.5	24	2.58	39

Number of Samples - 14.

Note: Material passing the No. 4 sieve was not plastic. Could not roll 1/8" diameter thread due to sand grains. Specific gravity of the rock (larger than #4 sieve) = 2.64.

The curves showing the moisture content dry density relation of the material finer than the No. 4 sieve are shown on Plate III, Sheet #4. At an optimum moisture content of 18%, the dry density was 108.2 lb/cu ft. with 34% voids. When the material passing the No. 4 sieve and the larger material are combined, the theoretical density can be computed as follows:

$$Drs = \frac{Ds\ Dr}{PD_s + (1-P)\ D_r}$$

Where Drs = Theoretical density of combination
Ds = Density of soil
Dr = Density of rock
P = Percentage of rock (expressed as decimal)

$$Drs = \frac{(108.2)\ (62.4)\ (2.64)}{(\ .49)\ \ (108.2) + (\ .51)\ (165)} = 130 \text{ lb/cu ft.}$$

The above value is a theoretical quantity - which normally cannot be obtained in practice due to the interferance to compaction by the rock. A more practical equation is as follows:

$$Drs = (1-P)\ D_s + 0.9\ P\ Dr$$

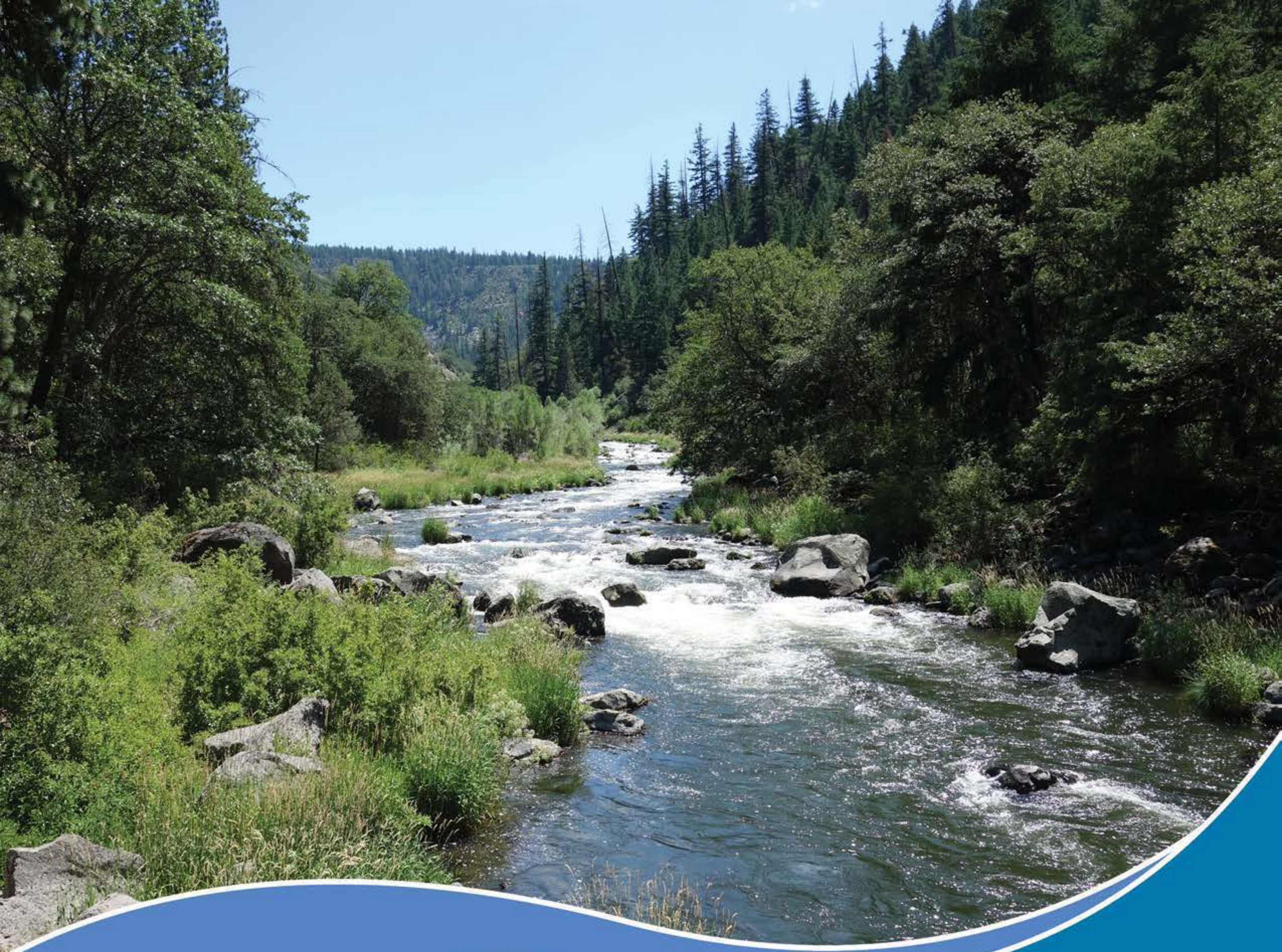
$$Drs = (1-.49)\ 108.2 + 0.9\ \ (\ .49)\ (165) = 128 \text{ lb/cu ft.}$$

II. Qualitative capillarity tests were performed on each of the four types of material. The test consisted of placing a 4" diameter by 4" high compacted sample of the material in a pan of water. In each case the sample of material became saturated in approximately 4 hours. After 48 hours, no sloughing or breakdown of the sample had taken place.

Permeability tests by the falling head method were performed on each type of material by Pittsburgh Testing Laboratories. The permeability was determined to be as follows:

Type 1	-	0.0000187	centimeters	per second
" 2	-	0.0000155	"	" "
" 3	-	0.000226	"	" "
" 4	-	0.00000383	"	" "

These co-efficients of permeability fall within the impervious sections of earth dams or dikes as classified by Casagrande and Fadum, Harvard University. The permeability test on Type No. 4 material was performed on the material passing the No. 4 sieve. While this material seems to have the smallest permeability, the gravel content is so high (50%) as to make the overall material questionable as to watertightness.



Definite Plan for the Lower Klamath Project

Appendix E – Reservoir Rim Stability Evaluation

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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KLAMATH RIVER RENEWAL CORPORATION

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Acronyms and Abbreviations

DEM	Digital Elevation Model
EM	Engineering Manual
ICU-TX	Isotopically Consolidated Undrained Tri-Axial Strength Test
KRRC	Klamath River Renewal Corporation
MC	Modified California Sampler
pcf	Pounds-Force per Cubic Foot
psf	Pounds-Force per Square Foot
SPT	Standard Penetration Test
USACE	United States Army Corp of Engineers

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Chapter 1: Introduction

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1. INTRODUCTION

The purpose of this evaluation is to summarize relevant geologic background information, recent field reconnaissance and explorations, and any assessments or analyses completed to assess reservoir rim stability at J.C. Boyle, Copco No.1 and Iron Gate reservoirs.

When discussing reservoir rim stability during drawdown at the various reservoir locations, it is important to differentiate between the potential for deep-seated large landslides, which could impact residences and other resources adjacent to the rim, and shallower slides of material beneath the current water surface, which would only impact resources within the local limited slide footprint. The methodology used and amount of data available for the current analyses does not allow for the prediction of exactly where and how many of these shallow slides may occur. This evaluation largely discusses the potential for deep-seated landslides, which have the greatest potential to cause large impacts to resource areas. The methodology KRRC used for evaluation of reservoir rim stability included the following steps:

1. A desktop geologic study of the reservoir rims including a literature review of previous geologic studies of the area and a review of available aerial photography.
2. A geologic reconnaissance along the reservoir rims
3. Field investigations and laboratory testing of soil samples in areas with potential instabilities.
4. Analysis of cross-sections and material properties based on available data, geotechnical field investigations, and laboratory testing.
5. Rapid drawdown and other slope stability analyses. The rapid drawdown analysis assumed instantaneous drawdown unless determined that transient analysis was needed.
6. Develop a map showing areas of identified potential impacts.

Based on the United States Army Corp of Engineers (USACE) Slope Stability Engineering Manual (EM-110-2-1902) (USACE, 2003), Table 1-1 shows criteria developed for factors of safety. The following sections summarize geologic conditions and evaluations of the reservoir rims behind J.C. Boyle, Copco No. 1, and Iron Gate dams for potential instability during reservoir drawdown.

Table 1-1 Slope Stability Criteria

Case	Minimum Factor of Safety
Existing Conditions	1.11
Rapid Drawdown	1.15
Long-Term (post drawdown)	1.5
Historical Drawdown	1.11

Notes:

1. Case used as a check of the model. Anything over a factor of safety of 1.1 would be considered acceptable.

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Chapter 2: J.C. Boyle Reservoir

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2. J.C. BOYLE RESERVOIR

KRRC based the assessment presented in this section on preliminary bathymetric data. KRRC will perform additional geologic mapping and interpretation once recently collected bathymetric data is finalized.

2.1 Previous Investigations

Previous investigations are the subsurface geologic data related to J.C. Boyle Dam (Black & Veatch, 1998) and sediment sampling (Shannon & Wilson, 2006). Neither of these investigations were deep enough to provide useful information concerning rim stability. However, based on KRRC's 2017 geologic site reconnaissance and review of existing materials, KRRC determined no additional exploratory borings were required.

2.2 Geologic Characterization

The following discussion of geologic conditions at J.C. Boyle Reservoir is excerpted from PanGEO (2008). Topography for the area around the reservoir is gently sloping (less than 10%) to rolling terrain without many steep slopes other than on stratovolcanoes that are scattered around the region. Upstream and downstream of the dam, the Klamath River has cut a series of deep canyons into the volcanic rocks that mantle this part of northeastern California and southeastern Oregon. These canyons have slopes up to about 60 degrees. Bands of 30 and 40 degree slopes form NW-SE-oriented lineations in the topography; one of these bands forms the upstream boundary of the topographic bowl that the reservoir is located within.

Bedrock geology in the J.C. Boyle area is complex, characterized by inter-fingered volcanic deposits from a variety of sources less than 5 million years old that are part of the High Cascade stratovolcanic deposits. Common lithologies include hard, resistant basalt and basaltic andesite and less resistant volcaniclastic deposits. The area is characterized by several stratovolcanoes (Mount McLoughlin, Chase, Hamaker, Buck, and Surveyor Mountains) as well as dozens of smaller vents that erupted lavas and volcaniclastic materials. Younger alluvium and colluvium (at least 18,000 years old) are present on some of the slopes and as gently sloped terraces around the margins of the reservoir. An outcrop of very light grayish tan diatomite is present along the margin of the reservoir on the north side of the river by the prominent eastward bend. The outcrop is at least 10 feet high and located at the foot of a rounded hill mapped as glacial material. The diatomite is underlain by black sand and is possibly interbedded with volcaniclastic material.

Faulting is prominent in the J.C. Boyle Reservoir area. The faulting appears to display a normal sense of offset associated with the extensional tectonics of the Basin Range geomorphic province. The bowl topography of the reservoir area likely owes its configuration, in part, to being within a down-dropped basin. One prominent fault system is a fault that trends northwest through the northeast corner of the reservoir extent. The fault is down-dropped to the southwest, and the fault forms the southwest boundary of the hard rock canyon located upstream of the reservoir. To the northwest of the dam site, another fault system exists along the east side and through the middle of a prominent hill. This fault appears to mark the west side of the down-dropped block that forms the reservoir basin, as the fault is down to the northeast.

Review of topographic data and reconnaissance of the reservoir slopes indicate that no landslides are present adjacent to the reservoir. Furthermore, the land surface surrounding the J.C. Boyle Reservoir is generally low gradient and underlain by competent materials.

2.3 Conclusions

The geologic reconnaissance of the J.C. Boyle Reservoir rim did not reveal obvious stability problems. Based on the results of the geologic reconnaissance, the historic performance of the slopes above the reservoir level, and the bathymetry, KRRC concluded that deep-seated large landslides are less likely. Therefore, stability analyses for the rim of J.C. Boyle Reservoir are deemed not required to support the preliminary design. Shallower slides could occur in the surficial soil deposits around the reservoir rim and on the reservoir slopes that are currently below the reservoir surface.

Chapter 3: Copco No. 1 Reservoir

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3. COPCO NO. 1 RESERVOIR

Copco No. 1 Dam and reservoir are mostly underlain by volcanic and volcaniclastic rock of the Western Cascades Volcanics group. Younger volcanic rock of the High Cascades Volcanics group is present at the dam site and at the western end of reservoir, as well as on parts of the canyon rim. Quaternary fluvio-lacustrine diatomaceous deposits are present around much of the reservoir rim and in the reservoir bed as terrace deposits with surfaces both above and below the modern reservoir level.

PanGEO (2006) suggests the slight possibility of drawdown-induced block sliding where hard strong volcanic flow rocks are underlain by saturated tuffaceous beds and bedding dips into the valley. Hammond (1983) reports several low to moderate dip angles of volcaniclastic beds into the valley, but there is no evidence of previous slope instability at these locations.

3.1 Historical Investigations and Reservoir Drawdowns

3.1.1 Historical Investigations

The available subsurface geologic data is limited to only the recent reservoir sediment sampling (Shannon & Wilson, 2006). For the investigation, Shannon & Wilson used a barge mounted CME-45 to continuously sample the reservoir sediments using either a pushed piston sampler or a driven MC sampler. No drilling was used to clean the hole between samples and casing was used when needed in a few locations. Twelve explorations were completed in the reservoir, which showed reservoir sediments ranging from 0.5 to 10 feet in thickness. These borings were examined and used to define the sediment thickness in the analysis profiles when applicable. No other useful investigations for rim stability were found.

3.1.2 Historical Reservoir Drawdowns

Copco No. 1 reservoir levels between November 1, 1978, and December 31, 2016, were reviewed by the KRRC for historical occurrences of reservoir drawdown. The three most significant drawdown events occurred in 1982, 2014, and 2015 (see Figure 3-1).

The maximum daily drawdown rate of 2 feet per day occurred in 2014 when the reservoir was drawn down nearly 14 feet. Based on inquiries made to PacifiCorp, slope failures were not observed in connection with the three reservoir drawdown events, although there was no specific effort made to determine whether slope failures occurred (email with Demian Ebert August 2, 2017).

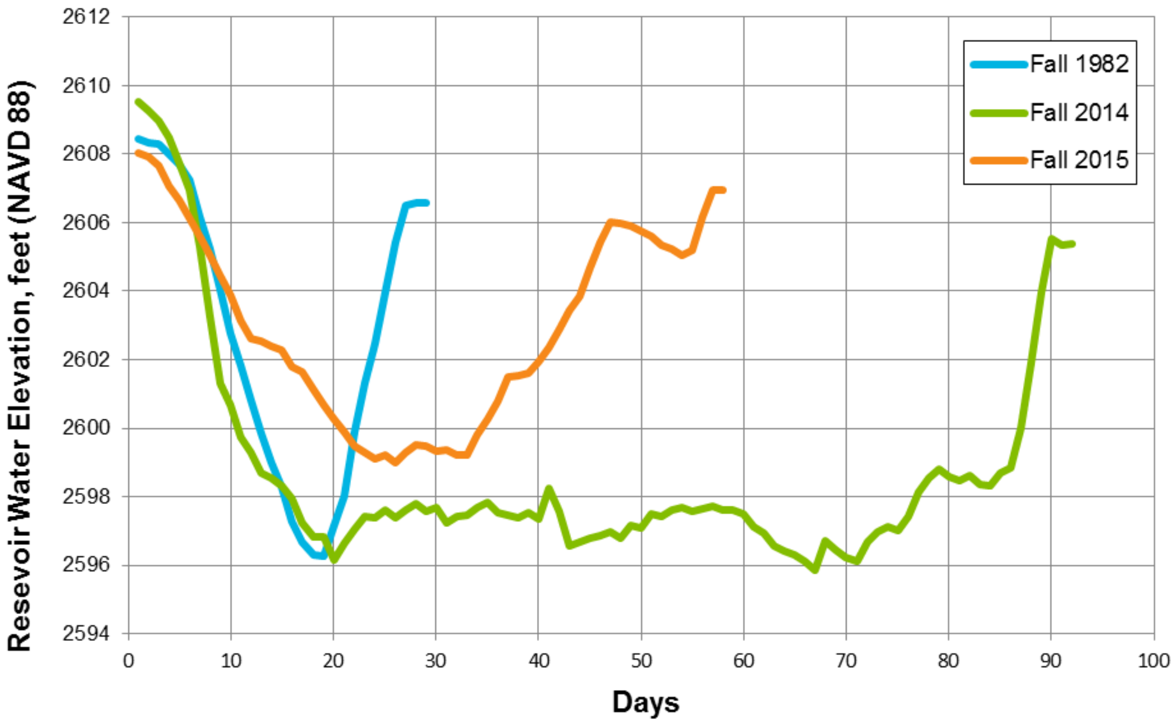

Figure 3-1 Copco Lake Maximum Historical Drawdown Events (1978 to 2016)

3.2 Project Investigations and Laboratory Testing

KRRC performed geologic mapping and a subsurface investigation with lab testing at Copco No. 1 reservoir to characterize and analyze the stability of the fluvio-lacustrine terrace deposits present around much of the rim of the reservoir and within the reservoir bed.

Access to the overland shoreline surfaces was not available, so KRRC performed drilling over water from a small platform barge using a CME-45 drill rig. Ten rotary wash borings were advanced into the reservoir bed between February 1 and 14, 2018, by Taber Drilling of West Sacramento. The boring depths ranged from 12 to 97 feet. Boring locations are shown on the geologic map (Figure 3-2). Table 3-1 summarizes the exploratory boring data, including depth and elevation of volcanic bedrock, where encountered. Boring logs are presented in Attachment B and a summary of the subsurface conditions are presented in Section 3.2.1.

KRRC obtained soil samples using standard penetration test (SPT) and 2.5-inch I.D. modified California (MC) drive samplers and 3-inch diameter thin-walled Shelby tubes. The tubes were advanced by direct push or with a hydraulically activated piston sampler (Osterberg). KRRC recorded blow counts at 6-inch intervals for drive samples and hydraulic gage down pressure necessary to advance Shelby tubes was noted.

Table 3-1 Summary of Exploratory Boring Data

Boring Id No.	Total Depth (feet)	Northing	Easting	Elevation (feet)	Depth to Rock (feet)
BC-01	30.4	2608898	6476516	2593.1	27.5
BC-02	64.6	2608331	6476958	2596.3	63
BC-02	96.5	2606643	6474657	2580.8	>96.5
BC-04	73.5	2604812	6472949	2593.1	69.5
BC-05	20.5	2604139	6474515	2597.8	17.5
BC-06	15.4	2605112	6476050	2574.9	7.5
BC-07	15.9	2605439	6477039	2577.8	15.5
BC-08	11.5	2605190	6480346	2582.4	-
BC-08a	85.2	2605249	6480346	2579.8	83.5
BC-09	70.5	2602526	6483561	2598.2	>71.5
BC-10	43	2604959	6472871	2575.1	39

KRRC sent samples to Cooper Testing Laboratory in Palo Alto, California. Lab testing performed included:

- Moisture Content (ASTM D2216)
- Moisture and Density (ASTM D7263B)
- Atterberg Limits (ASTM D4318)
- Grain Size Analyses with and without Hydrometer (ASTM D6913 & ASTM D7928)
- Percent Fines (ASTM D1140)
- Unconsolidated Undrained Triaxial Strength Test (ASTM D2850)
- Consolidated Undrained Triaxial Strength Test (ASTM D4767m)

The laboratory test results are provided in Attachment C and a summary of the laboratory test results received at the time of writing this report are shown in Section 3.4.1.

3.2.1 Summary of Subsurface Conditions from Borings

Borings encountered between 1 and 11 feet of very soft, recent lake sediments typically consisting of organic rich clayey sand to sandy clay/silt occasionally with coarse sand and small gravel clasts of weak, friable diatomite. The diatomite gravel was encountered at near shore borings and likely was derived from relatively recent bluff erosion along the shoreline.

Below the recent reservoir sediment, all the borings except BC-01 encountered alluvial terrace deposits and/or colluvium consisting of soft/loose to dense/stiff gravels, sands, and clays between 3 feet and 14 feet thick. Cobbles were observed in gravelly layers with a layer primarily of cobbles observed in BC-03.

Below the alluvial terrace deposits/colluvium or recent reservoir sediments, various forms of diatomite or diatomaceous clays were observed in all but borings BC-06 and BC-07, with thicknesses ranging from 6.5 feet in BC-09 to greater than 86 feet in BC-03. The various forms of diatomite encountered included diatomite rock, clayey diatomite, diatomaceous clay, and weakly cemented diatomite pieces.

Finally, below the diatomite or alluvial terrace deposits, volcanic bedrock was encountered consisting of basalt, andesite, cinders, volcaniclastic sandstone, and volcaniclastic/intrusive bedrock of various weathering and strength. While the strength of the volcanic bedrock varied, it was all considerably stronger than the materials above; no coring was performed to retrieve samples for strength testing since failure surfaces during reservoir drawdown are not likely to pass through the bedrock.

3.3 Geologic Characterization

3.3.1 Previous Mapping

Previously published mapping around Copco reservoir include:

- *Volcanic Formations Along the Klamath River Near Copco Lake, Siskiyou County,* PAUL E. HAMMOND, Department of Geology, Portland State University, Portland, Oregon; California Geology, May 1983.
- *Geology of the Macdoel Quadrangle,* HOWEL WILLIAMS , California Division of Mines and Geology Bulletin 151, November, 1949
- *Circular Soil Structures in Northeastern California*, PETER H. MASSON, California Division of Mines and Geology Bulletin 151, November, 1949
- *Geotechnical Report, Klamath River Dam Removal Project, California and Oregon, Project No. 07-153,* PanGEO Incorporated, prepared for Philip Williams & Associates, Ltd. And California State Coastal Conservancy, August, 2008
- *Geologic Map of the Weed Quadrangle,* D. L. Wagner and G. J. Saucedo, California Division of Mines and Geology, 1987)

These maps primarily show bedrock units, with surficial deposits typically not differentiated. Williams shows terrace deposits around Copco reservoir as diatomite and suggests it may have economic value. Wagner and Saucedo show the terrace deposits around Copco reservoir as lacustrine in origin. Hammond provides the most detailed descriptions of volcanic bedrock, but the area covered extends west only to the upstream end of Iron Gate reservoir, and mapping does not differentiate surficial deposits. Hammond also reports a maximum age for Copco basalt of 0.14 million years, based on Potassium/Argon isotope analysis of one sample. No other published ages of the Copco basalt are available.

3.3.2 Geologic and Surficial Mapping

Geologic reconnaissance along public right of ways and at Copco No. 1 dam site was performed several times during summer and fall of 2017. KRRC performed reconnaissance of the reservoir shoreline on October 4, 2017 using a boat and, to a lesser extent, during subsurface investigations in February, 2018.

KRRC used observations made during field investigations, preliminary results of subsurface investigation, and previously published maps to develop a geologic surficial map of Copco reservoir (Figure 3-2). Surficial deposits and landforms were identified on high-resolution topographic (LiDAR, 2010) and bathymetric (GMA, 2018) surface data for the shoreline and reservoir bed areas, respectively. This mapping focused on identifying the full extent of the quaternary lacustrine terrace deposits along the shoreline and any large, deep seated landslides or other areas of potential instability within the shoreline slopes.

Figure 3-2: Geologic Overview of Copco Lake (Attachment A)

Surficial Deposits

Previously undifferentiated surficial deposits around much of Copco reservoir include talus and rockfall debris, colluvium, alluvium and alluvial fans associated with tributary drainages, and older, likely Quaternary, fluvio-lacustrine terrace deposits, described below.

No large-scale landslides have been identified in either the terrestrial or submarine slopes around Copco reservoir by this or previous studies. PanGEO (2008) identified two small to medium-size inactive landslides on the north shore and concluded that these are not likely to be reactivated by reservoir lowering, due to their position above the reservoir rim. One notable feature is a large alluvial fan on the north side of the reservoir, just west of Spannus Gulch. PanGEO (2008) states that the location of this fan between tributary drainages suggests that the feature could be colluvial or landslide related, but if this is the case, the feature is likely ancient and inactive. Additionally, there is a notch in the bedrock at the head of this fan suggesting that the fan was once associated with Spannus Gulch, which now flows down a steeper, bedrock channel to the east. To confirm this interpretation, boring BC-09 was located offshore of the feature and results indicate it is a relatively thin alluvial fan deposit overlying Quaternary lacustrine deposits. For this study, KRRC identified one medium size slide deposit just above the reservoir level on the south shore. This feature appears rocky and is interpreted as a rock slide/fall deposit. Based on the limited extent below the water, low submarine relief and rocky nature of the deposit, it is very unlikely that this feature will be affected by reservoir drawdown.

Surficial deposits and landforms mapped during this study and shown on Figure 3-2 include:

- Active channel alluvium associated with pre-dam Klamath river (Qac)
- Flood plain deposits associated with the pre-dam Klamath river (Qfp)
- Alluvial fans (Qaf)
- Undifferentiated alluvium, usually associated with tributary drainages (Qa)
- Local accumulations of colluvium (Qc)

- Talus deposits (Qtl)
- Landslide deposits (Qls)
- Debris flow deposits (Qdf)
- Fluvio-lacustrine terrace deposits (Qtg, Qt, and Qtl), described below

Fluvio-Lacustrine Terrace Deposits

Fluvio-lacustrine terrace deposits surround much of the shoreline of Copco reservoir, extending to approximately 40 feet above the current reservoir level. These consist of diatomite, fine-grained diatomaceous reservoir sediment and dense, coarse-grained alluvial deposits. The terrestrial (onshore) extent of these deposits has been mapped (see Figure 3-2) by KRRC on modern topography and aerial imagery, based on field reconnaissance and modified from previous mapping by Williams (1949), Hammond (1983), and PanGEO (2008). The diatomite and lacustrine sediments were presumably deposited in a freshwater lake setting formed by volcanic damming of the Klamath River at or near the Copco No. 1 dam site by the 0.14 million-year-old Copco basalt.

Coarse-grained alluvial deposits were encountered on submarine terrace surfaces in borings (BC-03, BC-08/8a, and BC-10) and observed in shoreline deposits in the upstream half of the reservoir, occasionally interbedded with fine-grained lacustrine deposits. In the borings, these deposits ranged from 3 to 8 feet thick, likely representing river deposits after a partial volcanic dam breach with base level several tens of feet higher than that of the modern Klamath River. The degree of weathering and thickness of overlying soil suggest these deposits are geologically old, perhaps as little as a few thousand years younger than the emplacement of the Copco basalt. Upstream alluvial deposits, locally interbedded with diatomaceous lake sediments, are likely of similar age; however, surficial coarse-grained deposits may be much younger.

The most extensive on-shore deposits of diatomite are along the downstream south shore and along the Beaver Creek arm of the reservoir on the north shore where the deposits form a flat-lying to gently dipping surface, into which steep shoreline bluffs have been formed by modern shoreline erosion. Along much of the rest of the shoreline, the diatomite is present as a relatively thin wedge or prism, often with a modern colluvial/alluvial depositional capping layer. In this case, the maximum extent of the deposits was based on elevation and morphology. In other areas, bedrock was exposed at the shoreline and the diatomite was not observed on the slopes, presumably due to wave and/or hillslope and tributary channel erosion. The diatomite along the shoreline and at shallow depths in borings is generally a light gray to light tan colored material which is low density and weak to very weak. In the more extensive deposits, near-vertical bluffs have formed in the diatomaceous deposits as a result of undercutting due to wave erosion and failure of the weak material. In some places, this erosion has exposed volcanic bedrock at the base of the bluffs, indicated with thick black line on Figure 3-2.

Where the toe of the terrestrial diatomite terrace deposit lies above the current high lake level, the response of the slope to rapid drawdown are determined by the properties and geometry of the underlying volcanic and volcaniclastic strata. Where the toe of the terrestrial diatomite terrace deposit lies below the current high lake level, the response of the slope to rapid reservoir drawdown are determined by the properties of the diatomite deposits, the thickness of the diatomite deposits, and the properties of the underlying material. Lacustrine diatomite deposits also exist completely below the current range of reservoir levels, and appear as prominent benches in the bathymetry. Along the south shore, this bench is mostly continuous and ranges between 100 and 300 feet wide. Along the north shore, the terrace bench is wider, with large peninsulas extending to the south with very steep to near vertical side slopes.

Mapped terrace deposits include:

- Quaternary alluvial terrace deposits, with gravels (Qtg)
- Quaternary fluvio-lacustrine terrace deposits, undifferentiated (Qt)
- Quaternary lacustrine deposits (Qtl)

The thickness of lacustrine diatomaceous sediments in borings further from the shoreline indicate that this material is likely present beneath surficial terrace and alluvial fan deposits in the upstream part of the reservoir bed and shoreline areas.

High Cascade Volcanics

Copco Basalt (Qb), a 0.14 million years old intracanyon flow unit (Hammond 1983), outcrops at the west end of the reservoir and likely underlies some of the western (downstream) submarine terrace deposits. This unit erupted from vents on both sides of the Klamath River, damming the river to form a lake that was approximately 35-40 feet higher than the modern reservoir (Hammond 1983). Other Quaternary basalt lava flows (QTb) unconformably overlie the older volcanics of the Western Cascades Group to form the generally flat-lying rim rock at the topo of the slopes around much of Copco No. 1 reservoir, but more prominent to the north.

Western Cascade Volcanics

Volcanic and volcaniclastic bedrock of the Western Cascade Volcanics around the rim include Spannus Ranch Andesite, undifferentiated intrusives, and several members of the Bogus Mountain volcaniclastic beds.

The Spannus Ranch Andesite consists mainly of pyroxene andesite flows with interbeds of lithic breccia (PanGEO 2008).

The Bogus Mountain Beds consist of interstratified tuff-breccia, volcaniclastic sandstone and tuffs, with thinner interbedded andesite flows. The strata tend to be greenish gray, and the tuffs and sandstones are fine to medium grained. One of the basal members of the Bogus Mountain Beds has been dated at roughly 23 million years old (Hammond, 1983).

For this mapping effort, the Western Cascade volcanics are not differentiated and are presented at Tertiary Volcanics (Tv)

3.4 Stability Analyses

This section presents the current results from material characterization, segment and cross section selection, and slope stability analyses. KRRC is still completing analyses and will update this evaluation once they are finalized. KRRC completed the following steps for the analyses:

1. Develop material properties
2. Complete generalized slope stability models assuming diatomite slopes with different slope heights and angles
3. Produce a map highlighting potential areas of instability using a Graphical Information System (GIS) model
4. Select segments
5. Create and analyze a conservatively representative cross section in segments with areas of potential instability

The section s below discuss further details of the analyses.

3.4.1 Material Characterization

Based on blow count data, field descriptions of soils, and laboratory test results, KRRC divided the subsurface materials into three layers, as summarized below. Attachment C provides the laboratory results and Table 3-2 shows the chosen analysis parameters . Attachment B provides blow counts and soil descriptions on the boring logs.

Diatomite

The diatomite consists of a low density material that is significantly weaker than the underlying bedrock materials. In addition, the material has a low permeability (about $1x10^{-6}$ cm/s) and will behave as an undrained material during reservoir drawdown, regardless of the drawdown rate. Several different types of diatomite were observed including a rock like diatomite (referred to as diatomite in the boring logs), diatomite that had more of an elastic silt like behavior (referred to as diatomite with elastic silt in the boring logs), and a weakly cemented diatomite. Properties of the diatomite with elastic silt were chosen to represent all the types of diatomite since it was the most common type observed. Table 3-2 and Figure 3-3 summarize strength testing of the diatomite.

Fluvio-Lacustrine Terrace Deposit with Gravel

In general, the fluvio-lacustrine terrace deposit with gravel is a relatively dense layer of alluvium, colluvium, or lacustrine deposit with significant amounts of gravel. The material generally has a relatively high permeability and will likely behave as a drained material during rapid drawdown. KRRC chose material properties based on lab data (as summarized in Table 3-2 below), blow counts, and material descriptions.

Recent Reservoir Sediments

The recent reservoir sediments generally consist of very soft silt, sand, or clay, which have been deposited since Copco Dam was constructed. KRRC chose material properties based on lab data (as summarized in Table 3-2 below), blow counts, material description, and testing of similar material from other reservoirs.

Volcanic Bedrock

Bedrock was encountered in eight of the ten borings completed. The rock consisted of basalt, andesite, volcanic sandstone, and volcanic cinder from the Copco/Quarternary Basalt and Bogus Mountain Beds formations. The rock is significantly stronger than the diatomite, fluvio-lacustrine terrace deposits, and recent reservoir sediments. The properties of the bedrock were chosen based on field descriptions and laboratory testing of two rock cores completed in Iron Gate Reservoir (see Section 4), and previous experience with similar rock. The strength parameters were calculated using Hoek-Brown (Hoek et. al., 2002) procedures.

Table 3-2 Summary of Material Properties for Slope Stability Analyses

Material	Mositure (%)	Dry Unit Weight (pcf)	Gravel (%)	Sand (%)	Fines (%)	LL	PI
Diatomite[1]	μ: 116.7 N: 22 σ: 40.3	μ: 43.1 N: 17 σ: 15.3	μ: 0.0 N: 7 σ: 0.0	μ: 0.6 N: 7 σ: 0.4	μ: 99.4 N: 7 σ: 0.4	μ: 111 N: 7 σ: 15	μ: 51 N: 7 σ: 40
Fluvio-Lacustrine Terrace Deposit with Gravel	μ: 30.3 N: 3 σ: 4.5	μ: 121.4 N: 2 σ: 5.4	μ: 42.2 N: 3 σ: 37.3	μ: 33.4 N: 3 σ: 27.8	μ: 24.4 N: 3 σ: 34.9	μ: 111 N: 2 σ: 2.8	μ: 51 N: 2 σ: 2.8
Recent Lake Sediments[2]	μ: 38.9 N: 2 σ: 5.9	μ: NA N: 0 σ: NA	μ: 3.5 N: 3 σ: 0.7	μ: 40.3 N: 3 σ: 10.6	μ: 56.1 N: 3 σ: 11.2	μ: 41 N: 2 σ: 10.6	μ: 16 N: 2 σ: 10.6

μ = Mean
N = Number of data points
σ = Standard deviation

1. Does not include weakly cemented diatomite gravel
2. One sample (BC-02, S-01) was removed from statistics due to it being an outlier (more gravelly than others)

Table 3-3 Summary of Material Properties for Slope Stability Analyses

Layer	Unit Weight (pcf)	Undrained (Total) Strength Parameters		Drained (Effective) Strength Parameters	
		Φ (deg.)	C (psf)	Φ' (deg.)	C' (psf)
Recent Reservoir Sediments	90	0	100	-	-
Fluvio-Lacustrine Terrace Deposits with Gravel (Qtg)	120	-	-	35	0
Diatomite (Lacustrine Terrace Deposits, Ql)	82	19.9	660	35.3	150
Volcanic Bedrock	135	-	-	34	1110

Notes:
Φ = friction angle
C = cohesion

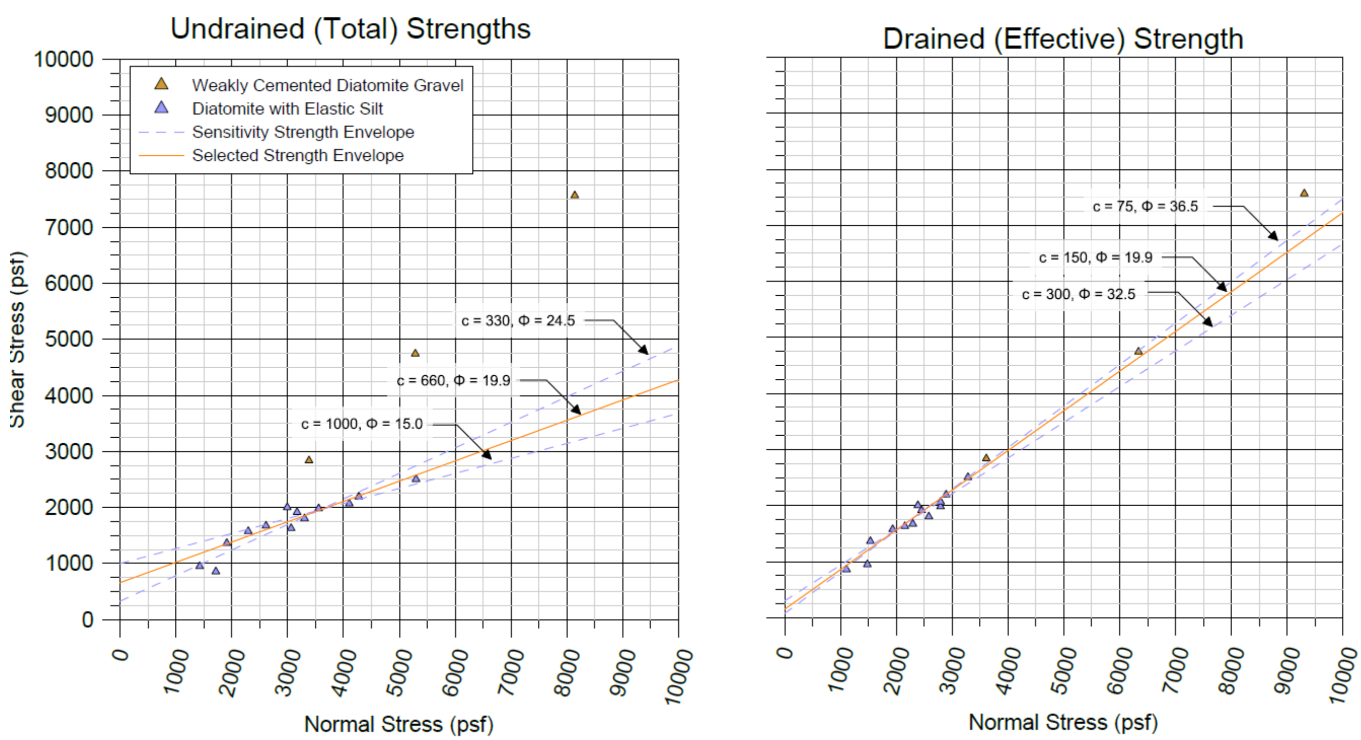

Figure 3-3 Selected Strength Envelopes

3.4.2 Segment and Cross Section Selection

To facilitate the rim stability analysis, KRRC separated the slopes within and around the reservoir rim into segments. Each segment is separated from the previous or following segment by a change in condition that could significantly change the slope stability analysis results. Some changes include a flattening or steepening of the slope, an increase in the slope height, or the mapped extent of the diatomite limiting the slope.

To aid in segment and cross section selection, KRRC performed a GIS analysis using results from a generalized slope stability analysis using the strength parameters in Table 3-3 and the methodology described in Section 3.4.3. In the generalized analysis, KRRC evaluated diatomite slopes of various heights and inclinations, providing a set of slope heights and inclinations that had a potential for instability (factor of safety less than 1.15). KRRC used the slope heights and inclinations in the GIS analysis to produce a map highlighting areas of potential concern, which was then used in segment and cross section selection.

After completing the GIS analysis and selecting segments, cross sections were selected at the most critical portion of each segment, as appropriate. KRRC created cross sections mostly for segments that the GIS analysis showed to be potentially unstable, and KRRC chose a few locations where the GIS analysis showed segments as stable to confirm those results.

Table 3-4 provides a list of the segments selected and some general information about them along with the results of the GIS analysis. Figure 3-4 shows a plan view of the segments and the status of the segment after slope stability analyses, as discussed below.

Table 3-4 Segment Description and GIS Assessment Summary

Segment	Segment Summary				GIS Analysis Result
	Approximate Length (feet)	Average Height (feet)	Average Slope (Horz:Vert)	Segment Differentiation	
N1	2,200	12.5 (range = 0 to 27)	5.2:1 (steepest = 1.2:1)	At downstream edge: by the start of the slope (at the edge of the diatomite) At upstream edge: by a decrease in the slope angle	Stable
N2	2,115	44.8 (range = 20 to 56)	2.5:1 (steepest = 0.3:1)	At downstream edge: by the start of the slope At upstream edge: by a decrease in the slope angle and increase in the slope height	Further Analysis Req.
N3	1340	18.0 (range = 1 to 40)	2.5:1 (steepest = 0.6:1)	At downstream edge by a decrease in the slope height At upstream edge by an increase in the slope height	Stable
N4	1,145	52.0 (range = 33 to 60)	2.8:1 (steepest = 0.3:1)	At downstream edge by a decrease in the slope angle and an increase in the slope height At upstream edge by an increase in the slope angle	Further Analysis Req.
N5	805	49.6 (range = 36 to 54)	2.0:1 (steepest = 0.7:1)	At downstream edge by an increase in the slope angle At upstream edge by a decrease in the slope height	Further Analysis Req.
N6	565	23.9 (range = 6 to 37)	2.7:1 (steepest = 1.1:1)	At downstream edge by a decrease in the slope height At upstream edge by the end of the slope	Stable
N7	400	-	-	At downstream edge by the start of the slope At upstream edge by an increase in the slope height	Not Completed (Further Analysis Required)
N8	2,030	40.0 (range = 11 to 52)	3.4:1 (steepest = 0.5:1)	At downstream edge an increase in the slope height At upstream edge by a decrease in the slope angle	Stable
N9	2,245	37.6 (range = 11 to 51)	3.8:1 (steepest = 1.2:1)	At downstream edge a decrease in the slope angle At upstream edge by an decrease in the slope angle	Stable
N10	2,420	19.8 (range = 9 to 28)	3.3:1 (steepest = 0.7:1)	At downstream edge a decrease in the slope angle At upstream edge by an increase in the slope angle	Not Completed (Further Analysis Required)
N11	925	-	-	At downstream edge an increase in the slope angle At upstream edge by an increase in the slope height	Not Completed (Further Analysis Required)
N12	2,665	28.6 (range = 6 to 43)	2.9:1 (steepest = 0.7:1)	At downstream edge an increase in the slope height At upstream edge by the end of the slope (decrease in the slope angle)	Not Fully Completed (Further Analysis Required)
N13	1,445	20.1 (range = 3 to 28)	3.2:1 (steepest = 1.5:1)	At downstream edge the start of the slope At upstream edge by an increase in the slope angle	Stable

Segment	Segment Summary				GIS Analysis Result
	Approximate Length (feet)	Average Height (feet)	Average Slope (Horz:Vert)	Segment Differentiation	
N14	505	37.6 (range = 1 to 45)	2.4:1 (steepest = 0.2:1)	At downstream edge an increase in the slope angle At upstream edge by a decrease in the slope height (at the edge of the diatomite)	Further Analysis Req.
N15	970	5.6 (range = 0 to 18)	4.5:1 (steepest = 1.8:1)	At downstream edge by a decrease in the slope height (at the edge of the diatomite) At upstream edge by an increase in the slope height (at the edge of the diatomite)	Stable
N16	370	52.0 (range = 16 to 59)	2.4:1 (steepest = 0.9:1)	At downstream edge by an increase in the slope height (at the edge of the diatomite) At upstream edge by a decrease in the slope angle and decrease in the slope height	Further Analysis Req.
N17	1,210	22.7 (range = 2 to 45)	3.7:1 (steepest = 1.1:1)	At downstream edge by a decrease in the slope angle and decrease in the slope height At upstream edge by an increase in the slope height (at the edge of the diatomite)	Stable
N18	1,455	-	-	At downstream edge by the start of the slope (increase in the slope angle) At upstream edge by the end of the slope (decrease in the slope angle)	Not Completed (Further Analysis Required)
N19	985	24.9 (range = 17 to 40)	3.8:1 (steepest = 1.1:1)	At downstream edge by the start of the slope (increase in slope angle) At upstream edge by an increase in the slope angle	Stable
N20	1,015	35.3 (range = 11 to 44)	3.0:1 (steepest = 0.6:1)	At downstream edge by an increase in the slope angle At upstream edge by a decrease in the slope height (edge of the diatomite)	Further Analysis Required
N21	670	9.0 (range = 0 to 15)	5.1:1 (steepest = 0.9:1)	At downstream edge by a decrease in the slope height (edge of the diatomite) At upstream edge by the end of the slope (edge of the diatomite)	Stable
S1	665	70.5 (range = 46 to 87)	3.8:1 (steepest = 0.8:1)	At downstream edge by the start of the slope (at the edge of the diatomite) At upstream edge by a decrease in the slope height (due to an intermediate plateau)	Further Analysis Req.

Segment	Segment Summary				GIS Analysis Result
	Approximate Length (feet)	Average Height (feet)	Average Slope (Horz:Vert)	Segment Differentiation	
S2	555	41.8 (range = 29 to 52)	3.7:1 (steepest = 0.6:1)	At downstream edge by a decrease in the slope height (due to an intermediate plateau) At upstream edge by a decrease in the slope height	Stable
S3	1,020	47.6 (range = 22 to 55)	2.4:1 (steepest = 0.6:1)	At downstream edge by a decrease in the slope height (due to an intermediate plateau) At upstream edge by a decrease in the slope height	Further Analysis Req.
S4	1,190	23.5 (range = 6 to 39)	2.9:1 (steepest = 0.4:1)	At downstream edge by a decrease in the slope height At upstream edge by the end of the slope (decrease in the slope angle)	Further Analysis Req.
S5	445	16.0 (range = 3 to 28)	3.0:1 (steepest = 1.2:1)	At downstream edge by a decrease in the slope height At upstream edge by the end of the slope (decrease in the slope angle)	Stable
S6	1,080	23.5 (range = 5 to 31)	3.0:1 (steepest = 1:1)	At downstream edge by the start of the slope (increase in slope angle) At upstream edge by an increase in the slope height	Stable
S7	350	49.2 (range = 31 to 66)	2.3:1 (steepest = 0.7:1)	At downstream edge by an increase in the slope height At upstream edge by a decrease in the slope angle	Further Analysis Req.
S8	1,410	48.8 (range = 36 to 59)	3.5:1 (steepest = 0.9:1)	At downstream edge by a decrease in the slope angle At upstream edge by a decrease in the slope height	Stable
S9	1,365	28.2 (range = 3 to 51)	2.4:1 (steepest = 0.4:1)	At downstream edge by a decrease in the slope height At upstream edge by an increase in the slope height	Further Analysis Req.
S10	670	66.0 (range = 42 to 79)	2.4:1 (steepest = 0.6:1)	At downstream edge by an increase in the slope height At upstream edge by the edge of observed bedrock along the shoreline	Further Analysis Req.
S11	765	70.0 (range = 32 to 82)	3.6:1 (steepest = 0.8:1)	At downstream edge by the edge of observed bedrock along the shoreline At upstream edge by the start of an intermediate plateau (decrease in slope height)	Further Analysis Req.

Segment	Segment Summary				GIS Analysis Result
	Approximate Length (feet)	Average Height (feet)	Average Slope (Horz:Vert)	Segment Differentiation	
S12	2,445	16.7 (range = 4 to 42)	3.7:1 (steepest = 0.9:1)	At downstream edge by the start of an intermediate plateau (decrease in slope height) At upstream edge by the end of an intermediate plateau (increase in slope height)	Stable
S13	640	20.5 (range = 7 to 29)	2.7:1 (steepest = 1.3:1)	At downstream edge by the start of an intermediate plateau (decrease in slope height) At upstream edge by an increase in the slope angle	Stable
S14	1,945	39.5 (range = 28 to 51)	2.1:1 (steepest = 0.2:1)	At downstream edge by an increase in the slope angle At upstream edge by the end of an intermediate plateau (increase in slope height)	Further Analysis Req.
S15	460	56.3 (range = 10 to 64)	1.9:1 (steepest = 0.2:1)	At downstream edge by the end of an intermediate plateau (increase in slope height) At upstream edge by a decrease in the slope angle	Further Analysis Req.
S16	1,105	35.5 (range = 6 to 44)	2.9:1 (steepest = 1:1)	At downstream edge by a decrease in the slope angle At upstream edge by a decrease in the slope height	Stable
S17	950	12.5 (range = 3 to 19)	3.6:1 (steepest = 1.3:1)	At downstream edge by a decrease in the slope height At upstream edge by the end of the slope (decrease in slope angle)	Stable
S18	1,565	20.7 (range = 5 to 29)	2.8:1 (steepest = 0.2:1)	At downstream edge by the start of the slope (increase in slope height) At upstream edge by a decrease in the slope height (edge of the diatomite)	Further Analysis Req.
S19	1,945	7.3 (range = 0 to 16)	4.5:1 (steepest = 1.2:1)	At downstream edge by the end of the slope (decrease in the slope height) At upstream edge by the end of the slope (decrease in slope angle)	Stable
S20	3,370	18.7 (range = 0 to 30)	3.7:1 (steepest = 0.2:1)	At downstream edge by the start of the slope (increase in slope angle) At upstream edge by the end of the slope (edge of the diatomite)	Stable

3.4.3 Slope Stability Analysis Methodology

The slope stability of individual sections (and the initial generalized analyses) was analyzed using the software SLOPE/W (GeoStudio 2018) and Morgenstern-Price's procedure (with a half-sine function) for the calculation of factor of safety. KRRC used a circular slip surface without optimization for the analyses unless otherwise noted.

The different analyses performed for the sections are discussed below. The rapid drawdown analyses were performed for every section analyzed, while the other existing conditions, long-term (post drawdown), and historical drawdown analyses were only performed on sections that had a factor of safety less than 1.15, to confirm the validity of the model.

Rapid Drawdown

Rapid drawdown analyses were performed using a staged rapid drawdown analysis approach proposed by Duncan et. al. (1990). During rapid drawdown, the stabilizing effect of the reservoir on the slope is absent but the pore water pressures within the slope remain high in materials with low permeability. The high pore pressures in combination with the lack of the stabilizing effect from the reservoir can lead to significantly reduced slope stability.

The diatomite was modeled with undrained shear strength parameters in the analysis. This model approach is reasonable considering the fact that the diatomite would take long time to drain because it has a very low permeability of about $1x10^{-6}$ cm/s. The recent reservoir sediment was also modelled in a similar fashion, although that choice is inconsequential to the stability of the slope overall since it makes up only a small percentage of the slope.

The groundwater was initially set as a horizontal line at Elevation +2,605 feet (the same as the existing conditions) and then drawn down to a horizontal line at the existing thalweg ground surface.

Historical Drawdown

Based on the historical drawdown information shown in Figure 3-1, KRRC performed a rapid drawdown analysis using the same method as the rapid drawdown analyses above but with a water level drop from Elevation +2,610 to +2,596. KRRC used this analysis to verify the model due to the fact that no landslides were observed during any of the previous drawdown events.

Existing Conditions

KRRC performed the existing condition analyses to assess the current stability of the slope. This analysis serves as verification of the model since there are no reported active slope instabilities around Copco No. 1 reservoir. These analyses used the drained (effective) strength parameters for all materials and the groundwater was set as a horizontal line at Elevation +2,605 feet based on the water level in the reservoir at the time of drilling.

Long-Term (Post Drawdown)

KRRC performed the long-term analyses to assess the stability of the slope after all the excess pore pressures from drawdown have dissipated. This analysis was also done to validate the model since the slopes, particularly those submerged in the reservoir, were at least semi-stable before the reservoir was filled. These analyses used drained (effective) strength parameters for the diatomite and groundwater was set as a horizontal line at the existing thalweg ground surface.

3.4.4 Slope Stability Analysis Results

A summary of the results of the slope stability analyses are presented below. KRRC used a factor of safety of 1.15 as the pass/fail criteria due to the critical nature of some areas and the lack of specific data at most of these locations. Figure 3-4 shows a plan view of the current analysis results, and Figure 3-5 shows cross section results for the rapid drawdown analyses.

Sensitivity Analyses

The shear strength of the diatomite is the parameter that has the greatest influence on the slope stability analysis results. Therefore, sensitivity analyses will be performed by assuming different interpretations of the laboratory strength test results for samples of diatomite, as shown in Figure 3-3 and summarized in Table 3-5. Using the strengths shown, any sections with factors of safety between 1.15 and 1.3 will be analyzed and included in the final report.

Table 3-5 Summary of Strength Parameters of Diatomite Used for Sensitivity Analysis

Strength Type	Selected Strength		Lower Cohesion Fit		Lower Friction Angle Fit	
	C (psf)	Φ (degrees)	C (psf)	Φ (degrees)	C (psf)	Φ (degrees)
Drained (effective) Strengths	150	35.3	75	36.5	300	32.5
Undrained (total) Strengths	660	19.9	330	24.5	1000	15

Figure 3-4 Summary of Segment Extents and Current Results (Attachment A)

Figure 3-5 Rapid Drawdown Analysis Cross Sections (Attachment A)

Table 3-6 Stability Analysis Summary

Segment	GIS Analysis Result	Cross Section Details		Slope Stability Analysis Results			
		Maximum Slope (H:V)	Slope Height (feet)	Rapid Drawdown	Historical Drawdown	Existing Conditions	Long-Term Conditions
N2	Further Analysis Req.	In Progress					
N4	Further Analysis Req.	In Progress					
N5	Further Analysis Req.	In Progress					
N7	Not Completed (Further Analysis Req.)	In Progress					
N9	Stable (GIS Analysis Check)	In Progress					
N10	Not Completed (Further Analysis Req.)	1.8:1	65	2.01	-	-	-
N11	Not Completed (Further Analysis Req.)	1.1:1	54	1.71	-	-	-
N12	Not Fully Completed (Further Analysis Req.)	In Progress					
N14	Further Analysis Req.	In Progress					
N16	Further Analysis Req.	In Progress					
N18	Not Completed (Further Analysis Req.)	In Progress					
N20	Further Analysis Req.	In Progress					
S1	Further Analysis Req.	1.9:1 (0.4:1 bluff)	163 (97 from water level)	1.09	1.66	1.53	2.26
S2	Stable (GIS Analysis Check)	In Progress					
S3	Further Analysis Req.	1.6:1	53	1.0	2.87	2.87	1.75
S4	Further Analysis Req.	In Progress					
S7	Further Analysis Req.	In Progress					
S8	Stable (GIS Analysis Check)	In Progress					
S9	Further Analysis Req.	In Progress					
S10	Further Analysis Req.	1.1:1	72	1.03	2.56	2.68	1.62

Segment	GIS Analysis Result	Cross Section Details		Slope Stability Analysis Results			
		Maximum Slope (H:V)	Slope Height (feet)	Rapid Drawdown	Historical Drawdown	Existing Conditions	Long-Term Conditions
S11	Further Analysis Req.	1.9:1	159 (81 from water level)	0.99	1.89	1.38	2.18
S14	Further Analysis Req.	In Progress					
S15	Further Analysis Req.	In Progress					
S18	Further Analysis Req.	0.7:1	29	1.39	-	-	-

3.4.5 Future Analyses and Investigations

While the analyses discussed above are still preliminary, the results indicate that certain areas or segments may have the potential for slope instability as a result of the project activities. Some of these segments are below the current reservoir water surface, and slope failures within these segments would not impact existing roads or private property/structures. KRRC does not propose additional field investigations for these segments.

For other segments, slope failure could result in impacts to existing roads or private property/structures. For each of these segments, KRRC will complete a boring or borings during the summer of 2018. KRRC will use boring logs and laboratory data to update the stability analyses completed to date to better understand the potential for slope failure and any project actions that may be required to offset the impact.

In addition to field investigations above, KRRC may complete additional analyses along certain segments, as appropriate, including:

- Deformation analysis of select profiles, as necessary, to assess the impact area of potential slope failures
- Sensitivity analyses of the impact of variations in the strength of the diatomite on the slope stability analysis results (as mentioned above)
- Analyses of possible engineered solutions (retaining wall, etc.), as appropriate

3.5 Conclusions

When discussing reservoir rim stability during drawdown, it is important to differentiate between the potential for deep-seated large landslides along the reservoir rim that could impact roads or property, and slides of material beneath the current water surface, which would only impact resources within the local limited slide footprint.

Minor, shallow slides of existing material beneath the existing reservoir water surfaces are possible during drawdown. These minor slides would not extend outside of the current reservoir footprint and would only potentially impact resources within the limited slide footprint (e.g. cultural resources). Some larger deeper slides are also possible within Copco No. 2 reservoir where submerged higher bluffs exist along the original Klamath River channel. These shallow slides and potential slides along the river channel pose no threat to roads or private property; however, KRRC will monitor these areas during and post-drawdown to assess any potential impact to existing cultural resources.

The geologic assessment and slope stability analysis summarized above indicate that certain segments along the Copco No. 1 reservoir rim have a potential for slope failure that could impact existing roads and/or private property. In some areas, the impact could be relatively minor, while in other areas the impact could be greater. Based on the referenced analysis, approximately 3,700 linear feet of slopes along Copco Road (north shore segments S4, S9, S11 and S15), and approximately 2,800 linear feet of slope adjacent to private property (along south shore – segments N9, N14, N16and N14) require additional field investigation and analysis to gain a more refined understanding of slope stability in those areas. Up to eight parcels along the referenced segments appear to have existing habitable structures that could potentially be impacted.

Additional field geologic data is required to confirm the potential for slope failure along the referenced reservoir rim segments. KRRC will complete the additional field investigation in July and August of 2018, followed by completion of a series of material property laboratory tests. KRRC will use results from the field investigation and laboratory testing to update stability assessments in the rim segments of concern in fall 2018. Should additional study determine that there is a high probability of slope failure in any of these areas, KRRC will consider the following actions to offset potential impacts:

1. For segments along Copco Road:
    a) Re-align of road segment away from rim slope
    b) Engineer structural slope improvements (e.g. drilled shafts or other structural elements that could be installed to resist slope movement)
2. For segments adjacent to property or structure:
    a) Move structure or purchase property
    b) Engineer structural slope improvements (e.g. drilled shafts or other structural elements that could be installed to resist slope movement)

Based on the low permeability of the diatomite, changing the drawdown rate would have minimal impact on the rapid drawdown stability analysis results. Therefore, KRRC is not proposing to limit the drawdown rate for drawdown of Copco No. 1 reservoir.

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Chapter 4: Iron Gate Reservoir

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4. IRON GATE RESERVOIR

4.1 Historical Investigations and Drawdowns

4.1.1 Historical Investigations

Historic subsurface geologic data at Iron Gate reservoir includes sediment sampling completed in 2006 (Shannon & Wilson, 2006). None of the borings for this previous investigation were deep enough to provide information useful for reservoir rim stability analysis.

4.1.2 Historical Drawdowns

Iron Gate Reservoir levels between January 1, 1979, and December 31, 2016, KRRC reviewed for historical occurrences of reservoir drawdown. The four most significant drawdown events occurred in the falls of 2004, 2014, 2015, and 2016 (see Figure 4-1).

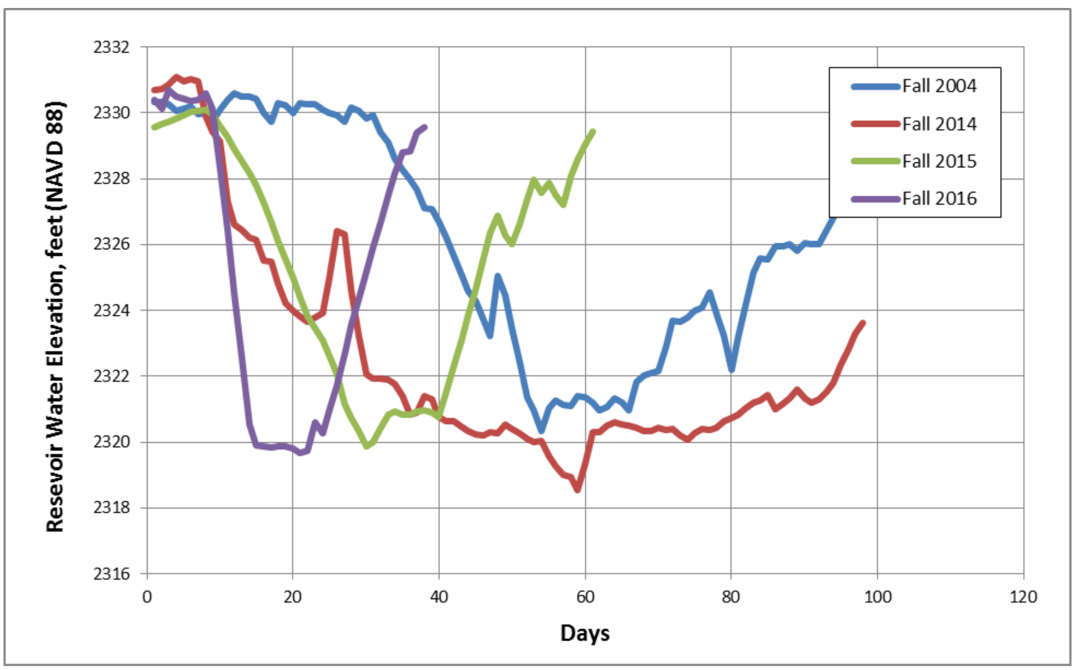

Figure 4-1 Iron Gate Reservoir Maximum Historical Drawdown Events (1979 to 2016)

The magnitude of the drawdowns ranged from about 9 feet to 14.5 feet. The maximum daily drawdown rate of 2 feet per day occurred in 2014. Based on inquiries made to PacifiCorp, there were no reported slope failures resulting from these drawdowns (email with Demian Ebert August 2, 2017).

4.2 Project Investigations

KRRC performed geologic mapping and subsurface investigations at Iron Gate Reservoir to characterize past landslides and for design of the replacement Yreka waterline.

Drilling within the reservoir area was performed over water from a small platform barge using a CME-45 drill rig for borings BI-01 and BI-03. Land-based drilling was performed with a truck-mounted CME-75 drill rig for BI-02. Taber Drilling of West Sacramento advanced the three rotary wash borings between February 20 and 23, 2018. The boring depths ranged from 22.2 to 67 feet. Figure 4-2 shows boring locations. Table 4-1 summarizes the exploratory boring data, including depth and elevation of volcanic bedrock, where encountered. Attachment A provides boring logs. KRRC obtained soil samples using standard penetration test (SPT) and 2.5-inch I.D. modified California (MC) drive samplers. KRRC recorded blow counts at 6-inch intervals for drive samples.

Table 4-1 Summary of Exploratory Boring Data (Iron Gate Reservoir)

Boring Name	Total Depth (feet)	Northing	Easting	Elevation (feet)	Depth to Rock (feet)
BI-01	22.2	2600814	6450534	2315.1	11.5
BI-02	67	2602024	6461383	2326.7	17.5
BI-03	35.1	2601812	6461399	2302.2	3.8

4.2.1 Summary of Subsurface Conditions

Boring BI-01 was completed to assess the rim stability around Iron Gate Reservoir. The boring encountered approximately 2 feet of recent lake sediment consisting of lean clay with organics which overlay approximately 9.5 feet of colluvium/residual soil consisting of lean clay. Below the colluvium/residual soil the boring encountered volcanic bedrock consisting of basalt and volcaniclastics.

Borings BI-02 and BI-03 were advanced as part of the design of the replacement Yreka waterline. While not directly related to rim stability, the results of these explorations were useful to develop estimates of rock strength for the analyses around Copco No. 1 reservoir. The two borings showed approximately 3.8 (BI-03) to 17.5 (BI-02) feet of alluvium (older and younger) consisting of lean clay with varying amounts of sand and gravel, clayey sand with gravel, and poorly graded gravel. Volcanic bedrock consisting of tuff breccia underlay the alluvium.

4.3 Geologic Characterization

4.3.1 Previous Mapping

Previously published geologic mapping of the Iron Gate Dam and lake area include:

- *Volcanic Formations Along the Klamath River Near Copco Lake, Siskiyou County,* PAUL E. HAMMOND, Department of Geology, Portland State University, Portland, Oregon; California Geology, May 1983.
- *Geology of the Macdoel Quadrangle,* HOWEL WILLIAMS , California Division of Mines and Geology Bulletin 151, November, 1949
- *Geotechnical Report, Klamath River Dam Removal Project, California and Oregon, Project No. 07-153,* PanGEO Incorporated, prepared for Philip Williams & Associates, Ltd. And California State Coastal Conservancy, August, 2008.
- *Geologic Map of the Weed Quadrangle,* D. L. Wagner and G. J. Saucedo, California Division of Mines and Geology, 1987)

PanGEO (2008) provide a thorough description of regional and local geology for Iron Gate area, including a geologic map compiled from Williams (1949) and Hammond (1983) that includes structural data from site reconnaissance in a 2008 Geotechnical Report for this project. Pertinent data is included in this evaluation.

4.3.2 Geologic and Surficial Mapping

Iron Gate Dam and its reservoir lie entirely within the Western Cascades geologic province. Hammond (1983) suggests that the volcaniclastic formation that he informally named the Beds of Bogus Mountain extends into the Iron Gate area (PanGEO 2008). Bedrock units include tuffaceous siltstones and sandstones, bouldery volcaniclastics and volcanic breccia, rhyolite tuff and tuff breccia, and pyroxene flow rocks. Geologic reconnaissance indicates generally shallow bedrock with a thin soil mantle. Surficial geologic units including landslide and alluvial deposits are not differentiated from the underlying volcanic rocks in previously published mapping.

PanGEO (2008) identified three possible landslide related features on the south rim of the reservoir (Figure 4-2), and characterized these as “weakly suggestive of old landslides ranging from small slumps only a few meters in size up to possible slides covering several square miles”. These existing features are considerations in the rim stability conclusions described in Section 4.4.

For this study, the KRRC reviewed the 2010 LiDAR-derived terrestrial digital elevation model (DEM), recently acquired high-resolution bathymetric survey data (GMA, 2018), and pre-dam stereoscopic aerial photographs (1944 and 1951) for the entire lake area. KRRC used these data to develop a detailed surficial geologic map (Figure 4-2). While some bedrock and structural data is included in this mapping, the primary intent is to identify larger surficial deposits along the lakeshore and in lake bed that could become unstable during drawdown. In addition to DEM and photo review, KRRC performed site reconnaissance along public roadways around the reservoir during the week of June 5, 2017, and the week of July 24, 2017. KRRC performed additional reconnaissance of the lake shoreline on October 5, 2017 using a small powered row boat. Based on preliminary reconnaissance, before bathymetric surveys were performed, boring BI-01 was located to investigate the toe zone of a possible landslide identified by PanGEO (2008). As noted in Section 4.2.1, the results of this boring did not indicate a slide deposit and encountered volcanic bedrock approximately 10 feet below the pre-dam surface.

Features previously identified by PanGEO as well as several other features with possible landslide morphology identified by the KRRC are delineated as shown on Figure 4-2. These features appear unchanged from 1944 and 1951 historical aerial photographs, and do not show indications of recent activity on the LiDAR/Bathymetric DEM. The morphology of the two larger features appears more consistent with differential erosion of different volcanic/volcaniclastic bedrock units or in the case of the western feature, possible volcanic flow collapse during or immediately after emplacement. The third, smallest potential landslide identified by PanGEO (2008) may represent a small, dormant slide, but the narrow width indicates a rather shallow slide surface that, if reactivated, does not pose a significant hazard.

The reservoir slopes in the area downstream of Jenny Creek exhibit some degree of bench and scarp morphology, sometimes associated with large, deep-seated landslides. The prevalence of outcrops with variable volcanic rock lithologies, the lack of indications recent activity, and consistent appearance on historic aerial photographs suggests that this morphology is most likely the result of bedrock structure, including volcanic flow rock emplacement, and differential weathering. Some of the bench surfaces may also be the result of past fluvial erosion.

One larger, likely landslide was identified along Copco Road within the peninsula between the east and west arms of the reservoir. KRRC based the identification on the presence of a subdued, 10- to 20-foot high break in slope that may represent the head scarp of a dormant, block-slide type feature. This feature does not have any indication of recent slope movement and is unchanged in historic aerial photos. As KRRC interprets the toe of this feature to lie in a small tributary drainage above the reservoir rim, it is very unlikely to be affected by drawdown.

Figure 4-2: Geologic Overview of Iron Gate Reservoir (Attachment A)

4.4 Conclusions

Much of the bedrock mapped around the rim of Iron Gate Reservoir consists of volcanic flow rock, rhyolite tuff and tuff breccia. The extent and morphology of these outcrops and general lack of surficial deposits suggest a shallow weathering profile that is interpreted to form generally stable reservoir slopes under drawdown conditions. Existing structural data (PanGEO 2008) and reconnaissance performed by the KRRC are in line with this interpretation.

Beds of Bogus Mountain are mapped at the very upstream end of the reservoir, but the outcrop pattern and structural measurements indicate the beds strike normal to the slope and dip gently to the east. PanGEO (2008) mapped volcaniclastic beds on the northwest arm of the reservoir, to the north and east of Juniper Point, dipping gently to the west. On the west facing, eastern slope of the reservoir, this orientation has the potential for structural block slide slope failure, however, the gentle slope, lack of historical movement and very low submarine relief indicate this type of failure is very unlikely in this area.

Shallower slides are likely to occur in the shallow surficial deposits around the reservoir rim and on the reservoir slopes that are currently below the reservoir surface. Small, shallow soil failures in the more deeply weathered volcaniclastic beds and in colluvial deposits present a minor hazard to Copco Road where the road is immediately adjacent to the shore. These slope failures are likely to be shallow and local, but may possibly require minor repair to maintain full use of the roadway. Minor repair may include installation of riprap on slope adjacent to Copco Road and/or road surface rehabilitation.

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Chapter 5: References

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Attachment A Figures

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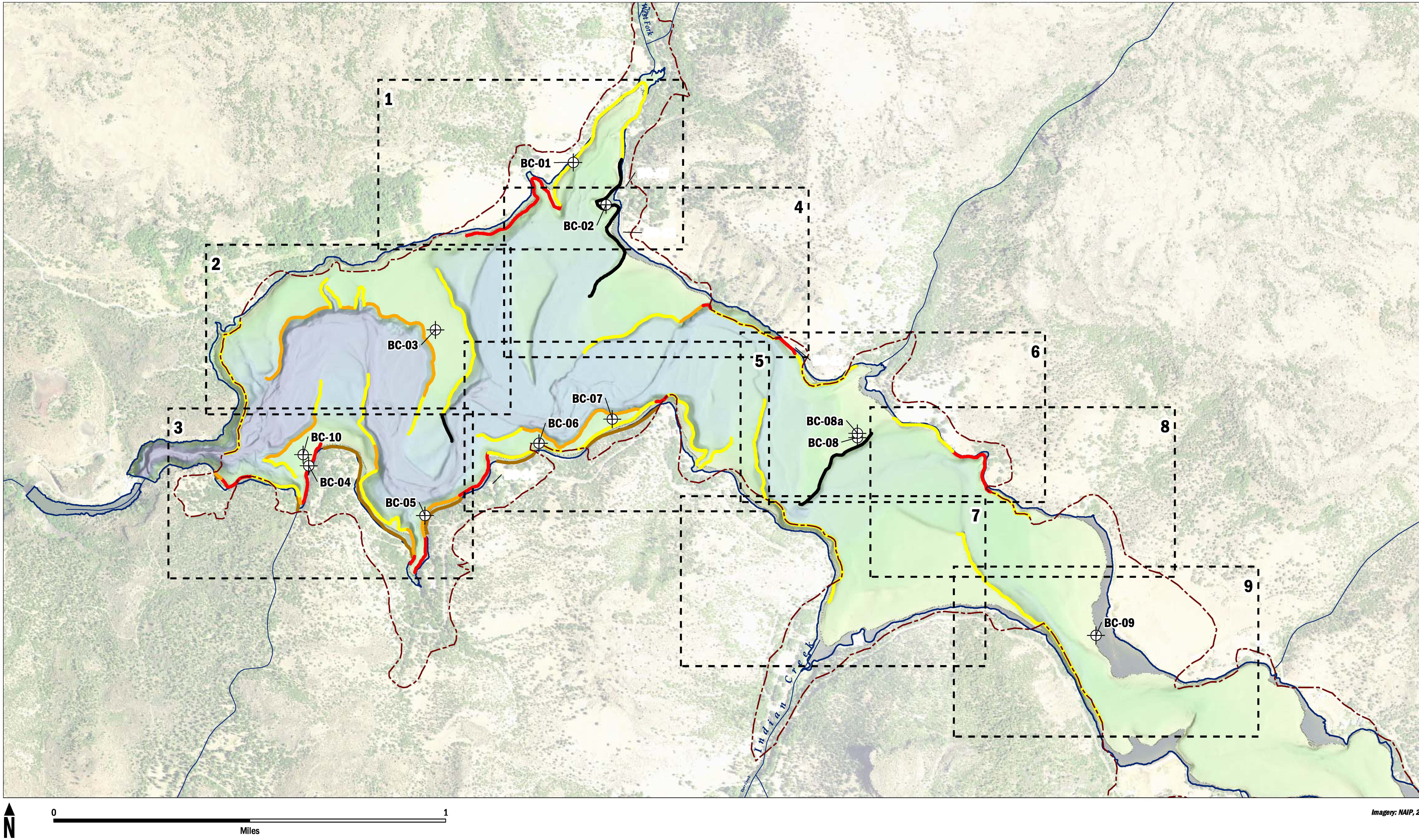
FIGURE 3-2
Geologic Overview of Copco Lake



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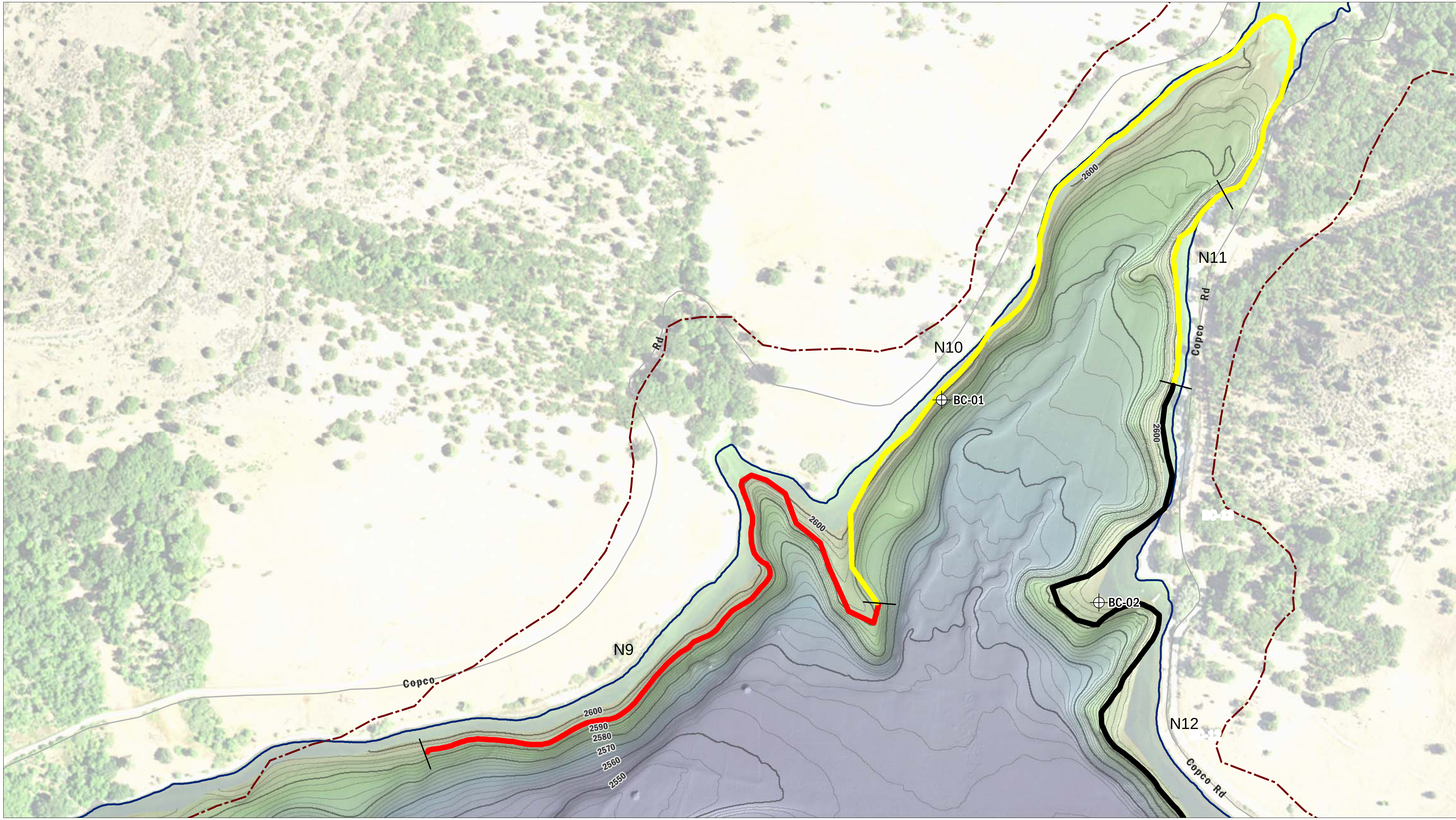
Borings
Mapbook Sheet Extent
Extent of Fluvio-Lacustrine Deposits
Volcanic Rock Exposed in Shoreline Notch
Current Reservoir Shoreline

Slope Failure Analysis Features
Incomplete Analysis
Stable Slope
Potentially Unstable Slope (failure contained within reservoir)
Potentially Unstable Slope

FIGURE 3-4
Copco Dam - Slope Failure Analysis
Overview Map



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Feet

Imagery: NAIP, 2014

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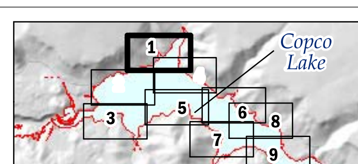


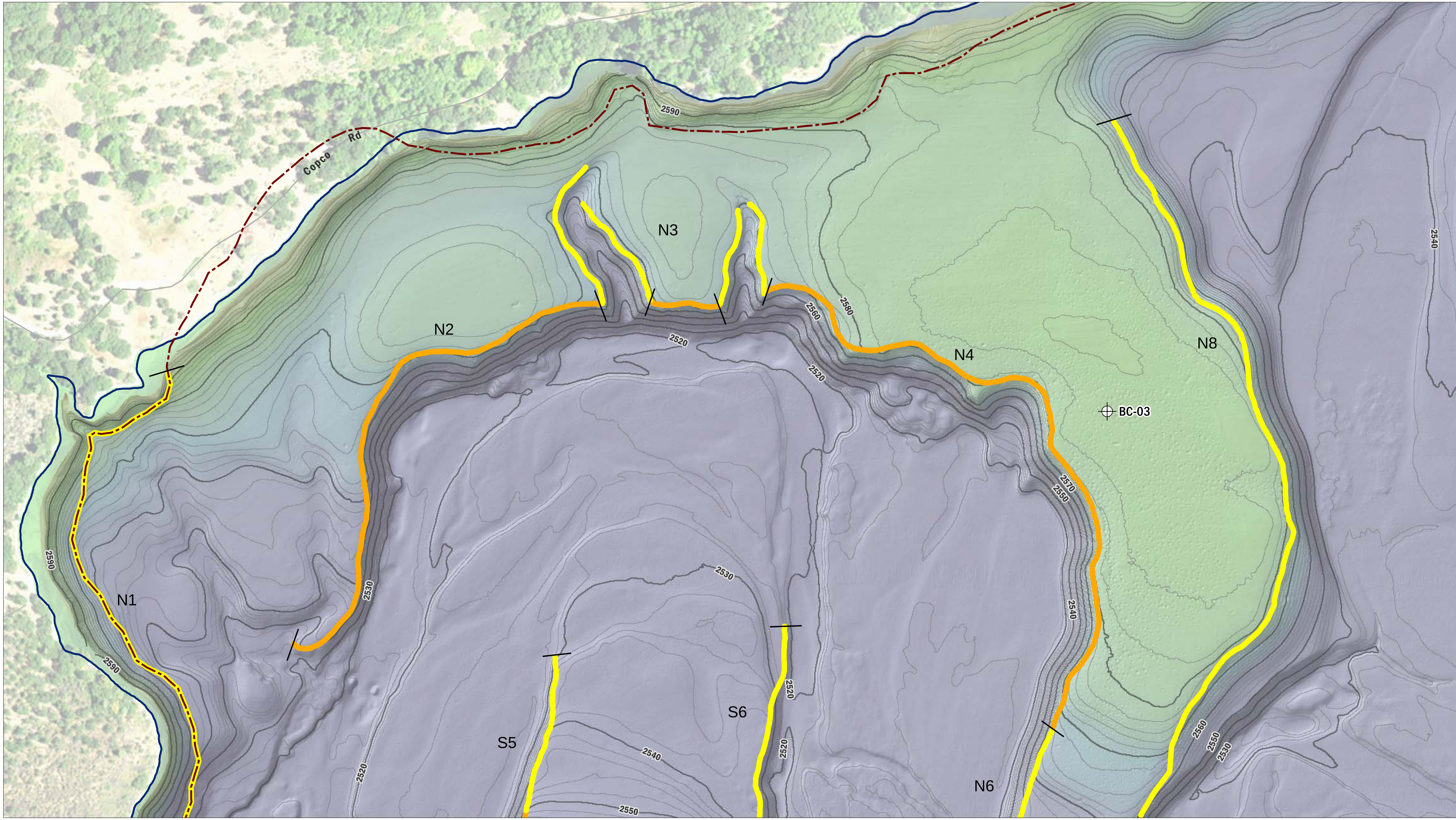
Borings
Extent of Fluvio-Lacustrine Deposits
Current Reservoir Shoreline

Slope Failure Analysis Features
Incomplete Analysis
Stable Slope
Potentially Unstable Slope

Bathymetric Contours
2 ft.
10 ft.

Segment Information
Segment Extents
N1 Segment Names

FIGURE 3-4
Copco Dam - Slope Failure Analysis
Sheet 1 of 9



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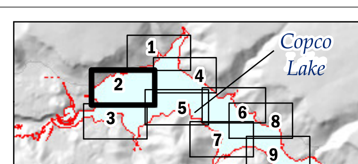


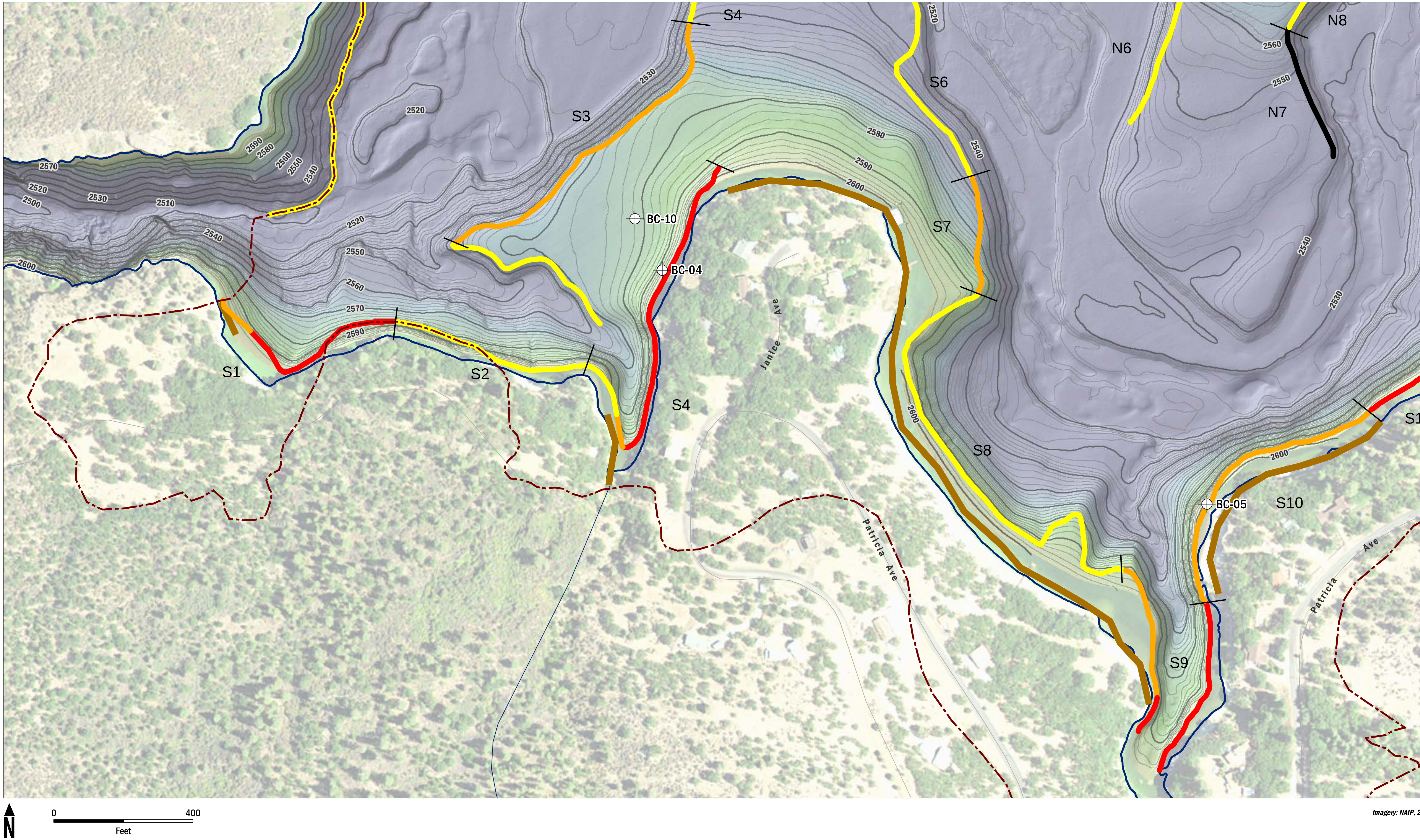
Borings
Extent of Fluvio-Lacustrine Deposits
Current Reservoir Shoreline

Slope Failure Analysis Features
Incomplete Analysis
Stable Slope
Potentially Unstable Slope (failure contained within reservoir)

Bathymetric Contours
2 ft.
10 ft.

Segment Information
Segment Extents
N1 Segment Names

FIGURE 3-4
Copco Dam - Slope Failure Analysis
Sheet 2 of 9



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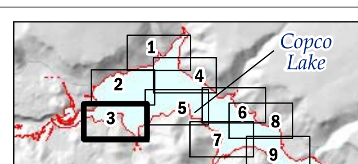


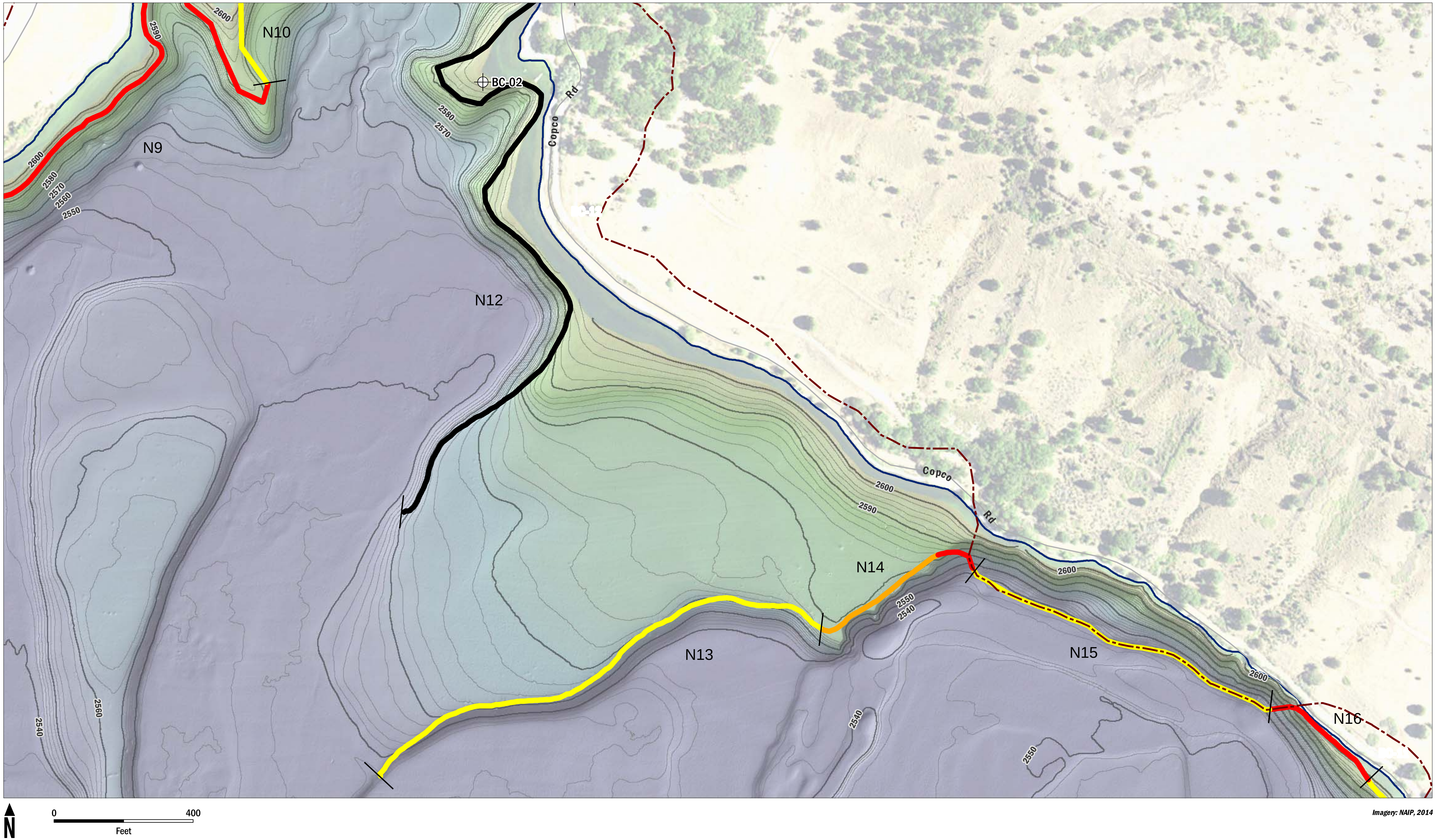
Borings
Extent of Fluvio-Lacustrine Deposits
Volcanic Rock Exposed in Shoreline Notch
Current Reservoir Shoreline

Slope Failure Analysis Features
Incomplete Analysis
Stable Slope
Potentially Unstable Slope (failure contained within reservoir)
Potentially Unstable Slope

Bathymetric Contours
2 ft.
10 ft.

Segment Information
Segment Extents
N1 Segment Names

FIGURE 3-4
Copco Dam - Slope Failure Analysis
Sheet 3 of 9



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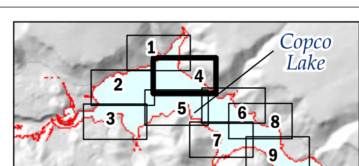


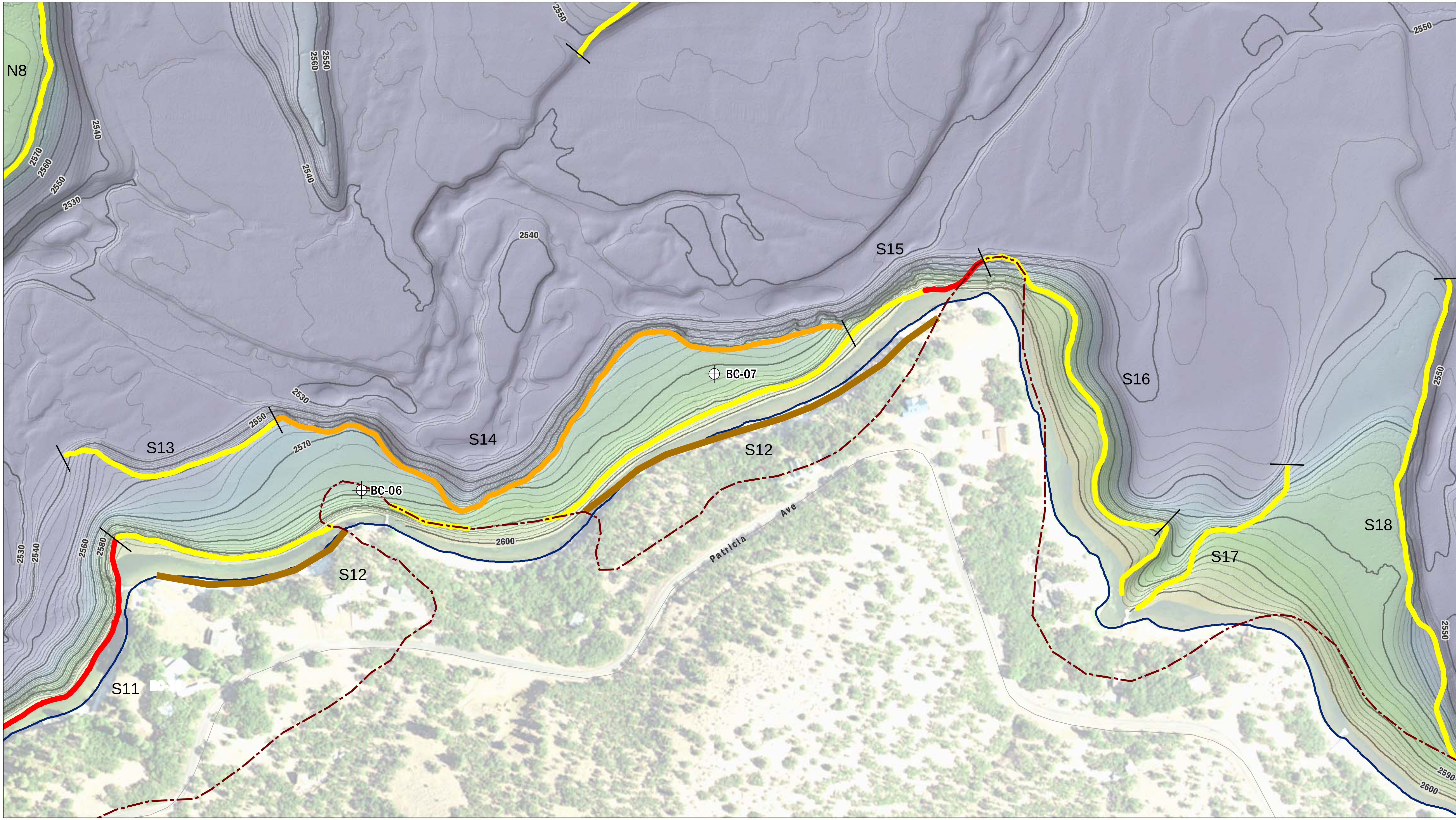
Borings
Extent of Fluvio-Lacustrine Deposits
Current Reservoir Shoreline

Slope Failure Analysis Features
Incomplete Analysis
Stable Slope
Potentially Unstable Slope (failure contained within reservoir)
Potentially Unstable Slope

Bathymetric Contours
2 ft.
10 ft.

Segment Information
Segment Extents
N1 Segment Names

FIGURE 3-4
Copco Dam - Slope Failure Analysis
Sheet 4 of 9



N
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Feet

Imagery: NAIP, 2014

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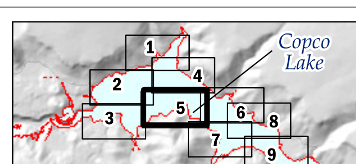
Klamath River Renewal Project



Borings
Extent of Fluvio-Lacustrine Deposits
Volcanic Rock Exposed in Shoreline Notch
Current Reservoir Shoreline

Slope Failure Analysis Features

Stable Slope
Potentially Unstable Slope (failure contained within reservoir)
Potentially Unstable Slope

Bathymetric Contours

2 ft.
10 ft.

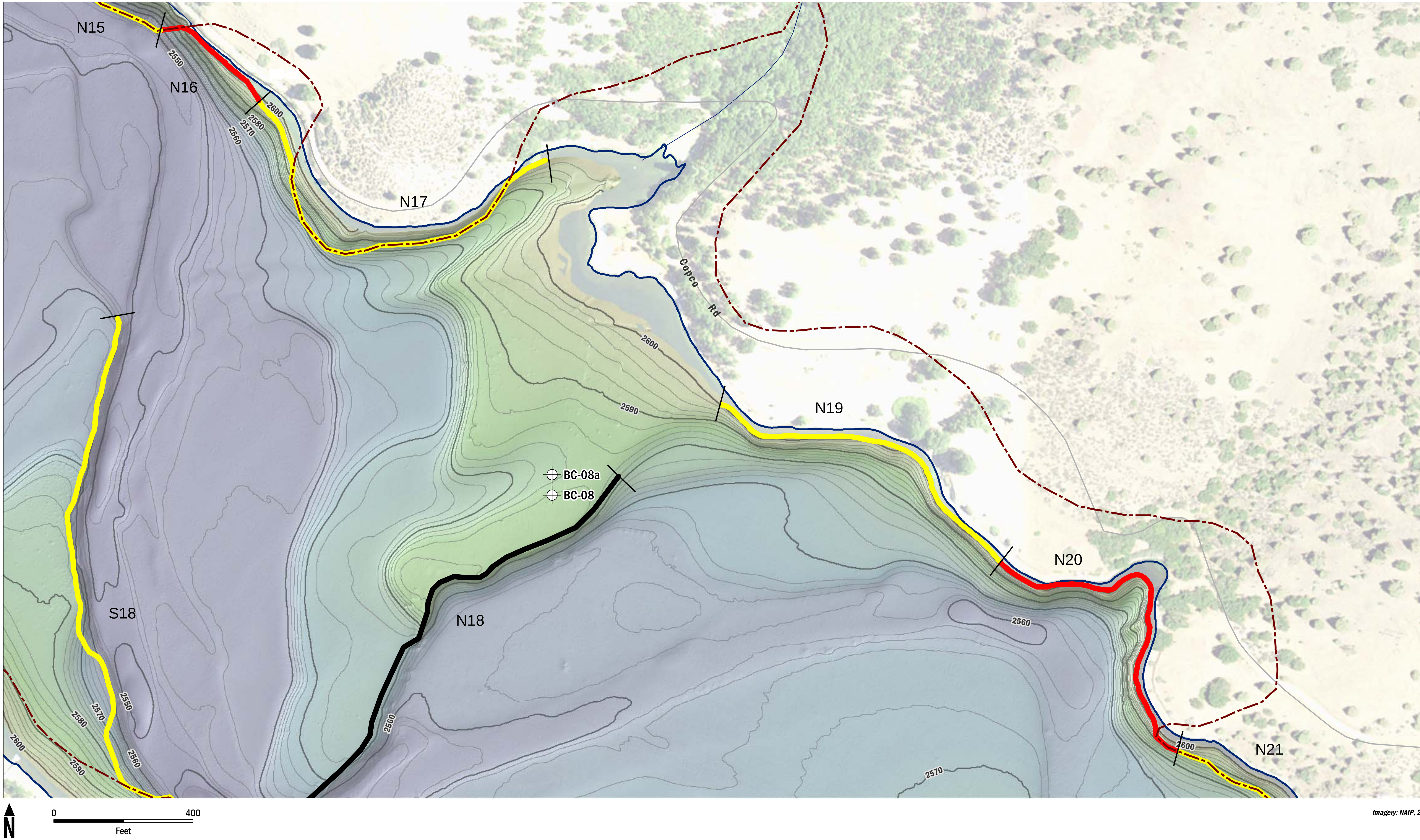
Segment Information

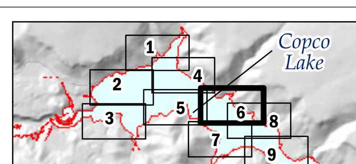
Segment Extents
N1 Segment Names

FIGURE 3-4

Copco Dam - Slope Failure Analysis

Sheet 5 of 9





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Borings
Extent of Fluvio-Lacustrine Deposits
Current Reservoir Shoreline

Slope Failure Analysis Features
Incomplete Analysis
Stable Slope
Potentially Unstable Slope

Bathymetric Contours
2 ft.
10 ft.

Segment Information
Segment Extents
N1 Segment Names

FIGURE 3-4

Copco Dam - Slope Failure Analysis

Sheet 6 of 9

Imagery: NAIP, 2014

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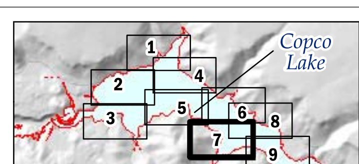
Klamath River Renewal Project



Extent of Fluvio-Lacustrine Deposits
Current Reservoir Shoreline

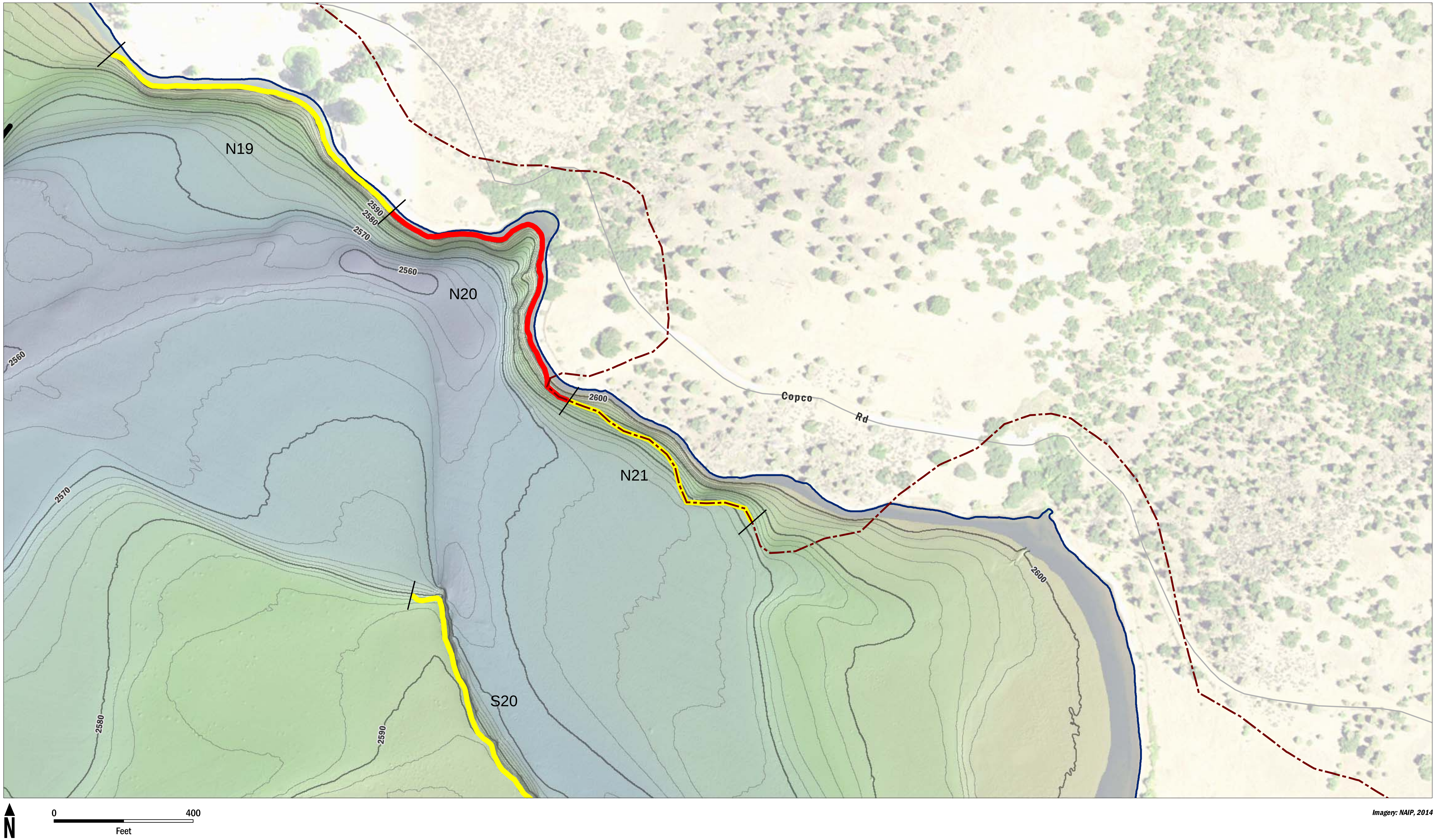
Slope Failure Analysis Features
Incomplete Analysis
Stable Slope

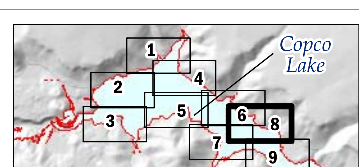
Bathymetric Contours
2 ft.
10 ft.

Segment Information
Segment Extents
N1 Segment Names

FIGURE 3-4

Copco Dam - Slope Failure Analysis
Sheet 7 of 9





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Extent of Fluvio-Lacustrine Deposits
Current Reservoir Shoreline

Slope Failure Analysis Features
Incomplete Analysis
Stable Slope
Potentially Unstable Slope

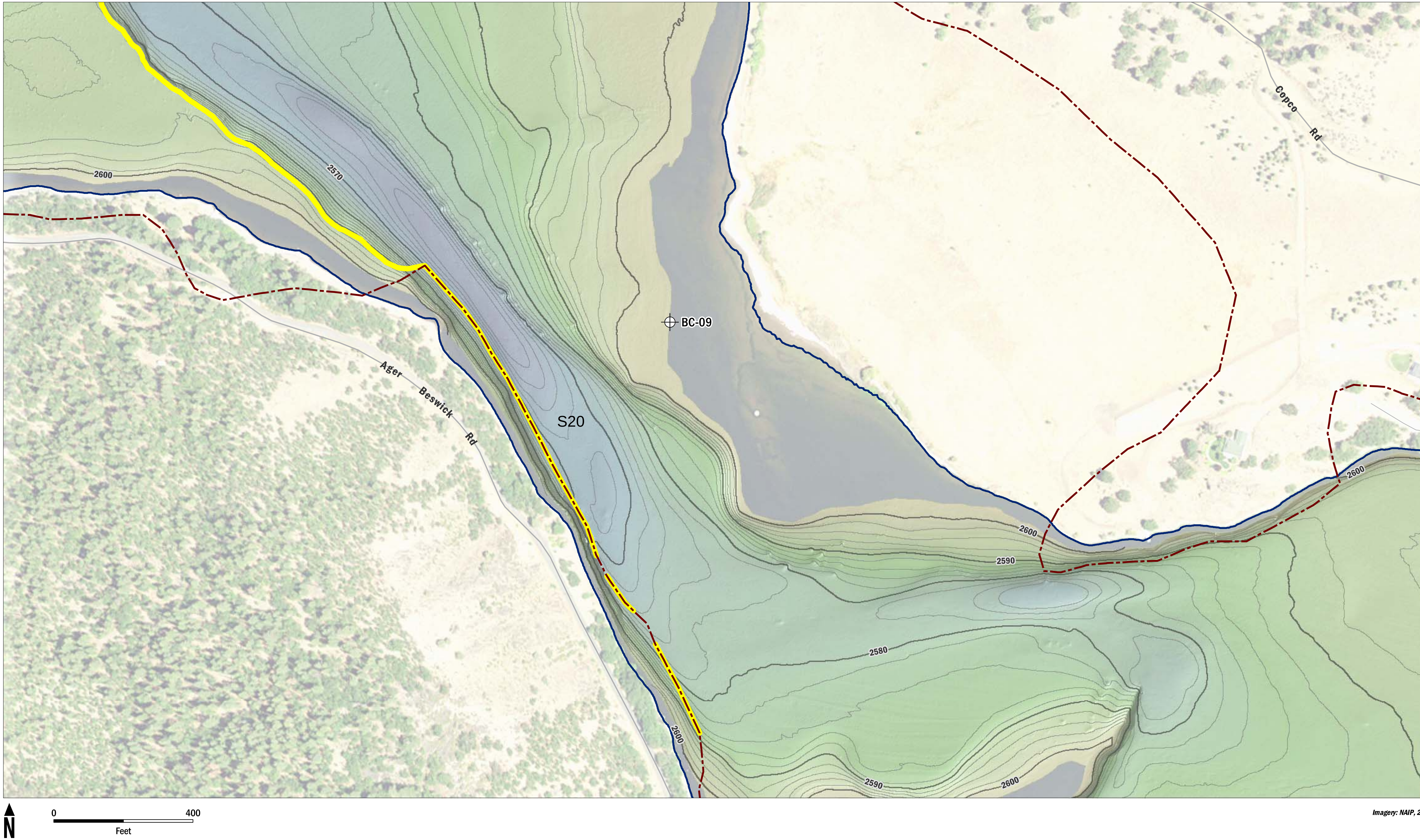
Bathymetric Contours
2 ft.
10 ft.

Segment Information
Segment Extents
N1 Segment Names

FIGURE 3-4

Copco Dam - Slope Failure Analysis

Sheet 8 of 9



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Copco Lake

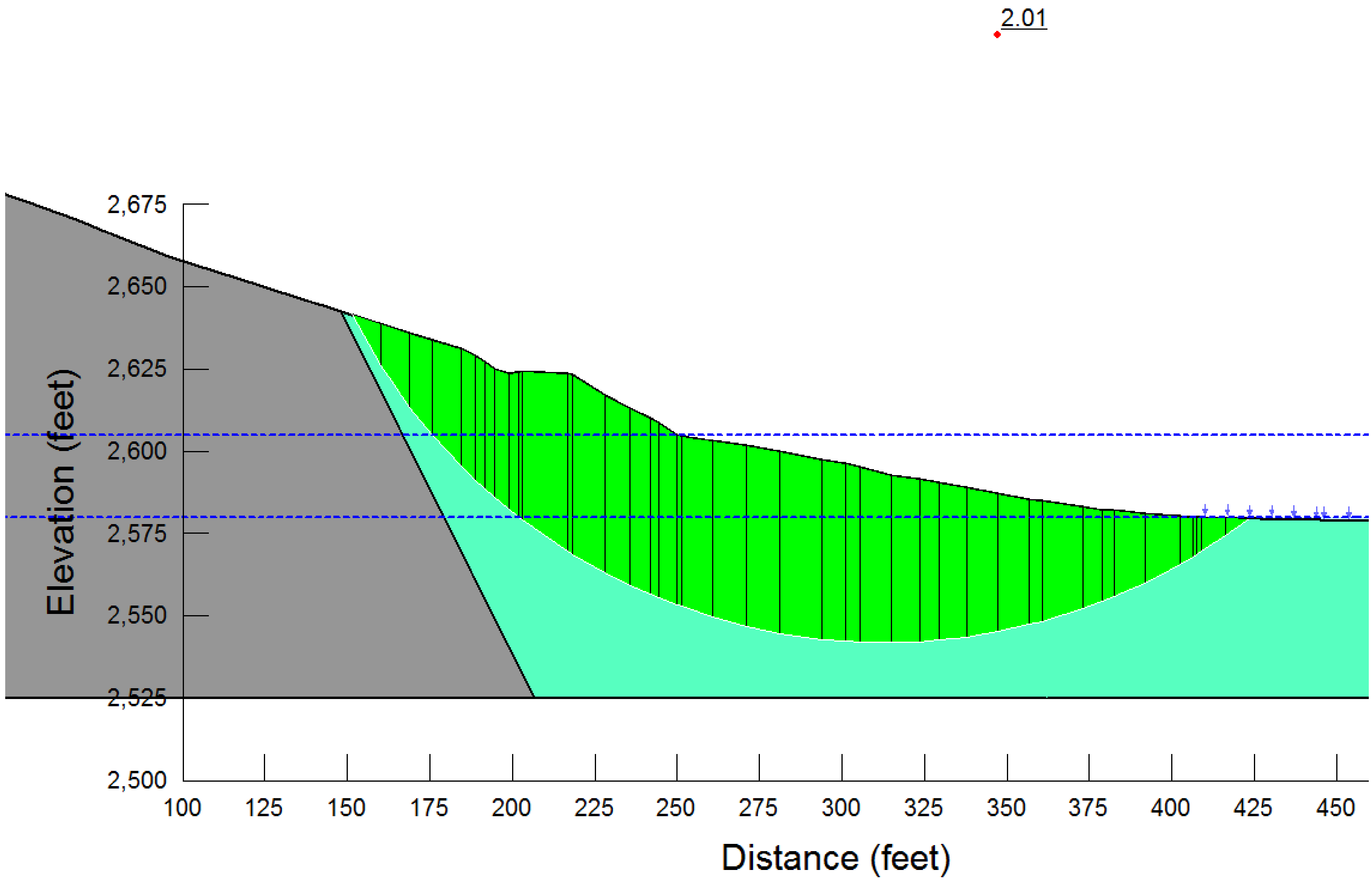
Borings
Extent of Fluvio-Lacustrine Deposits
Current Reservoir Shoreline

Slope Failure Analysis Features
Stable Slope

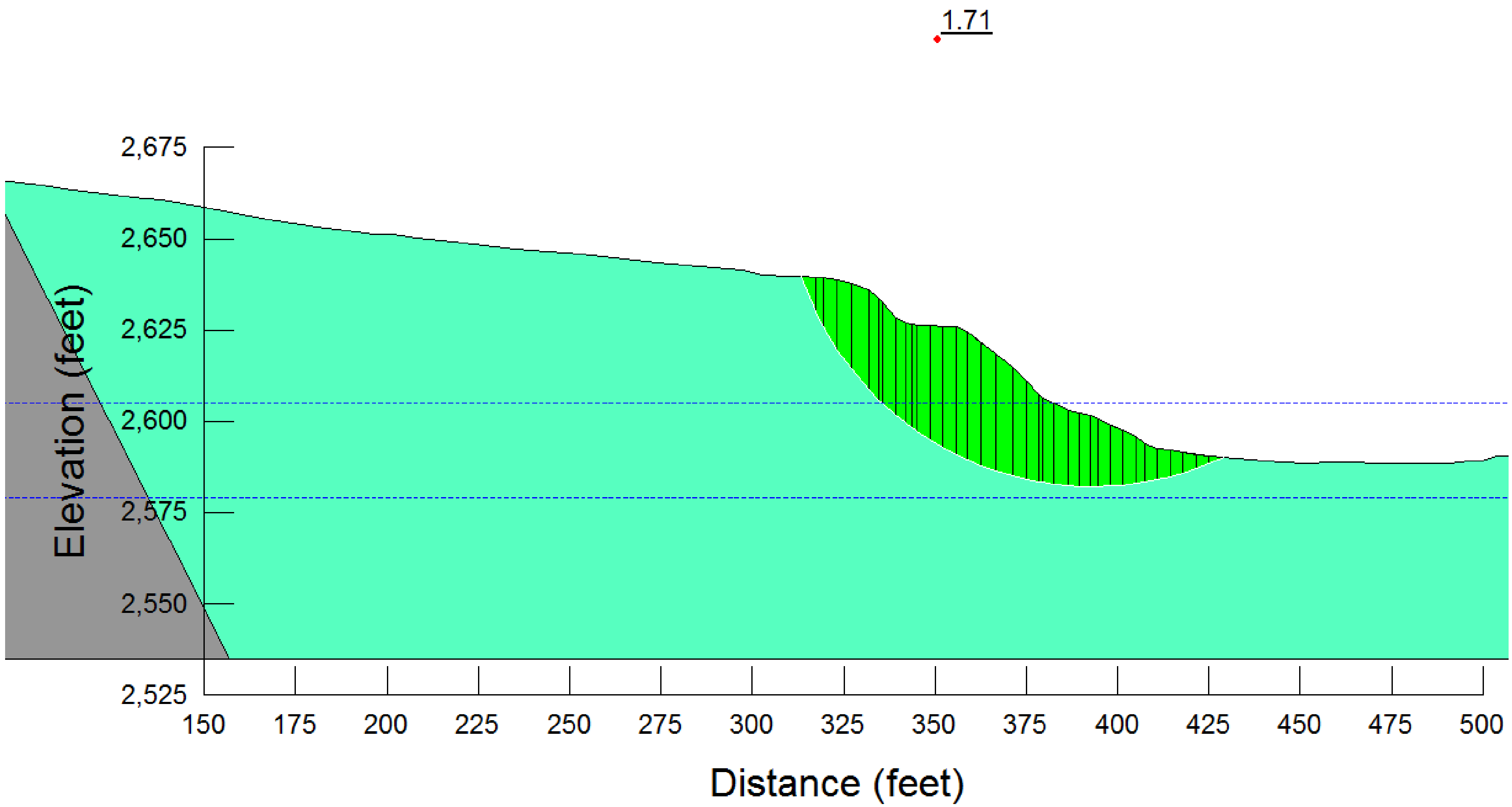
Bathymetric Contours
2 ft.
10 ft.

Segment Information
Segment Extents
N1 Segment Names

FIGURE 3-4
Copco Dam - Slope Failure Analysis
Sheet 9 of 9



Klamath River Renewal Corporation	Copco Reservoir Slope Stability Segment N10, Section 1 Rapid Drawdown Analysis	Figure 3-5a
AECOM		



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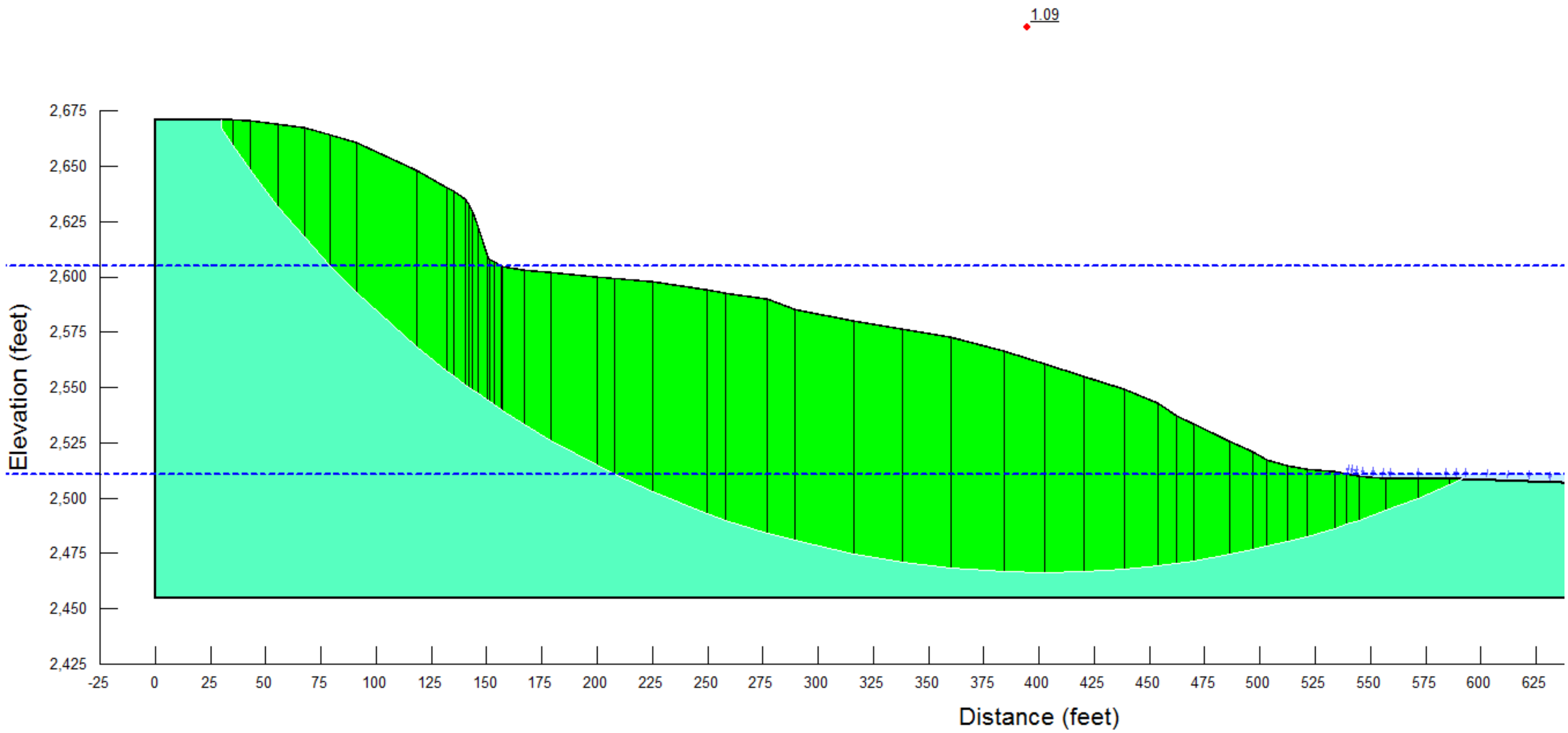

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AECOM		

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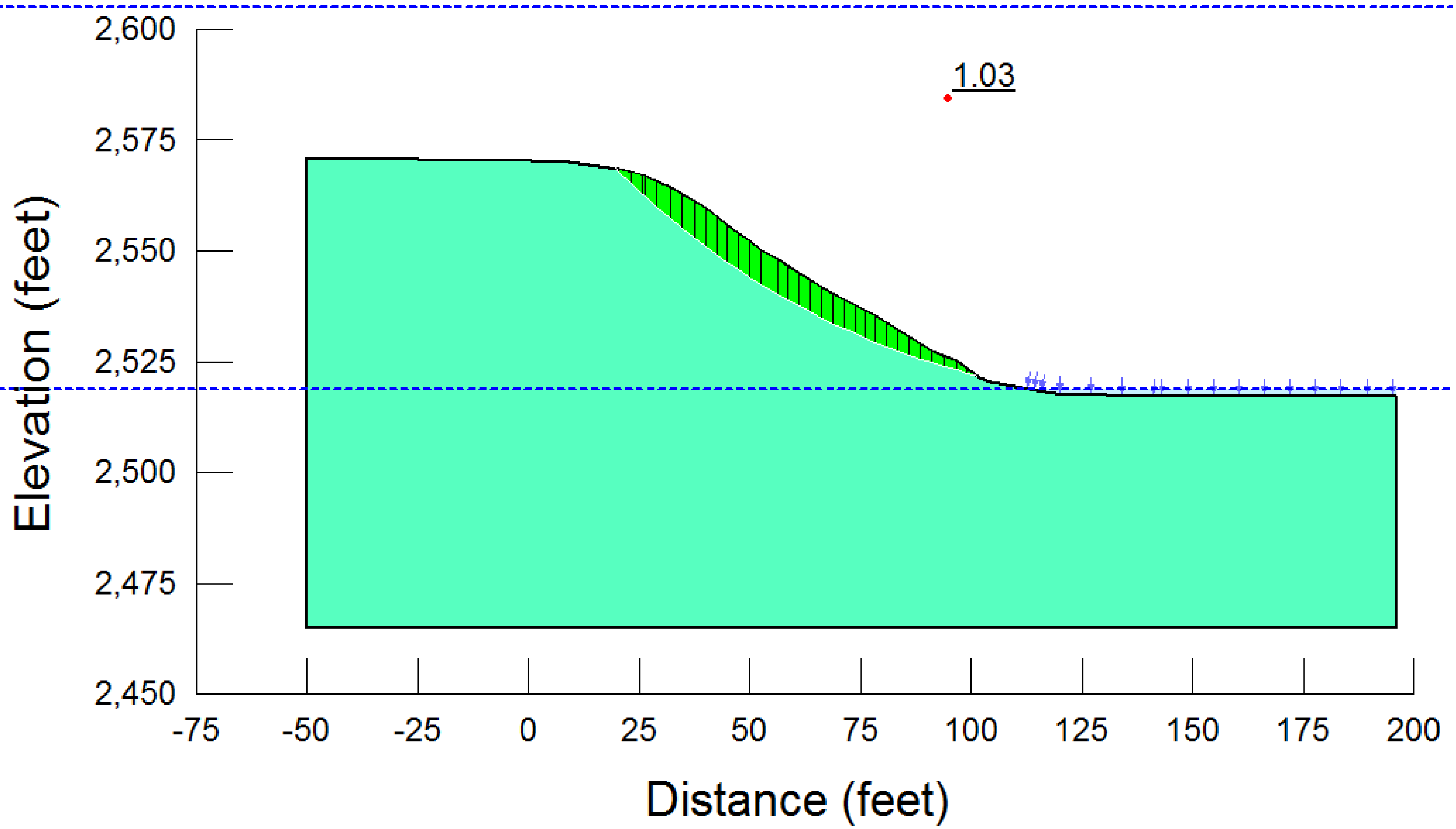

Klamath River Renewal Corporation	Copco Reservoir Slope Stability Segment S3, Section 1 Rapid Drawdown Analysis	Figure 3-5d
AECOM		

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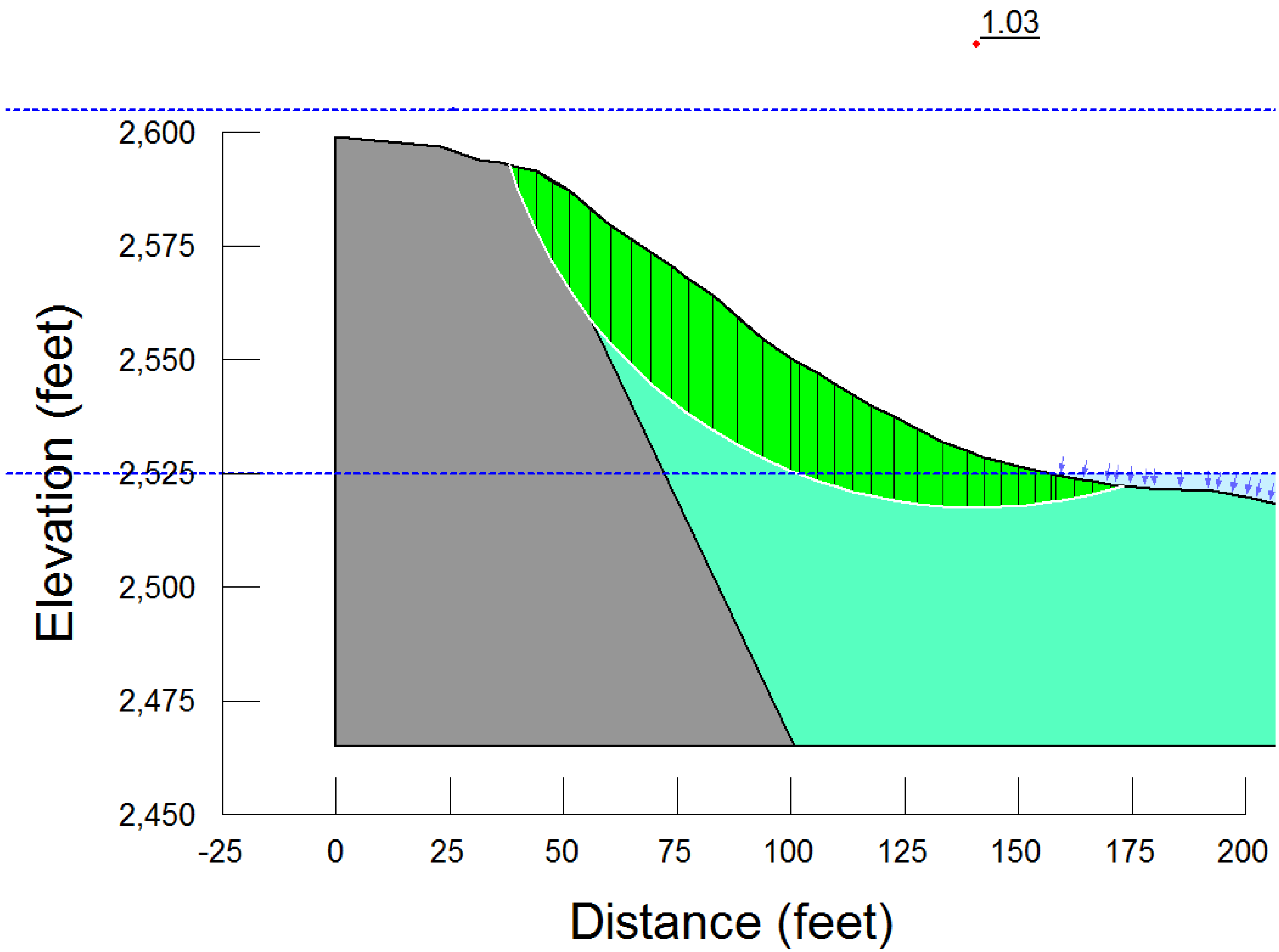
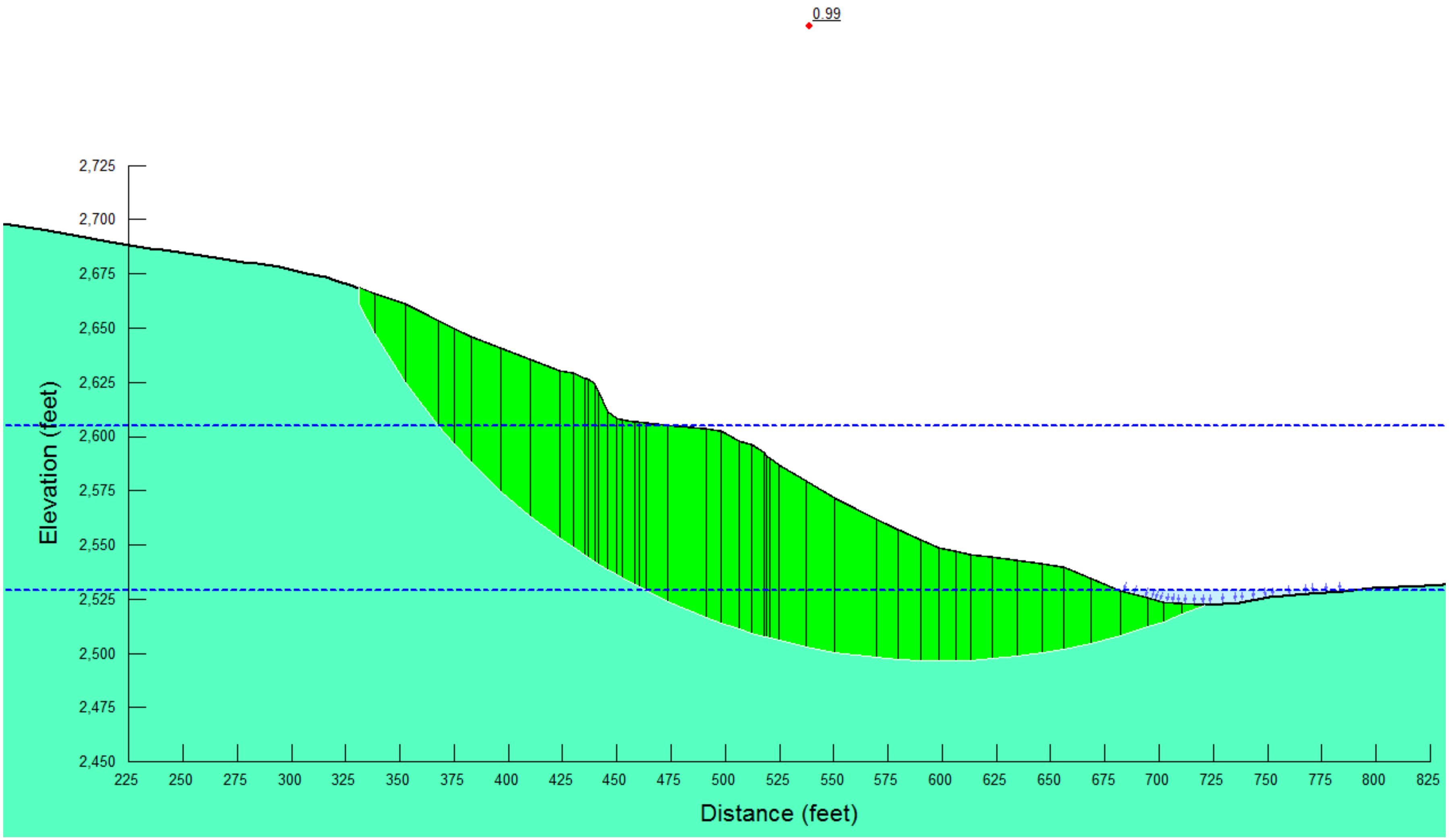


Klamath River Renewal Corporation AECOM	Copco Reservoir Slope Stability Segment S10, Section 1 Rapid Drawdown Analysis	Figure 3-5e



Klamath River Renewal Corporation

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Copco Reservoir Slope Stability
Segment S11, Section 1
Rapid Drawdown Analysis

Figure
3-5f

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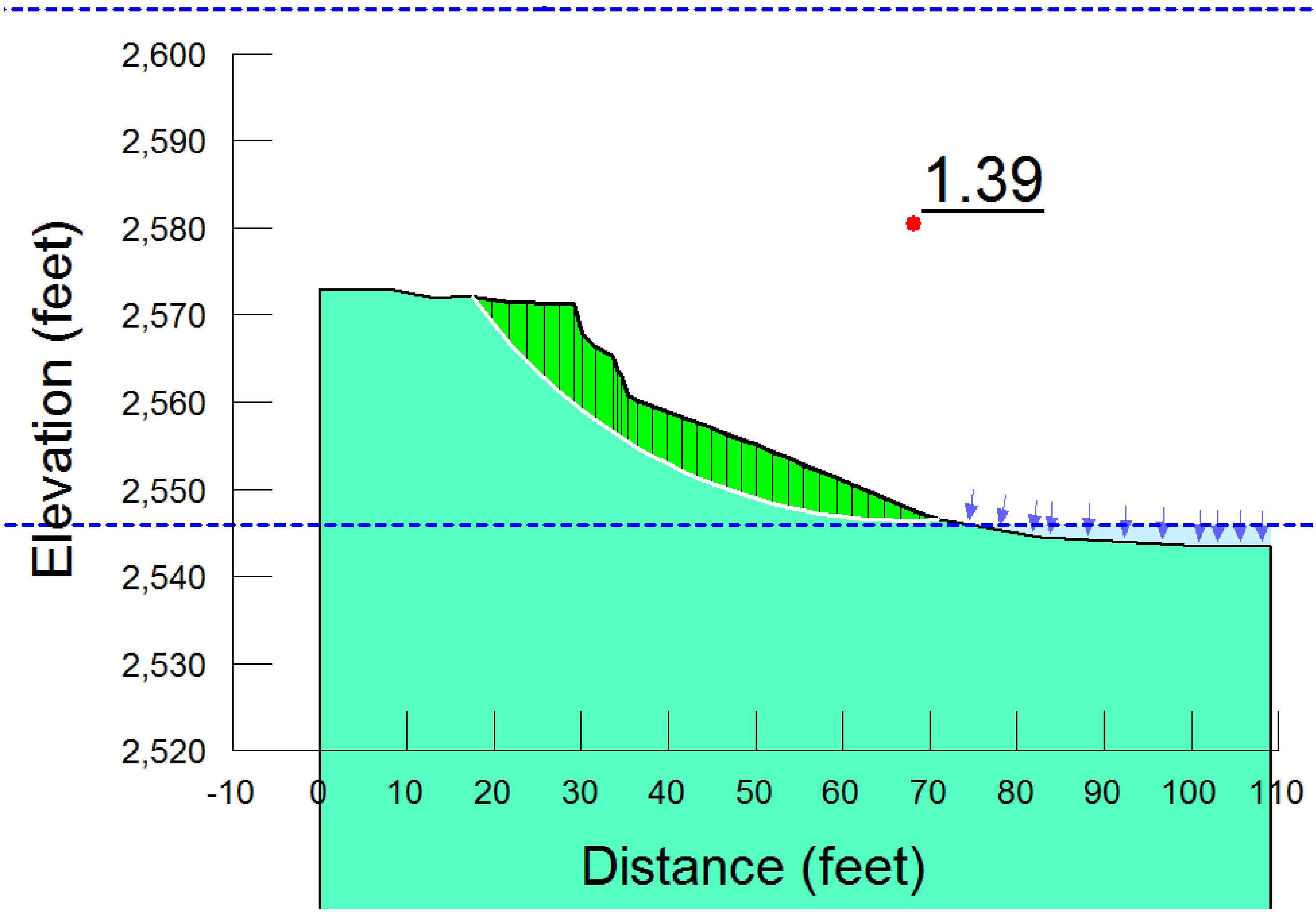

Klamath River Renewal Corporation

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Copco Reservoir Slope Stability
Segment S18, Section 1
Rapid Drawdown Analysis

Figure
3-5g

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Klamath River Renewal Project

FIGURE 4-2
Geologic Overview of Iron Gate Reservoir

Attachment B Boring Logs

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Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Key to Log of Boring

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance blows/6-in.	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight (pcf)	Fines Content (% <200 Sieve)	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8	9	10	11	12

COLUMN DESCRIPTIONS

1 **Elevation:** Elevation in feet referenced to specified datum.

2 **Depth:** Depth in feet below the ground surface.

3 **Sample Type:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.

4 **Sample Number:** Sample identification number.

5 **Sampling Resistance:** Number of blows required to advance driven sampler 12 inches beyond first 6-inch interval, or distance noted, using a 140-lb hammer with a 30-inch drop; or down-pressure for pushed sampler.

6 **Recovery:** Percentage of driven or pushed sample length recovered; "NA" indicates data not recorded.

7 **Graphic Log:** Graphic depiction of subsurface material encountered; typical symbols are explained below.

8 **Material Description:** Description of material encountered; may include density/consistency, moisture, color, and grain size.

9 **Water Content:** Water content of soil sample measured in laboratory, expressed as percentage of dry weight of specimen.

10 **Dry Unit Weight:** Density of soil as measured in the laboratory, in pounds per cubic foot

11 **Fines Content** Percentage passing the #200 sieve as measured in the laboratory

12 **Remarks and Other Tests:** Comments and observations regarding drilling or sampling made by driller or field personnel.

TYPICAL MATERIAL GRAPHIC SYMBOLS

- Diatomite
- Diatomite with Elastic Silt
- Weakly Cemented Diatomite
- Fat Clay with varying amounts of sand and gravel; diatomaceous in some areas
- Lean Clay with varying amounts of sand and gravel; diatomaceous in some areas
- Organic Silt
- Clayey Sand
- Silty Sand with varying amounts of sand and gravel
- Clayey Gravel with varying amounts of sand
- Well Graded Gravel with varying amounts of sand
- Volcanic Clastics
- Volcanic Cinder
- Volcanic Sandstone
- Andesite
- Basalt

TYPICAL SAMPLER GRAPHIC SYMBOLS

- Modified California Sampler (2.5-inch outer diameter)
- Standard Penetration Test
- Shelby tube (thin walled 3-inch outer diameter)

OTHER GRAPHIC SYMBOLS

GENERAL NOTES

Project: Klamath River Dam Removal Project **Project Location: Copco and Iron Gate Reservoirs** **Project Number: 60537920**	**Key to Log of Boring** Sheet 2 of 2

KEY TO DESCRIPTIVE TERMS USED ON CORE LOGS

DISCONTINUITY DESCRIPTORS

a Dip of discontinuity, measured relative to a plane normal to the core axis.

b **Discontinuity Type:**

- F - Fault
- J - Joint
- Sh - Shear
- Fo - Foliation
- V - Vein
- B - Bedding

c **Aperture (inches):**

- W - Wide (0.5-2.0)
- MW - Moderately Wide (0.1-0.5)
- N - Narrow (0.05-0.1)
- VN - Very Narrow (<0.05)
- T - Tight (0)

d **Type of Infilling:**

- Bi - Biotite
- Cl - Clay
- Ca - Calcite
- Ch - Chlorite
- Ep - Epidote
- Fe - Iron Oxide
- H - Healed
- My - Mylonite
- CR - Crushed Rock
- Mn - Manganese
- No - None
- Py - Pyrite
- Qz - Quartz
- Sd - Sand
- Se - Serpentine
- Si - Silty
- Uk - Unknown

e **Amount of Infilling:**

- Su - Surface Stain
- Sp - Spotty
- Pa - Partially Filled
- Fi - Filled
- No - None

f **Surface Shape of Joint:**

- Pl - Planar
- Wa - Wavy
- St - Stepped
- Ir - Irregular

g **Roughness of Surface:**

- Slk - Slickensided [surface has smooth, glassy finish with visual evidence of striations]
- S - Smooth [surface appears smooth and feels so to the touch]
- SR - Slightly Rough [asperities on discontinuity surfaces are distinguishable and can be felt]
- R - Rough [ridges and side-angle steps are evident; asperities are clearly visible; surface feels very abrasive]
- VR - Very Rough [near-vertical steps and ridges occur on discontinuity surface]

ROCK FRACTURING

Description	Recognition
Intensely Fractured	Fractures spaced less than 2 inches apart
Highly Fractured	Fractures spaced 2 inches to 1 foot apart
Moderately Fractured	Fractures spaced 1 foot to 3 feet apart
Slightly Fractured	Fractures spaced 3 feet to 10 feet apart
Massive	Fracture spacing greater than 10 feet

ROCK WEATHERING / ALTERATION

Description	Recognition
Residual Soil	Original minerals of rock have been entirely decomposed to secondary minerals, and original rock fabric is not apparent; material can be easily broken by hand
Completely Weathered/Altered	Original minerals of rock have been almost entirely decomposed to secondary minerals, although original fabric may be intact; material can be granulated by hand
Highly Weathered/Altered	More than half of the rock is decomposed; rock is weakened so that a minimum 2-inch-diameter sample can be broken readily by hand across rock fabric
Moderately Weathered/Altered	Rock is discolored and noticeably weakened, but less than half is decomposed; a minimum 2-inch-diameter sample cannot be broken readily by hand across rock fabric
Slightly Weathered/Altered	Rock is slightly discolored, but not noticeably lower in strength than fresh rock
Fresh/Unweathered	Rock shows no discoloration, loss of strength, or other effect of weathering/alteration

ROCK STRENGTH

Description	Recognition	Approximate Uniaxial Compressive Strength (psi)
Extremely Weak Rock	Can be indented by thumbnail	35 - 150
Very Weak Rock	Can be peeled by pocket knife	150 - 700
Weak Rock	Can be peeled with difficulty by pocket knife	700 - 3,600
Moderately Strong Rock	Can be indented 5 mm with sharp end of pick	3,600 - 7,200
Strong Rock	Requires one hammer blow to fracture	7,200 - 14,500
Very Strong Rock	Requires many hammer blows to fracture	14,500 - 36,000
Extremely Strong Rock	Can only be chipped with hammer blows	>36,000

Project: Klamath River Dam Removal Project Project Location: Klamath River Project Number: 60537920	Log of Boring BC-01 Sheet 1 of 2

Date(s) Drilled	2/5/2018 - 2/6/2018	Logged By	B. Kozlowicz	Checked By	D. Simpson
Drilling Method	Rotary Wash	Drill Bit Size/Type	4-inch Tricone	Total Depth of Borehole	30.4 feet
Drill Rig Type	Barge Mounted CME-45	Drilling Contractor	Taber Drilling	Surface Elevation	2597.1
Groundwater Level(s)	12.3 feet above ground surface (2/5 at 15:15)	Sampling Method(s)	2.5-inch ID Mod Cal, SPT	Hammer Data	Auto hammer (140 lb, 30-inch drop)
Borehole Backfill	Bentonite cement grout to 10 feet bgs	Location		Coordinates	N 2608898 E 6476516

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Sampling Resistance	SAMPLES Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0		S01	1 1 0 (1)	1.8		SILT WITH SAND AND GRAVEL (ML), very soft, very dark gray to black (2.5Y 3/1 to 2.5/1), fine to coarse grained sand, subangular to rounded gravel, sand and gravel consists of diatomite clasts. [Recent Lake Sediment]				Sampler fell 18 inches on last blow
2595											Advance 6-inch casing to 6 feet with hammer (hard/stiff at about 3.5 feet)
	5										Advance 6-inch casing to 8 feet with hammer
2590			S02	4 3 4 (7)	1.5		Becomes soft, dark olive brown (2.5Y 3/3) to very dark grayish brown (2.5Y 3/2) with trace gravel	43			LL = 33 PL = 25 PI = 8
	10						DIATOMITE, light olive brown (2.5Y 5/4), highly weathered, extremely weak, highly fractured, friable [Lacustrine Diatomaceous Terrace (Ql)]				
2585			S03	7 6 6 (12)	1.2			99		46	2/5/18 16:45 EOD 2/6/18 8:30 BOD Advance 6-inch casing to 11 feet with hammer
	15										
2580											
	20										
2575			S04	3 2 5 (7)	1.4		Becomes soft with iron staining on irregular subvertical fractures	93	99		LL = 85 PL = 51 PI = 34 1% Sand 99% Fines
	25										

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Elevation feet	Depth, feet	Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	25										
2570							BASALT, black (10Y 2.5/1), highly to completely weathered, friable				Cuttings become dark greenish gray sandy clay; slower drilling
			S05	31 50/6"	0.6						
	30		S06	50/5"	0.4						
							TOTAL DEPTH = 30.4 FEET				
2565											
	35										
2560											
	40										
2555											
	45										
2550											
	50										
2545											

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-02

Date(s) Drilled	**2/5/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**64.6 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2599.6**
Groundwater Level(s)	**9.4 feet above ground surface (2/5 at 9:00)**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT, 3-inch Shelby Tube**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2608331 E 6476958**

Elevation feet	Depth, feet	SAMPLES Number	Sampling Resistance	Recovery (feet)	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0	S01	2 10 12 (22)	1.7	SANDY LEAN CLAY (CL), very soft, very dark gray (2.5Y 3/1) to black (2.5Y 2.5/1), trace fine rounded gravel [Recent Lake Sediment]				Drove sampler for extra 6 inches (last three blowcounts reported)
					CLAYEY GRAVEL WITH SAND (GC), stiff/medium dense, very dark grayish brown (10YR 3/2), subangular to rounded fine to coarse gravel up to 2 inches in diameter, fine to coarse sand [Fluvio-Lacustrine Terrace Deposit with Gravel (Qtg)]		28		52% Gravel 20% Sand 28% Fines Advanced 6-inch casing to 3.8 feet with hammer
2595	5	S02	5 5 10 (15)	0.2	Black angular basalt cobble				
		S03	18 10 10 (20)	1.2	DIATOMITE, olive to olive yellow (5Y 4/3 to 2.5Y 6/6), moderately to highly weathered, extremely weak, highly fractured, with sub-horizontal bedding and irregular sub-vertical fractures, friable [Lacustrine Diatomaceous Terrace (Ql)]				Drove sampler for extra 6 inches (last three blowcounts reported) Advanced 6-inch casing to 8.8 feet with hammer
2590	10	S04	11 9 9 (18)	0.8					
					Becomes light yellowish brown (2.5Y 6/4), extremely weak/clayey, moderately fractured				
2585	15	S05	4 4 6 (10)	1.2		84	99		LL = 105 PL = 59 PI = 46 1% Sand 99% Fines
					DIATOMITE WITH ELASTIC SILT, greenish gray (10Y 5/1), soft to extremely weak, highly fractured, friable [Lacustrine Diatomaceous Terrace (Ql)]				
2580	20	S06	200 psi	2.3		148		32	About 50% WCR TX-ICU
2575	25		3						

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	25		S07	2 3 (5)	1.4						
											About 25% to 50% WCR
2570	30										
2565	35		S08	200 to 500 psi	2.1			149		33	TX-ICU
2560	40										Cuttings become very dark gray
							Increase in plasticity, soft, olive (5Y 5/3) and very dark gray to black (2.5Y 2.5/1 to 2.5Y 3/1) in ~2.5-inch beds, sub-horizontal bedding				
2555	45		S09	3 3 4 (7)	1.5			178	100		LL = 187 PL = 85 PI = 102 1% Sand 99% Fines
2550	50										

Project: Klamath River Dam Removal Project Project Location: Klamath River Project Number: 60537920	**Log of Boring BC-02** Sheet 3 of 3

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Sampling Resistance	SAMPLES Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2545	55		S10	2 3 5 (8)	1.5			171		30	
2540	60										
			S11	50/3"	0.3		BASALT, black (10Y 2.5/1), slightly weathered, strong; recovered as angular gravel up to 1-inch in diameter [Copco/Quaternary Basalt (Qb)]				Harder drilling, small black basalt chips in cuttings
2535	65						**TOTAL DEPTH = 64.6 FEET**				
2530	70										
2525	75										
2520	80										

Report: GEO_10B1_OAK; File: BORING LOGS.GPJ; 6/21/2018 BC-02

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Project: Klamath River Dam Removal Project **Project Location: Klamath River** **Project Number: 60537920**	**Log of Boring BC-03** Sheet 1 of 4

Date(s) Drilled	**2/6/2018 - 2/7/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**96.5 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2584.6**
Groundwater Level(s)	**24.3 feet above ground surface (2/6 at 12:00)**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT, 3-inch Shelby Tube, HQ Core Barrel**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2606643** **E 6474657**

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Sampling Resistance	SAMPLES Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0						ORGANIC SILT WITH SAND (OL), very soft, very dark grayish brown (2.5Y 3/2) [Recent Lake Sediment]	35	67		Sampler settled to 1-foot; drove sampler for extra 6 inches (last three blowcounts reported) LL = 48 PL = 25 PI = 23
			S01	1 2 3 (5)	2		LEAN CLAY WITH SAND (CL), soft, black (5Y 2.5/2), fine grained sand, trace rounded gravel, small angular rock fragements, and fine rootlets [Colluvium/Resdiual Soil]				
2580	5		S02	4 3 2 (5)	0.6		Without gravel	25		80	3% Gravel 29% Sand 68% Fines Advanced 6-inch casing to 4 feet (stiff from 3 feet)
							Subrounded gravel up to 2.5-inch in diameter with clayey infill [Fluvio-lacustrine Terrace Deposits with Gravel (Qtg)]				Hard chattering drilling Switch to rock core bit with SPT sampler
2575	10		R1		0.1						
							DIATOMITE, olive brown to dark grayish brown (2.5Y 4/3 to 2.5Y 4/2), massive, extremely weak, bedding/fractures not present [Lacustrine Diatomaceous Terrace (Ql)]				Faster drilling from 10.5 to 11.5 feet
			S03	6 3 2 (5)	0.1						Return fluid becomes olive
2570	15		R2		0.2						Advanced 6-inch casing to 14 feet with hammer
			S04	6 4 5 (9)	1						Switch back to tricone bit
2565	20										
							DIATOMITE WITH ELASTIC SILT, dark grayish brown (2.5Y 4/2), massive/soft to very soft [Lacustrine Diatomaceous Terrace (Ql)]				
2560	25			3				80	100		LL = 69

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-03

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	25		S05	3 4 (7)	1.3						PL = 59 PI = 10 100% Fines
2555	30										
2550	35										
2545	40		S06	200 to 400 psi	2.5			85		27	TX-ICU
								90		25	TX-ICU
							Increase in plasticity, soft, dark greenish gray (10Y 4/1), 1 to 2-inch beds/lenses of very dark gray to black clay				
2540	45										Cutting very dark greenish gray
2535	50										

AECOM

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2530	55										
2525	60										
2520	65		S07	5 5 7 (12)	1.5						2/6/18 16:25 EOD 2/7/18 8:30 BOD Cuttings greenish black
2515	70										
2510	75										
2505	80		S08	100 psi	0						

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-03

Elevation, feet	Depth, feet	Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2500	85		S09		0.25						
2495	90		S10		1			120		16	TX-ICU
2490	95		S11	7 5 5 (10)	0.3						Driller out of rods
							TOTAL DEPTH = 96.5 FEET				
2485	100										
2480	105										
2475	110										

AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-04

Date(s) Drilled	2/1/2018	Logged By	B. Kozlowicz	Checked By	D. Simpson
Drilling Method	Rotary Wash	Drill Bit Size/Type	4-inch Tricone	Total Depth of Borehole	73.5 feet
Drill Rig Type	Barge Mounted CME-45	Drilling Contractor	Taber Drilling	Surface Elevation	2595.1
Groundwater Level(s)	11.8 feet above ground surface (2/1)	Sampling Method(s)	2.5-inch ID Mod Cal, SPT, 3-inch Shelby Tube	Hammer Data	Auto hammer (140 lb, 30-inch drop)
Borehole Backfill	Bentonite cement grout to 10 feet bgs	Location		Coordinates	N 2604812 E 6472949

Elevation feet	Depth, feet	Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2595	0						SILTY SAND (SM), very loose, very dark brown (10YR 2/2), trace subangular diatomite gravel up to 0.75 inches in diameter [Recent Lake Sediment]				6-inch casing settles to 1.5 feet
									44		5% Gravel 51% Sand 44% Fines
			S01	1 0 1 (1)	2		Becomes organic rich and softer/looser with increased nonplasctic fines				Sampler advanced 1 foot on first blow and 2.5 feet on second blow
2590	5										Advanced 6-inch casing to 5.5 feet with hammer
							SANDY LEAN CLAY (CL), very loose/very soft, very dark brown (10YR 2/2), trace fine gravel and coarse organics [Recent Lake Sediment]		58		3% Gravel 39% Sand 58% Fines
			S02	2 3 3 (6)	2						Drove sampler for extra 6 inches (last three blowcounts reported)
2585	10										Advanced 6-inch casing to 11 feet (resistance at 11 feet)
			S03	4 11 18 (29)	1.3		WEAKLY CEMENTED DIATOMITE GRAVEL, medium dense, light olive brown (2.5Y 5/4), angular diatomite gravel, weakly cemented and friable with sub-horizontal bedding and sub-vertical fractures [Lacustrine Diatomaceous Terrace (Ql)]		41		Advanced 6-inch casing to 12.5 feet with hammer 9% Gravel 50% Sand 41% Fines
			S04	400 psi	2			61		59	TX-ICU
								54		65	TX-ICU
2580	15										
											100 percent WCR
			S05	400 psi	2.5						
								105		42	TX-ICU
2575	20										
							DIATOMITE WITH ELASTIC SILT, soft to completely weathered, light greenish gray (5GY 7/1) [Lacustrine Diatomaceous Terrace (Ql)]				
			S06	200 to 400 psi	2.5			155		32	TX-ICU
	25										

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-04

Elevation feet	Depth, feet	SAMPLES: Type	SAMPLES: Number	SAMPLES: Sampling Resistance	SAMPLES: Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2570	25										Lost circulation to 27.5 feet
							Becomes mottled with very pale brown (10YR 8/3) and light greenish gray (5GY 7/1) with 10 degree bedding				
			S07	2 3 5 (8)	1.8						Drove sampler for extra 6 inches (last three blowcounts reported) About 50% WCR
2565	30										
			S08	200 to 500 psi	1.5			117	99	37	TX-ICU
2560	35										LL = 60 PL = 24 PI = 36 1% Sand 99% Fines About 75% WCR
							Becomes with 0.25-inch very dark gray (5Y 3/1) 10-degree beds (varves?) and vertical dark gray (5Y 4/1) stained fractures				
2555	40										
											About 50% to 75% WCR
			S09	1 1 1 (2)	2						
2550	45										
2545	50										
								161		31	TX-UU
			S10	200 to 400 psi	2.5						

AECOM

Elevation feet	Depth, feet	Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2540	55							154		32	TX-ICU
2535	60						DIATOMITE, highly to completely weathered, pale yellow to olive yellow (2.5Y 6/6 to 2.5Y 8/4) with orange oxidation stain/mottling; fine grained vitreous gypsum xtals along very dark gray (5Y 3/1) sub-vertical fractures [Lacustrine Diatomaceous Terrace (Ql)]				
			S11	2 2 2 (4)							
2530	65										
2525	70						ANDESITE(?); moderatly to highly weathered, medium strong, fine to medium grained [Bogus Mountain Beds]				Hard drilling, very dark gray to black volcanic fragments in cuttings
			S12	30 50/5"							
							TOTAL DEPTH = 73.5 FEET				
2520	75										
2515	80										

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-05

Date(s) Drilled	**2/2/2018, 2/8/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**20.5 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2601.1**
Groundwater Level(s)	**8.2 feet (2/2 at 11:00) and 6.6 (2/8 at 12:15) feet above ground surface**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT, 3-inch Shelby Tube**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2604139 E 6474515**

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0		S01	0 0 0 (0)	0.7		SILTY SAND WITH GRAVEL (SM), very loose, very dark grayish brown (2.5Y 3/2), greenish gray clayey diatomite gravel clasts up to 1-inch in diameter, nonplastic fines [Recent Lake Sediment]				Sampler advanced 2 feet under hammer weight
2600											Advanced 6-inch casing to 5 feet with hammer
	5										
2595											
			S02	4 10 20 (30)			Clayey gravel made up of mostly Diatomite clasts up to 0.75 inches in diameter				Drove sampler for extra 6 inches (last three blowcounts reported) Advanced 6-inch casing to 8.5 feet (refusal) 2/2/18 EOD 2/8/18 BOD
							LEAN CLAY (CL), very stiff, very dark gray to very dark greenish gray (10Y 3/1 to 2.5Y 3/1), low to medium plasticity fines, trace highly to completely weathered clasts of diatomite [Fluvio-Lacustrine Terrace Deposit with Gravel (Qtg)]				
	10		S03	2 1 1 (2)	1.5		DIATOMITE WITH ELASTIC SILT, extremely weak/very soft, greenish gray (5GY 6/1), 20-degree bedding and 90-degree fractures [Lacustrine Diatomaceous Terrace (Ql)]				
2590							Fine roots				
	15		S04	200 to 400 psi	2.2		Becomes medium stiff to stiff with olive yellow (2.5Y 6/6) with angular clasts, friable	135		35	TX-ICU
2585								30		93	TX-ICU
							VOLCANIC SANDSTONE, yellowish brown(10YR 5/6), highly to completely weathered, very weak, locally clayey				Harder drilling with yellowish to reddish brown rock chips in cuttings
	20		S05	32 50/5"							
2580							**TOTAL DEPTH = 20.5 FEET**				
	25										

Project: Klamath River Dam Removal Project **Project Location: Klamath River** **Project Number: 60537920**	**Log of Boring BC-06** Sheet 1 of 1

Date(s) Drilled	**2/2/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**15.4 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2577.8**
Groundwater Level(s)	**29.2 feet above ground surface (2/2 at 13:00)**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2605112** **E 6476050**

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Sampling Resistance	SAMPLES Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0						[Recent Lake Sediment]				Advanced 6-inch casing to 5 feet with hammer from 2 to 5 feet
2575							LEAN CLAY WITH SAND (CL), stiff, olive gray to dark olive gray (5Y 4/2 to 5Y 3/2), fine grained sand, low to medium plasticity fines, trace fine angular volcanic gravel and wood debris/roots [Colluvium]				
	5		S01	5 9 14 (23)	1.5						
2570							VOLCANIC SANDSTONE, dark greenish gray to black (5GY 4/1 to GLEY1 2.5/N), moderately to slightly weathered [Bogus Mountain Beds]				Harder drilling with gravelly cuttings
	10		S02	50/4"	0.3						Hard, slow drilling
2565											
	15		S03	50/4"							
							TOTAL DEPTH = 15.4 FEET				
2560											
	20										
2555											
	25										

AECOM

Report: GEO_10B1_OAK; File: BORING LOGS.GPJ; 6/21/2018 BC-06

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-07

Date(s) Drilled	**2/2/2018 - 2/3/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**15.9 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2581.3**
Groundwater Level(s)	**26.2 feet above ground surface (2/2 at 15:30)**	Sampling Method(s)	**2.5-inch ID Mod Cal**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2605439 E 6477039**

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Sampling Resistance	SAMPLES Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0						[Recent Lake Sediments]				
2580			S01	0 0 0 (0)	2		FAT CLAY WITH SAND (CH), medium stiff, very dark gray (10YR 3/1), fine to medium grained sand, medium to high plasticity fines, trace rootlets [Colluvium/Residual Soil]				Sampler advanced 2 feet under weight of hammer Advanced 6-inch casing to 2 feet
			S02	5 7 8 (15)	1		← Wood/roots up to 1-inch in size	34	65	88	LL = 60 PL = 24 PI = 36
	5										15% Gravel 20% Sand 65% Fines 2/2/18 16:15 EOD 2/3/18 8:30 BOD Advanced 6-inch casing to 5 feet with hammer
2575			S03	2 5 4 (9)	0.6		CLAYEY SAND (SC), loose, very dark grayish brown (10YR 3/2), medium to coarse grained sand; medium plasticity fines; trace fine gravel with some diatomite clasts [Colluvium/Residual Soil]				Angular diatomite gravel and wood fibers in cutting to about 13 feet Advanced 6-inch casing to 10 feet with hammer
	10										
2570							POORLY GRADED SAND WITH SILT (SP-SM), loose to medium dense, coarse grained sand, dark greenish gray (10Y 4/1) subrounded to rounded diatomite gravel up to 1-inch in diameter in shoe [Colluvium/Residual Soil]				
			S04	9 9 7 (16)	1.5				8		27% Gravel 65% Sand 8% Fines
	15		S05	20 50/4"			With shell hash				Hole caving; advanced 6-inbch casing to 14 feet with hammer
2565							VOLCANIC SANDSTONE, very weak, light olive brown to strong brown (2.5Y 5/4 to 7.5YR 5/8), highly to completely weathered, with irregular 5 to 10-degree bedding [Bogus Mountain Beds]				
							TOTAL DEPTH = 15.9 FEET				
	20										
2560											
	25										

Project: Klamath River Dam Removal Project	Log of Boring BC-08
Project Location: Klamath River	Sheet 1 of 1
Project Number: 60537920	

Date(s) Drilled	2/3/2018	Logged By	B. Kozlowicz	Checked By	D. Simpson
Drilling Method	Rotary Wash	Drill Bit Size/Type	4-inch Tricone	Total Depth of Borehole	11.5 feet
Drill Rig Type	Barge Mounted CME-45	Drilling Contractor	Taber Drilling	Surface Elevation	2586.2
Groundwater Level(s)	22.2 feet above ground surface (2/3 at 14:00)	Sampling Method(s)	2.5-inch ID Mod Cal, SPT	Hammer Data	Auto hammer (140 lb, 30-inch drop)
Borehole Backfill	Bentonite cement grout to 10 feet bgs	Location		Coordinates	N 2605190 E 6480346

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Sampling Resistance	SAMPLES Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0						ORGANIC SILT TO ORGANIC CLAY (OL/OH), very soft, dark olive gray (5Y 3/2) with coarse organic debris				Advanced 6-inch casing to 3 feet with hammer past 1 foot
2585							FAT CLAY WITH SAND, stiff, black (5Y 2.5/2), fine grained sand, medium plasticity fines, trace angular to subrounded gravel up to 1.5 inches in diameter [Colluvium/Residual Soil]				
			S01	4 8 11 (19)	1.3			31			LL = 56 PL = 24 PI = 32
	5						WELL GRADED GRAVEL WITH SAND (GW), very dense, very dark grayish brown to black (10YR 3/2 to 10YR 2/1), broken rounded gravel up to 1.5 inches in diameter, medium to coarse grained sand, trace low plasticity fines [Fluvio-Lacustrine Terrace Deposit with Gravel (Qtg)]				Very hard drilling with volcanic rock chips in cuttings; switched to 2 7/8-inch drag but Blow counts affected by large particles
2580			S02	22 29 37 (66)	0.7						
	10										
2575							TOTAL DEPTH = 11.5 FEET				
	15										
2570											
	20										
2565											
	25										

AECOM

Project: Klamath River Dam Removal Project Project Location: Klamath River Project Number: 60537920	Log of Boring BC-08a Sheet 1 of 4

Date(s) Drilled	2/14/18	Logged By	B. Kozlowicz	Checked By	D. Simpson
Drilling Method	Rotary Wash	Drill Bit Size/Type	4-inch Tricone	Total Depth of Borehole	85.2 feet
Drill Rig Type	Barge Mounted CME-45	Drilling Contractor	Taber Drilling	Surface Elevation	2583.5
Groundwater Level(s)	25.3 feet above ground surface (2/14 at 10:00)	Sampling Method(s)	2.5-inch ID Mod Cal, SPT	Hammer Data	Auto hammer (140 lb, 30-inch drop)
Borehole Backfill	Bentonite cement grout to 10 feet bgs	Location		Coordinates	N 2605249 E 6480346

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Sampling Resistance	SAMPLES Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0						ORGANIC SILT (OL), very soft, very dark brown (10YR 2/2) [Recent Lake Sediment]				
2580											Sampler sank to 4 feet; drove sampler for extra 18 inches (last three blowcounts reported, previous blows were 2-2-7)
	5		S01	9 20 50/4" (70/10")	2		CLAYEY SAND TO SANDY LEAN CLAY, loose/medium dense, black (10YR 2/1), fine to medium grained sand, medium plasticity fines, trace fine rounded gravel [Colluvium/Residual Soil]				
			S02	50/5"	0.4		CLAYEY GRAVEL WITH SAND (GC), very dense, dark yellowish brown to very dark gray (10YR 4/6 to 10YR 3/1), subangular to rounded gravel and cobbles up to 3 inches in diameter in a sandy lean clay to clayey sand matrix [Fluvio-Lacustrine Terrace Deposit with Gravel (Qtg)]				Hard chattering drilling from 7 to 11 feet Advanced 6-inch casing to 8 feet with hammer
2575											
	10										
							DIATOMITE, light yellowish brown (2.5Y 6/4), extremely weak, with irregular 45 to 90-degree fractures with some iron staining and 0 to 15-degree fractures [Lacustrine Diatomaceous Terrace (Ql)]				Fast smooth drilling with olive brown diatomite cuttings
2570											
	15										Advanced casing to 15 feet with hammer
2565			S03	3 4 5 (9)	1.2						
	20										
2560											
	25										

AECOM

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	25										
2555											
	30										
							DIATOMITE WITH ELASTIC SILT; olive gray (5Y 4/2) and greenish black (10Y 2.5/1), very soft/extremely weak, 0.25 to 0.5-inch alternating beds [Lacustrine Diatomaceous Terrace (Ql)]				Cuttings become greenish gray
2550			S04	2 4 4 (8)	0						
	35										
2545											
	40										
2540											
	45										
2535											Cuttings become olive gray and greenish gray
	50										
2530											

Project: Klamath River Dam Removal Project Project Location: Klamath River Project Number: 60537920	**Log of Boring BC-08a** Sheet 3 of 4

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	55		S05	2 2 3 (5)	1.5			179	99		LL = 200 PL = 88 PI = 112 1% Sand 99% Fines
2525											
	60										
2520											
	65										
2515											
	70										
2510											
	75		S06	1 2 4 (6)							
2505											
	80										

Project: Klamath River Dam Removal Project	**Log of Boring BC-08a**
Project Location: Klamath River	Sheet 4 of 4
Project Number: 60537920	

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
2500											Harder drilling
	85		S07	50/3"	0.1		BASALT, black (10Y 2.5/1), slightly weathered, strong; recovered as angular gravel up to 1-inch in diameter [Copco/Quaternary Basalt (Qb)]				Tricone refusal
							TOTAL DEPTH = 85.2 FEET				
2495											
	90										
2490											
	95										
2485											
	100										
2480											
	105										
2475											
	110										

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-09

Date(s) Drilled	**2/13/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**70.5 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2601.7**
Groundwater Level(s)	**5.8 feet above ground surface (2/13 at 9:00)**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT, 3-inch Shelby Tube, HQ Core Barrel**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2602526 E 6483561**

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Sampling Resistance	SAMPLES Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0						[Recent Lake Sediment]				Sampler advanced 2 feet under weight of hammer
2600			S01	0 0 0 (0)	1		FAT CLAY WITH SAND (CH), medium stiff, brown (10YR 4/3) [Alluvium/Residual Soil]				
			R01		1.4		CLAYEY GRAVEL (GC), dark gray (10YR 4/1) and yellowish brown (10YR 5/6), cored and wash subrounded to rounded basalt gravel and cobbles; some clayey sand matrix observed [Fluvio-Lacustrine Terrace Deposit with Gravel (Qtg)]				Set casing to 2 feet; hard driving at 2 feet (casing bouncing); switched to core bit
			R02		0						
	5		S02	4 2 7 (9)	1		DIATOMITE WITH ELASTIC SILT, medium stiff/weak, dark yellowish brown (10YR 4/4), trace fine grained sand [Lacustrine Diatomaceous Deposit (Ql)]				Advanced 6-inch casing to 4.5 feet
2595											
			S03	9 9 7 (16)	1						
	10										
2590							Becomes greenish gray (10Y 5/1), extremely weak/soft				
			S04	3 3 4 (7)	1.2						
	15										
2585											
	20										
2580											
			S05	200 psi	1.7			76	100	54	TX-UU
											LL = 74 PL = 53 PI = 21
	25							80		52	

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-09

Elevation feet	Depth, feet	Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	25										100% Fines TX-ICU
2575											
	30										
2570											
			S06	3 3 4 (7)	0						
	35										
2565											
			S07	3 3 5 (8)	1.8						Sampler advanced an additional 6 inches by pushing
	40										
2560											
	45										
2555											
	50										
2550											

AECOM

Project: Klamath River Dam Removal Project
Project Location: Klamath River
Project Number: 60537920

Log of Boring BC-09

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
		■	S08	200 psi	0						
	55										
2545											
	60										
2540											
	65										
2535											
		■	S09	200 to 400 psi	2.5			92		47	TX-ICU
	70							96		46	TX-ICU
							TOTAL DEPTH = 70.5 FEET				
2530											
	75										
2525											
	80										
2520											

AECOM

Project: Klamath River Dam Removal Project **Project Location: Klamath River** **Project Number: 60537920**	**Log of Boring BC-10** Sheet 1 of 2

Date(s) Drilled	**2/7/2018 - 2/8/2018**	Logged By	**B. Kozlowicz**	Checked By	**D. Simpson**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**43.0 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	**2578.2**
Groundwater Level(s)	**29.3 feet above ground surface (2/7 at 14:40)**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT, 3-inch Shelby Tube**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Bentonite cement grout to 10 feet bgs**	Location		Coordinates	**N 2604959 E 6472871**

Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Sampling Resistance	SAMPLES Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0						[Recent Lake Sediment]				Set 6-inch casing to 4 feet (very soft to 2.5 feet)
2575							WELL GRADED GRAVEL WITH SAND (GW), dense, dark brown (10YR 3/3), subangular to rounded gravel up to 3 inches in diameter consisting of various volcanic lithologies [Fluvio-Lacustrine Terrace Deposit with Gravel (Qtg)]				
	5										Hard, chattering drilling
2570											
	10		S01	25 26 19 (45)	1.5				1		85% Gravel 15% Sand Advanced 6-inch casing to 9 feet with hammer
											Tricone bit refusal; rock core barrel used to advance
2565							DIATOMITE WITH ELASTIC SILT, olive (5Y 5/3), medium stiff/extremely weak, with trace oxidation [Lacustrine Diatomaceous Terrace (Ql)]				Clayey diatomite curring; switched back to tricone bit Advanced 6-inch casing to 14 feet with hammer
	15		S02	10 5 5 (10)	0.4						
2560											
	20										
2555											
	25			5			Becomes light olive brown (2.5Y 5/4) and olive brown (5Y 5/3)				

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	25		S03	4 6 (10)	1.3		with 0.1 to 0.5 inch 10-degree bedding and some oxidation stains				
2550	30										
2545	35										
2540	40		S04	200 to 400 psi	0.9		VOLCANIC CINDER, very dark brown (10YR 2/2), very weak/dense to very dense, medium to coarse grained weakly welded sand, friable with corestones and weakly expressed 10 to 15-degree bedding [Bogus Mountain Beds]				Harder drilling
			S05	6 20 37 (57)	1.5		ANDESITE/TUFF, reddish brown (5YR 5/3), strong brown (7.5YR 5/6), and dusky purple, highly to completely weathered, very weak, coarse grained [Bogus Mountain Beds]				
2535							**TOTAL DEPTH = 43.0 FEET**				
2530	45										
2525	50										

Project: Klamath River Dam Removal Project **Project Location: Klamath River** **Project Number: 60537920**	**Log of Boring BI-01** Sheet 1 of 1

Date(s) Drilled	**2/20/2018**	Logged By	**K. Zeiger**	Checked By	**B. Kozlowicz**
Drilling Method	**Rotary Wash**	Drill Bit Size/Type	**4-inch Tricone**	Total Depth of Borehole	**22.2 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	Surface Elevation	
Groundwater Level(s)	**11.8 feet above ground surface (2/20)**	Sampling Method(s)	**2.5-inch ID Mod Cal, SPT**	Hammer Data	**Auto hammer (140 lb, 30-inch drop)**
Borehole Backfill	**Neat cement grout to the ground surface**	Location		Coordinates	**N 2600814** **E 6450534**

Elevation, feet	Depth, feet	SAMPLES: Type	SAMPLES: Number	SAMPLES: Sampling Resistance	SAMPLES: Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Fines Content (%<#200 Sieve)	Dry Density, pcf	REMARKS AND OTHER TESTS
	0						LEAN CLAY WITH ORGANICS (CL), very soft, wet, dark red brown (5YR 3/4), twigs and roots [Recent Lake Sediment]				
			S-1	0 0 0 (0)	2		LEAN CLAY (CL), stiff, dry, dark red brown (5YR 3/4), trace rootlets, CaCO3 ribbons, developed soil texture [Colluvium/Residual Soil]				
	5										
			S-2	4 7 8 (15)	1.5						
	10		S-3	6 8 13 (21)	1						
			S-4	50/4"	0.3		BASALT, dark red brown (5YR 2.5/2), fresh, strong [QUARTERNARY VOLCANICS]				
	15										
			S-5	50/3"	0.1		VOLCANIC CLASTICS, mottled dark gray (2.5Y 4/1) and light yellow brown (2.5Y 6/4), slightly weathered, moderately strong, coarse grained with quartz phenocrysts [MIOCENE VOLCANICS]				
	20										
			S-6	50/3"	0.2						
							TOTAL DEPTH = 22.2 FEET				
	25										

AECOM

Project: Klamath River Dam Removal Project **Project Location: Copco and Iron Gate Reservoirs** **Project Number: 60537920**	**Log of Boring BI-02** Sheet 1 of 5

Date(s) Drilled	**2/22/2018 - 2/23/2018**	Logged By	**K. Zeiger**	Checked By	**B. Kozlowicz**
Drilling Method	**Rotary Wash, HQ-3 Rock Core**	Drill Bit Size/Type	**4-inch solid stem auger, 3-7/8 inch tricone, 4-inch #2 diamond coring bit**	Total Depth of Borehole	**67.0 feet**
Drill Rig Type	**Truck mounted CME 75**	Drilling Contractor	**Taber Drilling**	Approx. Ground Surface Elevation	**2334.3 NAVD 88**
Groundwater Level	**4.8 feet (15:00 2/22)**	Sampling Methods	**2.5-inch ID Mod Cal, Rock Core**	Hammer Data	**Auto hammer (140 lbs, 30-inches)**
Borehole Backfill	**Neat cement to ground surface**	Borehole Location	**Iron Gate Reservoir**	Coordinate Location	**N 2602023 E 6461382**

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	0								FAT CLAY WITH SAND (CH), stiff, very dark brown (7.5YR 2.5/3), moist, low plasticity fines, 10 percent rounded gravel up to 1-inch in diameter [Alluvium]						4-inch solid stem auger
2334															
	1														
	2														
2332															
	3														
	4														
2330									▽						
	5											6		14:30	LL = 78 PL = 28 PI = 50
	6										S-1	8	1.3		11% Gravel 21% Sand 68% Fines
2328									← 2-inch rounded clasts with trace decomposed rootlets			13			
	7														
	8														
2326															
	9														
	10								SANDY FAT CLAY (CH), stiff, dry, brown (7.5YR 4/3), low plasticity fines, fine grained sand, trace rounded gravel up to 0.25 inches in diameter, $CaCO_3$ ribbons [Older Alluvium/Residual Soil]			5		14:40	LL = 58 PL = 28 PI = 30
2324											S-2	7	1.5		5% Gravel 33% Sand 62% Fines
	11											12			
	12														
2322															
	13														

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	MATERIAL DESCRIPTION	Soil Sample Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	13													
2320	14													First water at 14.0 feet; after 20 minutes at 4.8 feet
	15							SANDY FAT CLAY (CH), loose, brown (7.5YR 5/4), fine grained sand, low plascticity fines, trace rounded gravel up to 1-inch in diameter [Older Alluvium]		S-3	6 / 6 / 7	1.5	15:00	LL = 51 PL = 27 PI = 24 8% Gravel 40% Sand 53% Fines 4-inch casing to 14 feet Switch to rotary wash
2318	16													
	17	1	1	18	NA	0	1, 2	TUFF BRECCIA, green gray (10Y 6/1), highly to completely weathered, extremely weak, intensely fractured with angular breccia clasts up to 1-inch, fine to medium grained matrix [Miocene Volcanics - Bogus Mountian Beds] 1: 60, J, N, No, No, Pl, SR 2: 10, J, MW, No, No, Wa, SR					1549	Refusal with tricone bit; switched to HQ rock core
2316	18				NA									
	19				NA		NR						[21]	Clayey volcanics cuttings
2314	20				NA									100% fluid return
	21	2		100	NA	48*	1	Becomes moderately to slightly weathered, moderately strong, moderately fractured Rough, irregular fractures likely mechanical along weathered contacts of breccia clasts 1: 10, J, T, No, No, Wa, SR 2: 20-80, J, N, No, No, Ir-St, R 3: 10, J, MW, No, No, Wa, SR					1601 1610	
2312	22				2		2, 3, 3, 1							
	23				3		4	4: 20, J, N, No, No, Wa, SR					[22]	*Does not meet soundness criteria for RQD calculation
2310	24				1		m	Run break					1618	
	25	3		100	2	100	1	1: 30, J, N, No, No, Wa, SR					1622	
							2, 1	2: 5, J, T, H + ?, Pa, Wa, ?					[21]	
2308	26				1		1							
	27						m	Run break					1629 1634	
					1									
2306	28				0		1, m	1: 5, J, N, No, No, Wa, SR						
	29													

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Number	Lithology	MATERIAL DESCRIPTION	Soil Samples: Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	29	4		100	1	100	2		TUFF BRECCIA, green gray (10Y 6/1), moderately to slightly weathered, moderately strong, moderately fractured with angular breccia clasts up to 1-inch, medium grained matrix [Miocene Volcanics - Bogus Mountian Beds] (continued) 2: 10-15, J, N, No, No, Wa-St, R					[30]	Broken while placing in the box
2304	30				1		2								100% fluid return
	31				0										
2302	32				1		m 1		1: 10, J, N, No, No, Wa, SR					1644 1647	
	33				2		1								
2300	34	5	2	100	1	96	2 3		2: 40, J, N, No, No, St, SR 3: 30, J, T, H+?, No, No, Wa?					[31]	
	35				1		4		4: 10, J, N, No, No, Wa-St, SR						
2298	36				0										
	37				1		1		1: 10, J, N, No, No, Wa-St, R					1657 1701	
2296	38				1		1								
	39	6		100	1	100	2		2: 15, J, T, No, No, Wa, SR					[26]	
2294	40				1										
	41				0		3		3: 30, J, N, No, No, Wa-Pl, SR						
2292	42				1		1		1: 10, J, N, No, No, Wa, SR					1712 1206	EOD 2/22/2018 BOD2/23/2018
	43				4		2		2: 10-30, J, T, No, No, Wa, SR						
2290	44	7		100	1	96	1							[43]	
	45														

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Number	MATERIAL DESCRIPTION	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	45				1		3	TUFF BRECCIA, green gray (10Y 6/1), moderately to slightly weathered, moderately strong, moderately fractured, angular breccia clasts up to 1-inch, fine to medium grained matrix [Miocene Volcanics - Bogus Mountian Beds] (continued) 3: 10-30, J, MW, No, No, Wa-Ir, SR-R		100% fluid return
2288	46		3		1		4	4: 30, J, N, No, No, Wa-Pl, SR	1213	
	47				0			Becomes strong, slightly fractured	1216	
2286	48				0		1 2	1: 20, J, MW, H+Ca, F, Wa, ? 2: 15, J, N, No, No, Wa-St, R		
	49	8		100	1	100			[25]	
2284	50				0					
	51				1		2		1228	
2282	52				0				1232	
	53				0					
2280	54	9		100	1	98	1	1: 30, J, N, No, No, St, R	[23]	
	55				0		m			Mechanical fractures from placing in box
2278	56				1		m 2	2: 20, J, N, No, No, Wa-St, SR	1245	
	57				1		1	1: 20, J, N, No, No, Wa, SR	1250	
2276	58				0					
	59	10		100	1	96	2	2: 10, J, N, No, No, Wa-St, R	[20]	
2274	60				0					100% fluid return
	61									

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	61		4		1		m m 3		TUFF BRECCIA, green gray (10Y 6/1), moderately to slightly weathered, strong, slightly fractured, angular breccia clasts up to 1-inch, fine to medium grained matrix [Miocene Volcanics - Bogus Mountian Beds] (continued) 3: 6, J, N, No, No, Wa, SR					1305	
2272	62				0									1311	Mechanically broken from placement in box
	63				1		1 2		1: 30, V, N-T, H+Ca, Fi, Wa, ? 2: 10, J, N, No, No, Wa-St, SR-R						
2270	64	11		100	0	72								[19]	
	65				1		3		3: 60, J/V, MW, Ca, Pa, Wa-Pl, SR						
2268	66				3		4 4 m		4: 60-70, J/V, N, H+Ca, Fi, Wa, ?					1327	
	67								**TOTAL DEPTH = 67.0 FEET**						
2266	68														
	69														
2264	70														
	71														
2262	72														
	73														
2260	74														
	75														
2258	76														
	77														

Project: Klamath River Dam Removal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Boring BI-03

Date(s) Drilled	**2/21/2018**	Logged By	**K. Zeiger**	Checked By	**B. Kozlowicz**
Drilling Method	**Rotary Wash, HQ-3 Rock Core**	Drill Bit Size/Type	**4-inch solid stem auger, 3-7/8 inch tricone, 4-inch #2 diamond coring bit**	Total Depth of Borehole	**35.1 feet**
Drill Rig Type	**Barge mounted CME 45**	Drilling Contractor	**Taber Drilling**	Approx. Ground Surface Elevation	**2302.2 NAVD 88**
Groundwater Level	**25.3 feet above ground surface (2/21)**	Sampling Methods	**2.5-inch ID Mod Cal, Rock Core**	Hammer Data	**Auto hammer (140 lbs, 30-inches)**
Borehole Backfill	**Neat cement to ground surface**	Borehole Location	**Iron Gate Reservoir**	Coordinate Location	**N 2601812 E 6461399**

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES: Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
2302	0								POORLY GRADED GRAVEL WITH CLAY (GP-GC), dark green gray (N 4/1), wet, loose, subangular to subrounded gravel up to 0.25-inch in diameter [Alluvium]						Advanced 5-inch casing to 3 feet
2300	2														
2298	4								TUFF BRECCIA, green gray (5G 6/1). highly weathered, weak to very weak, fine to medium grained matrix with angular to subrounded clasts up to 0.75 inches [Miocene Volcanics - Bogus Mountian Beds]		S-1	12 50/2.5"	0.7	10:10	LL = 51 PL = 27 PI = 24 61% Gravel 30% Sand 9% Fines Advanced 5-inch casing to 4 feet
	5.5	1		4	6+	0	1, 2		Becomes moderately weathered, weak, intensely fractured to locally crushed					1059	Refusal with tricone bit; switched to HQ-3
2296	6				6+		3, 4, 2, 5, 4, 4		Most rough, irregular fractures likely mechanical due to weathering on clasts/matrix boundaries 1: 60, J, N, No, No, St, R 2: 40, J, T, No, No, St, R 3: 50-60, J, T, No, No, St, R 4: 30, J, MW, No, No, St, R 5: 10, J, N, No, No, St, R						
	7				6+									[13]	
2294	8				6+		6, 4, 7		6: 40, J, N, No, No, Wa, SR 7: 70, J, T, No, No, Wa, SR						
	9				NA		5 (NR)								
2292	10	2		5	NA	14*	1		1: ~10, J, N, No, No, Wa, SR					1120 1143	LL = 58 PL = 28 PI = 30 5% Gravel 33% Sand 62% Fines
	11				4		2, 3, 3		2: 30, J, N-T, No, No, Wa-St, SR 3: 40-50, J, N, No, No, Wa-St, SR-R						
2290	12				5		4, 3, 4, 2		4: 20, J, MW, No, Wa, St, SR-R					[19]	Does not meet soundness criteria for RQD calculation
	13														

Project: Klamath River Dam Removal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Boring BI-03

Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Number	Lithology	MATERIAL DESCRIPTION	Soil Samples: Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	13				5		5, 2, 2		TUFF BRECCIA, green gray (5G 6/1), moderately weathered, weak, intensely fractured to locally crushed, fine to medium grained matrix with angular to subrounded clasts up to 0.75 inches [Miocene Volcanics - Bogus Mountian Beds] (continued) 5: 30, J, N, No, No, Wa-Pl, SR						
2288	14				5		1, 2, 2								
	15				3		1		1: 35, J, N, No, No, St, R Becomes slightly fractured, moderately strong					1159 1215	LL = 51 PL = 27 PI = 24 8% Gravel 40% Sand 53% Fines Packer test #1 from 15.1 to 35.1
2286	16				0										
	17	3		5	1	100*	2		2: 30, J, N, No, No, Wa, SR					[23]	Does not meet soundness criteria for RQD calculation
2284	18				1		3		3: 20, J, T, No, No, Wa, SR						
	19				0										
2282	20				3		1, 2, 3		Becomes highly fractured 1: 10, J, MW, No, No, Wa, SR 2: 25, J, T, No, No, Wa-St, SR-R 3: 10, J, MW, No, No, Wa, SR-R					1228 1239	
	21				2		3, 2		Becomes moderately fractured						
2280	22	4		5	1	86*	3							[18]	
	23				0										
2278	24				1		3								
	25				0									1256 1301	
2276	26				5		1, 2, 3, 3		Moderately to highly weathered, weak to very weak, fractures 1, 2, 3 are likely mechanical						Clayey coating 26.5-27.2 is from when return hose got disconnected during run
	27	5		5	5	48*	3, 3, 4, 5		1: 15, J, T, No, No, Wa, SR 2: 40, J, T, No, No, Wa-St, SR 3: 5-10, J, MW, No, No, Wa, SR 4: 80, J, N, No, No, Wa-Ir, SR					[15]	
2274	28				6+		6		5: 30, J/V, T, Ca, Pa, Pl-Wa, SR Crushed zone 6: 65, J, MW, Sd, Pa, Wa, SR						
	29														

Project: Klamath River Dam Removal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Boring BI-03

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES: Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	29				0				TUFF BRECCIA, green gray (5G 6/1), moderately weathered, moderately strong, moderately fractured, fine to medium grained matrix with angular to subrounded clasts up to 0.75 inches [Miocene Volcanics - Bogus Mountian Beds] (continued)						
2272	30				2		1, 1		Becomes intensely fractured 1: 5, J, N, No, No, Pl-Wa, SR					1321 1327	
	31				4		2, 2, 3, 1		2: 20, J, N-MW, No, No, Wa, SR 3: 35, J, N, Ca+Sd, Pl, S						
2270	32	6		5	0	54*								[15]	
	33				3		4, 3		4: 30, J, N, No, No, Pl, SR						Does not meet soundness criteria for RQD calculation
2268	34				4		5, 6		Becomes highly weathered, weak, crushed along a fracture? 5: 65, J, MW-W, Fe+Sd, Su+Pa, Pl, SR-R with ~0.75-inch Fe stained highly weathered rind 6: 10-20, J, T, No, No, Wa-Lr, SR					1347	
	35								**TOTAL DEPTH = 35.1 FEET**						
2266	36														
	37														
2264	38														
	39														
2262	40														
	41														
2260	42														
	43														
2258	44														
	45														

Attachment C Laboratory Testing Results

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Moisture-Density-Porosity Report

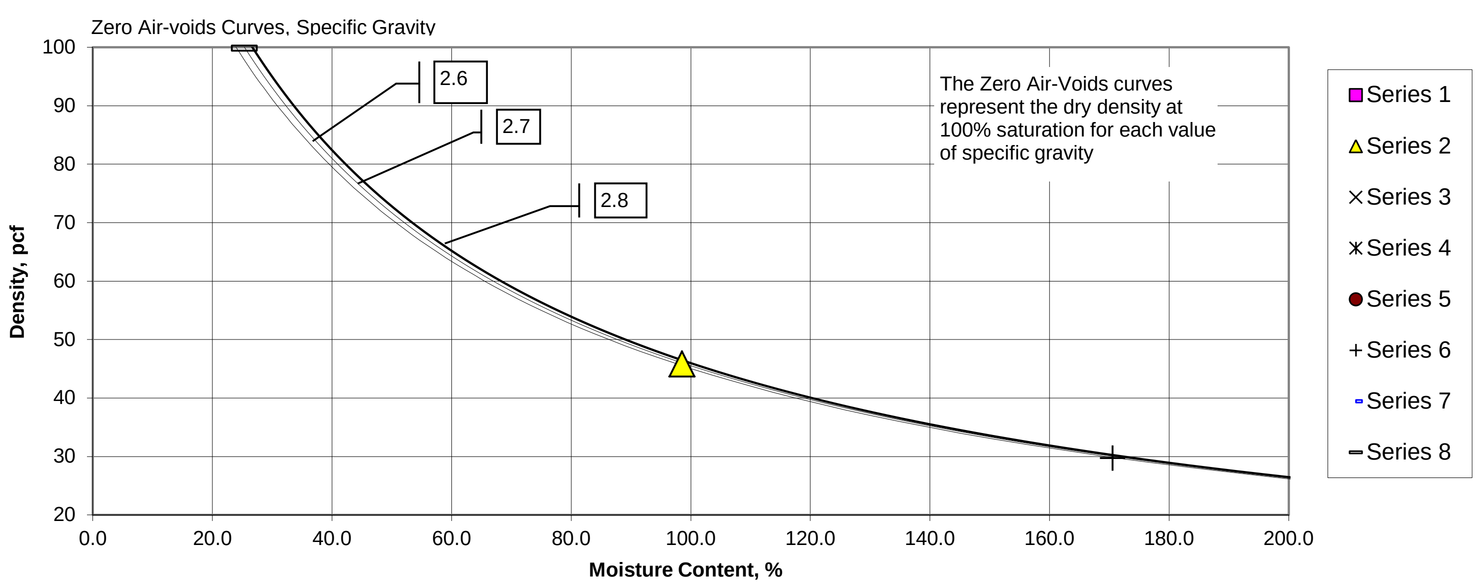
Cooper Testing Labs, Inc. (ASTM D7263b)

CTL Job No:	020-251a	**Project No.**	60537920	**By:**	RU
Client:	AECOM	**Date:**	06/13/18		
Project Name:	Klamath River Dam Removal Project	**Remarks:**			

Boring:	BC-01	BC-01	BC-01	BC-02	BC-02	BC-02	BC-03	BC-03
Sample:	S-02	S-03	S04	S05	S09	S10	S-01	S-02
Depth, ft:	6.5	12.5-13	21.5	14.5	44.5	54.8-55.3	1	5.5-6.0
Visual Description:	Dark Olive Gray Sandy SILT	Light Yellowish Brown Sandy CLAY	Gray Elastic SILT	Gray Elastic SILT	Gray Elastic SILT	Black CLAY	Dark Olive Brown Sandy Lean CLAY	Dark Olive Brown Sandy CLAY w/ Gravel
Actual G_s								
Assumed G_s		2.70				2.70		2.70
Moisture, %	43.1	98.6	92.9	83.7	177.8	170.6	34.7	25.4
Wet Unit wt, pcf		91.0				80.3		125.2
Dry Unit wt, pcf		45.8				29.7		99.9
Dry Bulk Dens.pb, (g/cc)		0.73				0.48		1.60
Saturation, %		99.3				98.3		99.4
Total Porosity, %		72.8				82.4		40.8
Volumetric Water Cont,Өw,%		72.3				81.0		40.6
Volumetric Air Cont., Өa,%		0.5				1.4		0.2
Void Ratio		2.68				4.68		0.69
Series	1	2	3	4	5	6	7	8

Note: All reported parameters are from the as-received sample condition unless otherwise noted. If an assumed specific gravity (Gs) was used then the saturation, porosities, and void ratio should be considered approximate.

Moisture-Density



Moisture-Density-Porosity Report

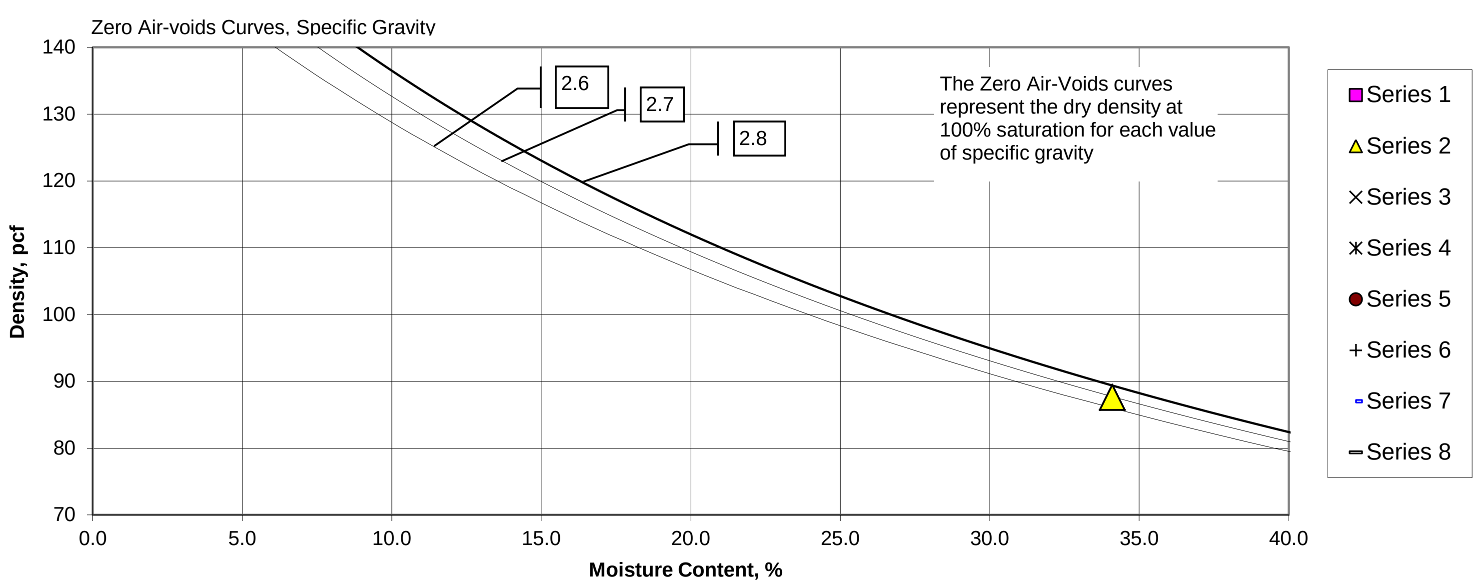
Cooper Testing Labs, Inc. (ASTM D7263b)

CTL Job No:	020-251b	**Project No.**	60537920	**By:** RU
Client:	AECOM	**Date:**	06/13/18	
Project Name:	Klamath River Dam Removal Project	**Remarks:**		

Boring:	BC-03	BC-07	BC-08	BC-08A	BI-02	BI-02	BI-02	BI-03
Sample:	S05	S-02	S-01	S05	S1	S2	S3	S-1
Depth, ft:	24.5	4-4.5	3	54	5	10	15	3.5
Visual Description:	Light Olive Brown Elastic SILT	Very Dark Olive Brown Sandy Fat CLAY w/ Gravel	Dark Reddish Brown Sandy Fat CLAY	Light Olive Brown Elastic SILT	Dark Reddish Brown Sandy Fat CLAY	Yellowish Brown Sandy Fat CLAY	Yellowish Brown Sandy Fat CLAY	Olive Gray Poorly Graded GRAVEL w/ Silt & Sand
Actual G_s								
Assumed G_s		2.70						
Moisture, %	80.3	34.1	31.4	178.6	27.8	28.7	38.4	12.0
Wet Unit wt, pcf		117.5						
Dry Unit wt, pcf		87.6						
Dry Bulk Dens.pb, (g/cc)		1.40						
Saturation, %		99.5						
Total Porosity, %		48.1						
Volumetric Water Cont,Θw,%		47.8						
Volumetric Air Cont., Θa,%		0.2						
Void Ratio		0.93						
Series	1	2	3	4	5	6	7	8

Note: All reported parameters are from the as-received sample condition unless otherwise noted. If an assumed specific gravity (Gs) was used then the saturation, porosities, and void ratio should be considered approximate.

Moisture-Density



COOPER TESTING LABORATORY

#200 Sieve Wash Analysis
ASTM D 1140

Job No.: 020-251 **Project No.:** 60537920 **Run By:** MD
Client: AECOM **Date:** 6/14/2018 **Checked By:** DC
Project: Klamath River Dam Removal Project

Boring:	BC-02	BC-03	BC-04	BC-04				
Sample:	S-01	S-01	S-01	S02				
Depth, ft.:	1-2	1	1.5	7				
Soil Type:	Dark Olive Brown Clayey GRAVEL w/ Sand	Dark Olive Brown Sandy Lean CLAY	Dark Olive Brown Clayey SAND	Dark Olive Brown Sandy CLAY				
Wt of Dish & Dry Soil, gm	1247.4	707.6	696.3	656.3				
Weight of Dish, gm	175.6	175.8	172.4	173.0				
Weight of Dry Soil, gm	1071.8	531.8	523.9	483.3				
Wt. Ret. on #4 Sieve, gm	556.7	16.7	22.3	15.6				
Wt. Ret. on #200 Sieve, gm	774.5	177.4	291.7	205.6				
% Gravel	**51.9**	**3.1**	**4.3**	**3.2**				
% Sand	**20.3**	**30.2**	**51.4**	**39.3**				
% Silt & Clay	**27.7**	**66.6**	**44.3**	**57.5**				

Remarks: As an added benefit to our clients, the gravel fraction may be included in this report. Whether or not it is included is dependent upon both the technician's time available and if there is a significant enough amount of gravel. The gravel is always included in the percent retained on the #200 sieve but may not be weighed separately to determine the percentage, especially if there is only a trace amount, (5% or less).

#200 Bulk Sieve Wash Analysis
ASTM D 1140m

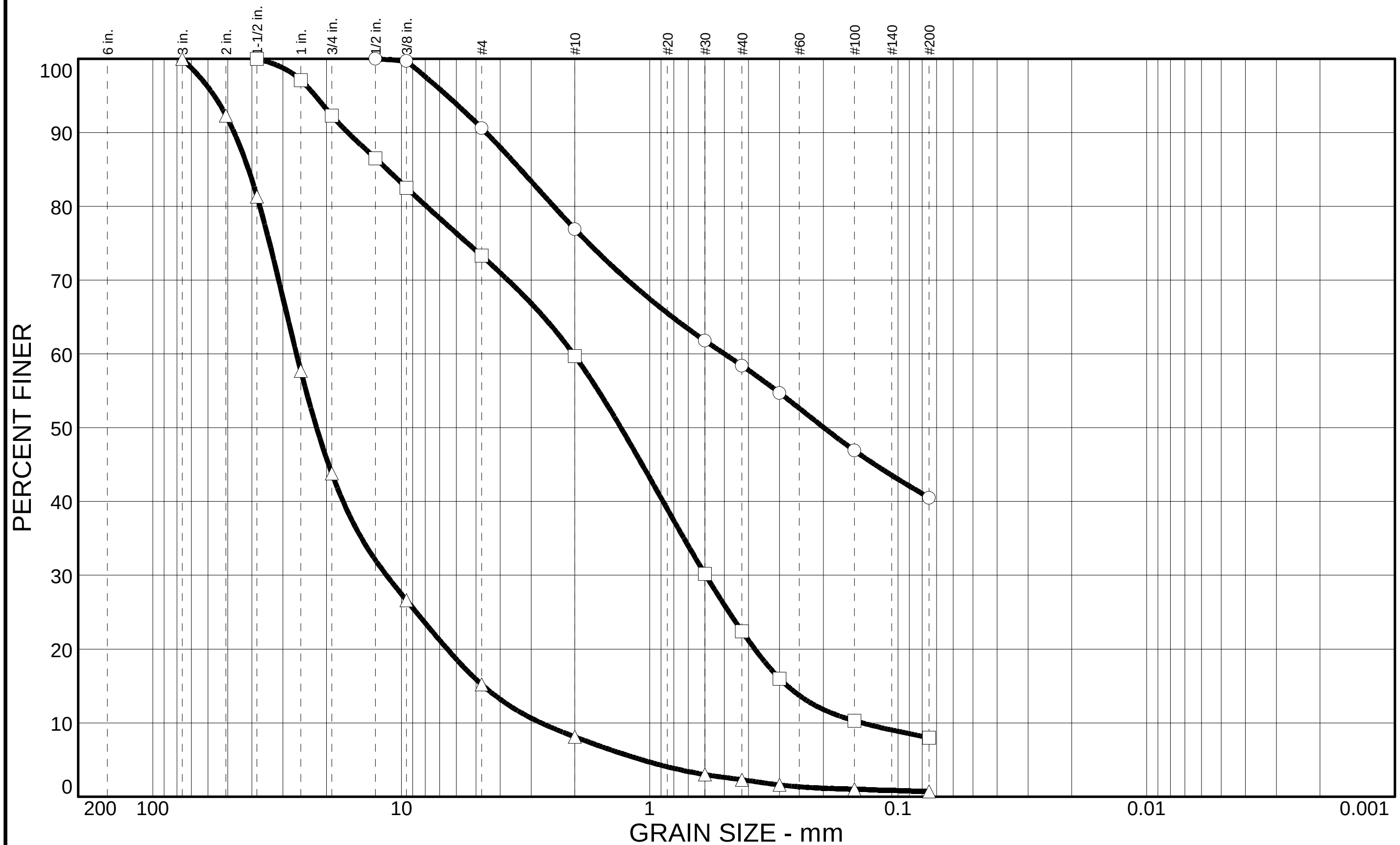
COOPER TESTING LABORATORY

Job No.: 020-251 **Project No.:** 60537920 **Run By:** MD
Client: AECOM **Date:** 6/14/2018 **Checked By:** DC
Project: Klamath River Dam Removal Project

Boring:	BC-07							
Sample:	S-02							
Depth, ft.:	4-4.5							
Soil Type:	Very Dark Olive Brown Sandy Fat CLAY w/ Gravel							
Bulk Sample wt. lb.	218.0							
Wt of Dish & Dry Soil <#4,gm	389.5							
Weight of Dish, gm	171.0							
Weight of Dry Soil <#4, gm	218.5							
Wt. Ret. on #4 Sieve, lb	33.1							
Wt. Ret. on #200 Sieve, gm	52.3							
% Gravel	**15.2**							
% Sand	**20.3**							
% Silt & Clay	**64.5**							

Remarks: As an added benefit to our clients, the gravel fraction may be included in this report. Whether or not it is included is dependent upon both the technician's time available and if there is a significant enough amount of gravel. The gravel is always included in the percent retained on the #200 sieve but may not be weighed separately to determine the percentage, especially if there is only a trace amount, (5% or less).

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		9.4	50.1	40.5					
□		26.7	65.3	8.0					
△		84.8	14.5	0.7					

SIEVE inches size	PERCENT FINER ○	□	△
3			100.0
2			92.3
1.5"		100.0	81.3
1"		97.1	57.7
3/4"		92.3	43.8
1/2"	100.0	86.5	
3/8"	99.7	82.5	26.6
	GRAIN SIZE		
D_{60}	0.500	2.03	26.4
D_{30}		0.595	11.5
D_{10}		0.139	2.74
	COEFFICIENTS		
C_c		1.25	1.82
C_u		14.56	9.65

SIEVE number size	PERCENT FINER ○	□	△
#4	90.6	73.3	15.2
#10	76.9	59.7	8.1
#30	61.8	30.2	3.0
#40	58.4	22.4	2.3
#50	54.7	16.0	1.6
#100	46.9	10.3	1.0
#200	40.5	8.0	0.7

SOIL DESCRIPTION

○ Reddish Brown Clayey SAND

□ Dark Olive Brown Well-Graded SAND w/ Silt & Gravel

△ Dark Olive Brown Well-Graded GRAVEL

REMARKS:

○

□ Due to the small sample size, relative to the largest particle size, this data should be considered to be approximate.

△

○ Source: BC-04 Sample No.: S-03 Elev./Depth: 11-12.5'

□ Source: BC-07 Sample No.: S-04 Elev./Depth: 13'

△ Source: BC-10 Sample No.: S-01 Elev./Depth: 9.5'

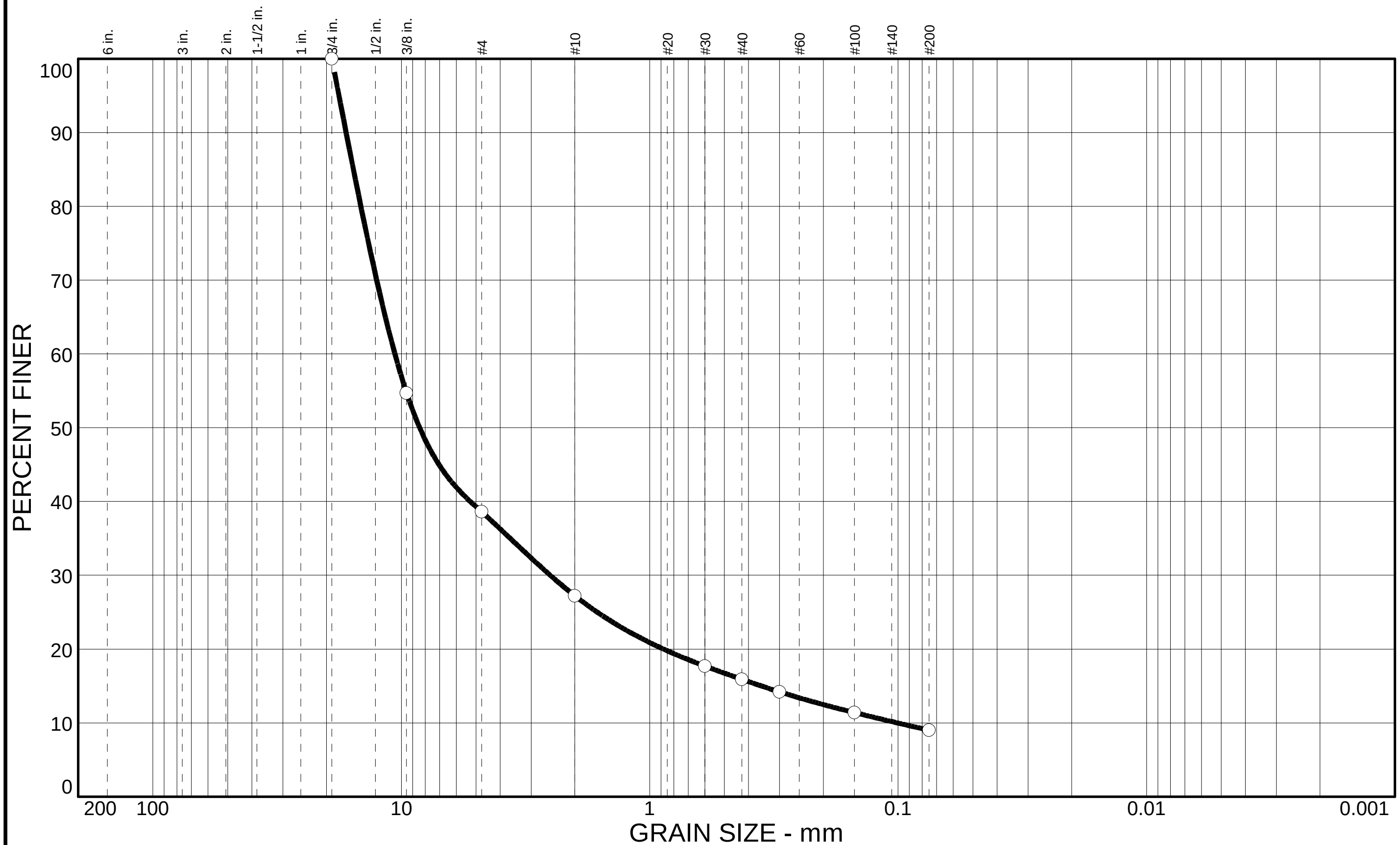
COOPER TESTING LABORATORY

Client: AECOM

Project: Klamath River Dam Removal Project - 60537920

Project No.: 020-251 Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		61.4	29.6	9.0		GP-GM		26	41

SIEVE inches size	PERCENT FINER ○		
3/4"	100.0		
3/8"	54.7		

	GRAIN SIZE		
D_{60}	10.6		
D_{30}	2.52		
D_{10}	0.101		

	COEFFICIENTS		
C_c	5.92		
C_u	105.44		

SIEVE number size	PERCENT FINER ○		
#4	38.6		
#10	27.2		
#30	17.7		
#40	15.9		
#50	14.2		
#100	11.4		
#200	9.0		

SOIL DESCRIPTION

○ Olive Gray Poorly Graded GRAVEL w/ Silt & Sand

REMARKS:

○

○ Source: BI-03 Sample No.: S-01 Elev./Depth: 3.5'

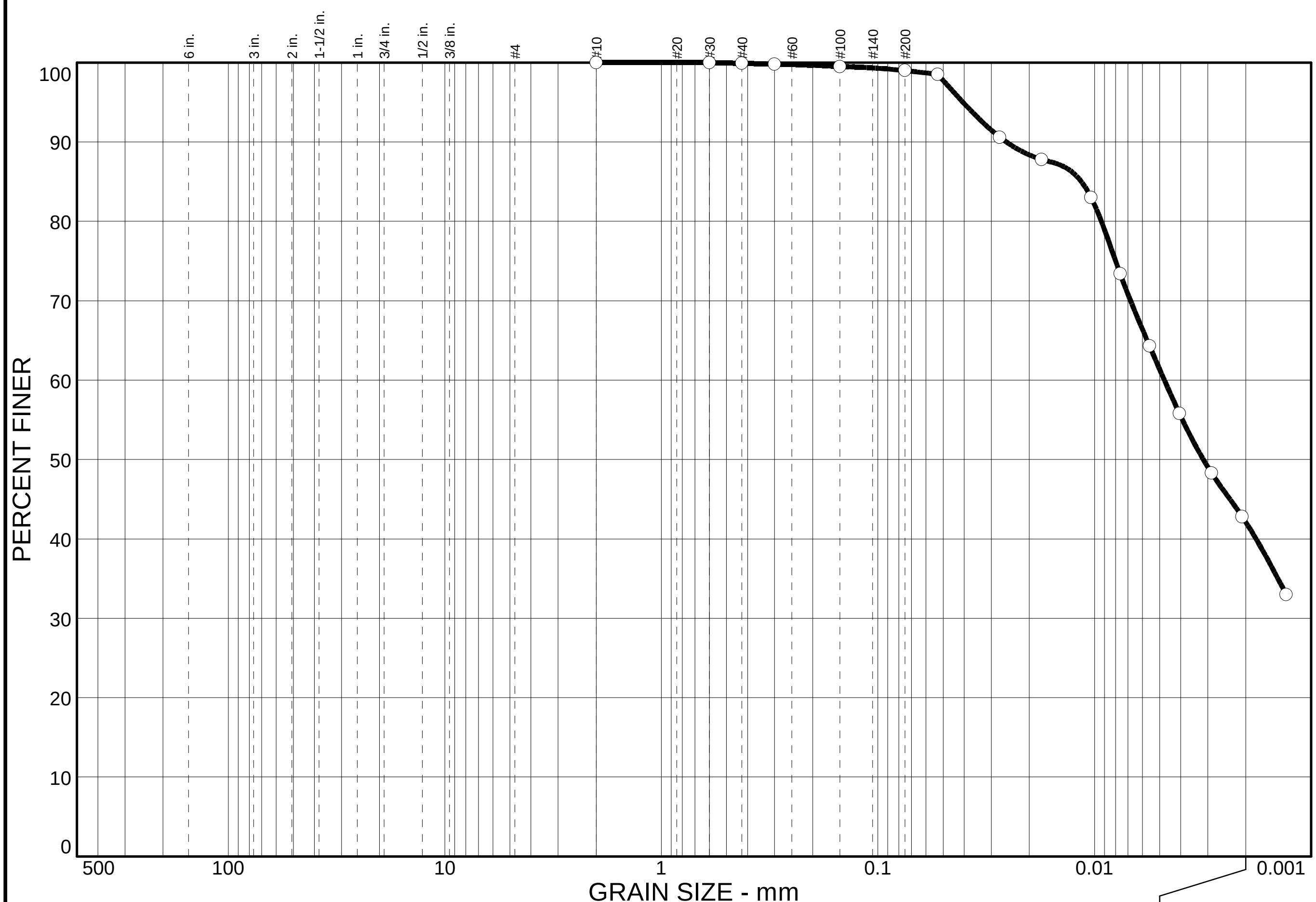
COOPER TESTING LABORATORY

Client: AECOM

Project: Klamath River Dam Removal Project - 60537920

Project No.: 020-251 Figure

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	1.0	56.9	42.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	100.0		
#40	99.9		
#50	99.8		
#100	99.5		
#200	99.0		
#270	98.5		
0.0274 mm.	90.6		
0.0176 mm.	87.8		
0.0104 mm.	83.0		
0.0076 mm.	73.4		
0.0056 mm.	64.3		
0.0041 mm.	55.8		
0.0029 mm.	48.3		
0.0021 mm.	42.8		
0.0013 mm.	33.0		

* (no specification provided)

Soil Description

Olive Gray Elastic SILT

Atterberg Limits

PL= 51 LL= 85 PI= 34

Coefficients

D_{85}= 0.0115 D_{60}= 0.0048 D_{50}= 0.0031
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

Remarks

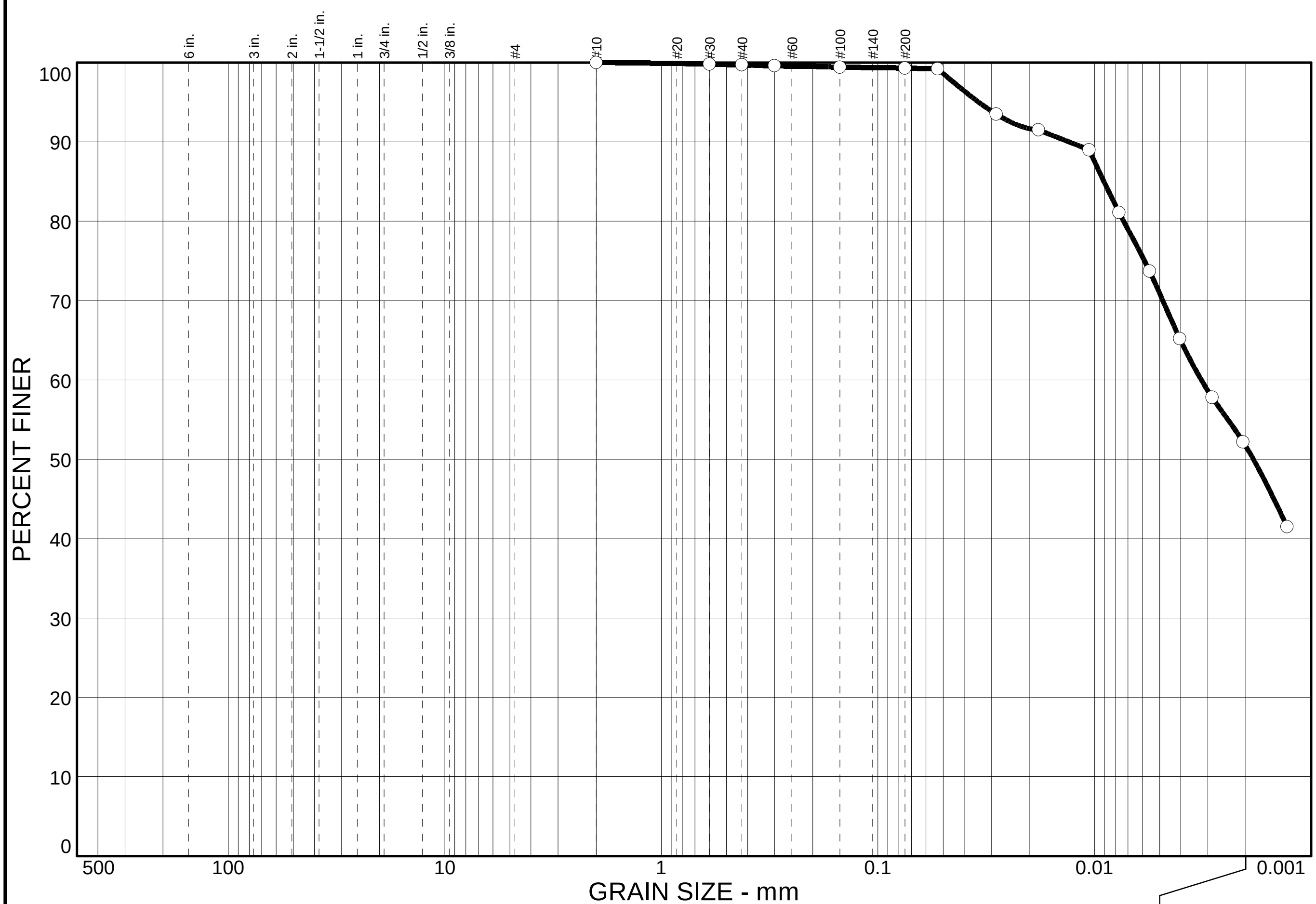
Sample No.: S-04 **Source of Sample:** BC-01 **Date:** 6/5/18
Location: **Elev./Depth:** 21.5'

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	0.7	47.7	51.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	99.8		
#40	99.7		
#50	99.6		
#100	99.4		
#200	99.3		
#270	99.2		
0.0285 mm.	93.5		
0.0182 mm.	91.5		
0.0106 mm.	89.0		
0.0077 mm.	81.1		
0.0056 mm.	73.7		
0.0040 mm.	65.2		
0.0029 mm.	57.8		
0.0021 mm.	52.2		
0.0013 mm.	41.5		

* (no specification provided)

Soil Description

Gray Elastic SILT

Atterberg Limits

PL= 59 LL= 105 PI= 46

Coefficients

D_{85}= 0.0090 D_{60}= 0.0032 D_{50}= 0.0018
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

Remarks

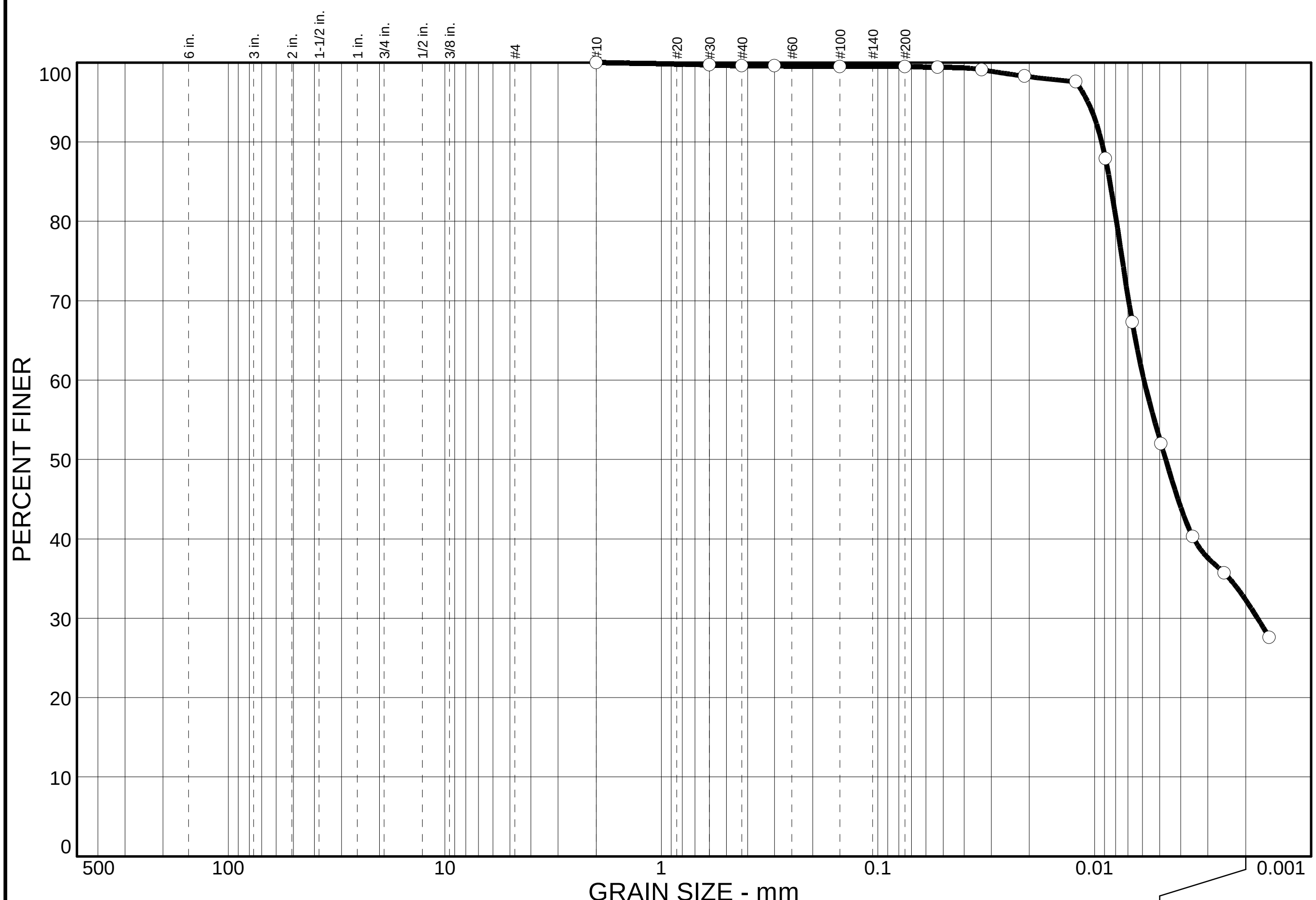
Sample No.: S-05 **Source of Sample:** BC-02 **Date:** 6/5/18
Location: **Elev./Depth:** 14.5'

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	0.5	67.2	32.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	99.7		
#40	99.6		
#50	99.6		
#100	99.5		
#200	99.5		
#270	99.4		
0.0331 mm.	99.1		
0.0210 mm.	98.3		
0.0122 mm.	97.6		
0.0089 mm.	87.9		
0.0067 mm.	67.3		
0.0049 mm.	52.0		
0.0035 mm.	40.3		
0.0025 mm.	35.7		
0.0016 mm.	27.6		

* (no specification provided)

Soil Description

Gray Elastic SILT

Atterberg Limits

PL= 85 LL= 187 PI= 102

Coefficients

D_{85}= 0.0085 D_{60}= 0.0059 D_{50}= 0.0047
D_{30}= 0.0018 D_{15}= D_{10}=
C_u= C_c=

Classification

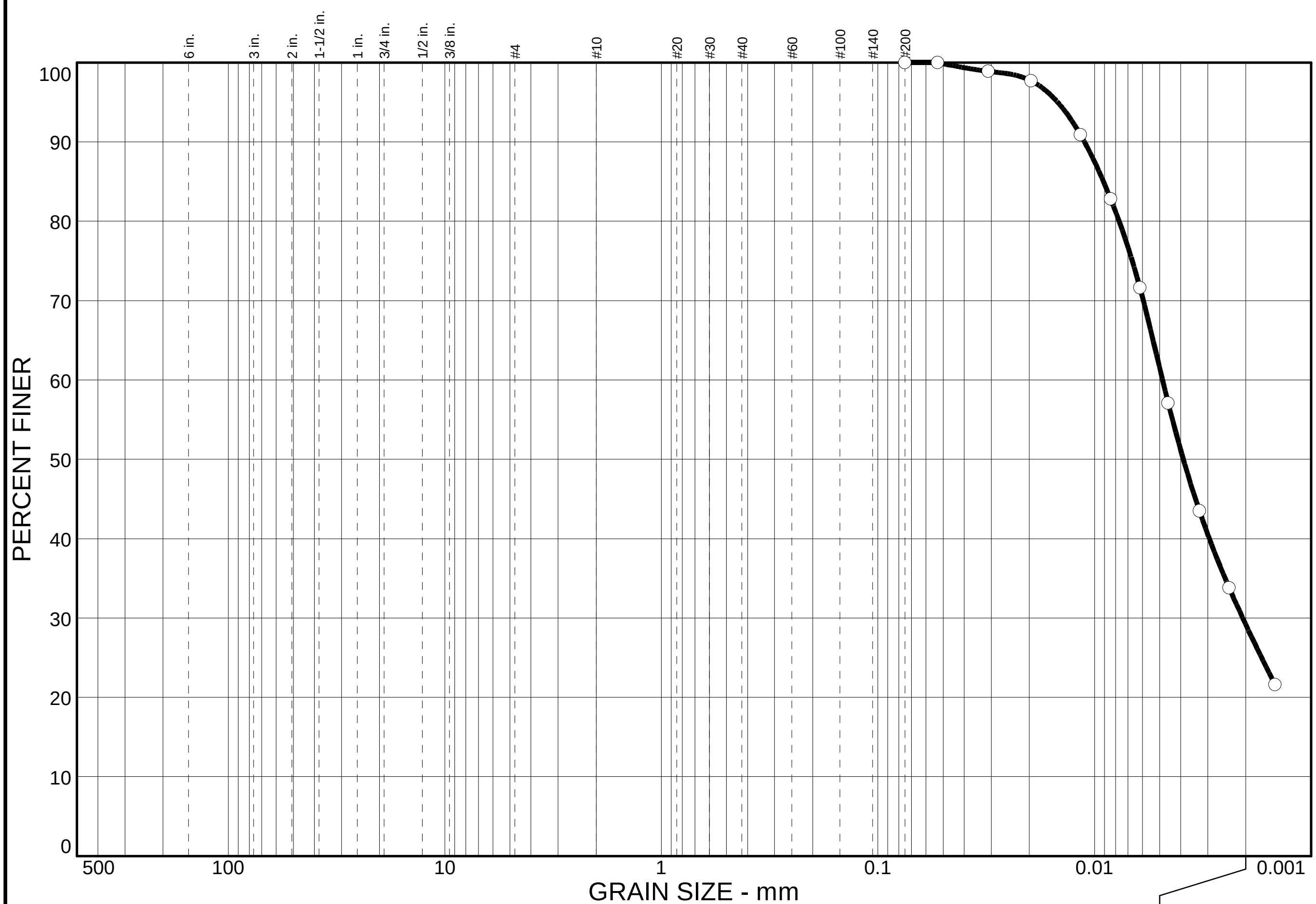
USCS= MH AASHTO=

Remarks

Sample No.: S-09 **Source of Sample:** BC-02 **Date:** 6/5/18
Location: **Elev./Depth:** 44.5'

COOPER TESTING LABORATORY	**Client:** AECOM **Project:** Klamath River Dam Removal Project - 60537920 **Project No:** 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	0.0	70.9	29.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	100.0		
#270	100.0		
0.0309 mm.	98.9		
0.0196 mm.	97.7		
0.0116 mm.	90.9		
0.0084 mm.	82.8		
0.0062 mm.	71.6		
0.0046 mm.	57.1		
0.0033 mm.	43.5		
0.0024 mm.	33.8		
0.0015 mm.	21.6		

* (no specification provided)

Soil Description

Light Olive Brown Elastic SILT

Atterberg Limits

PL= 59 LL= 69 PI= 10

Coefficients

D_{85}= 0.0091 D_{60}= 0.0049 D_{50}= 0.0039
D_{30}= 0.0021 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

Remarks

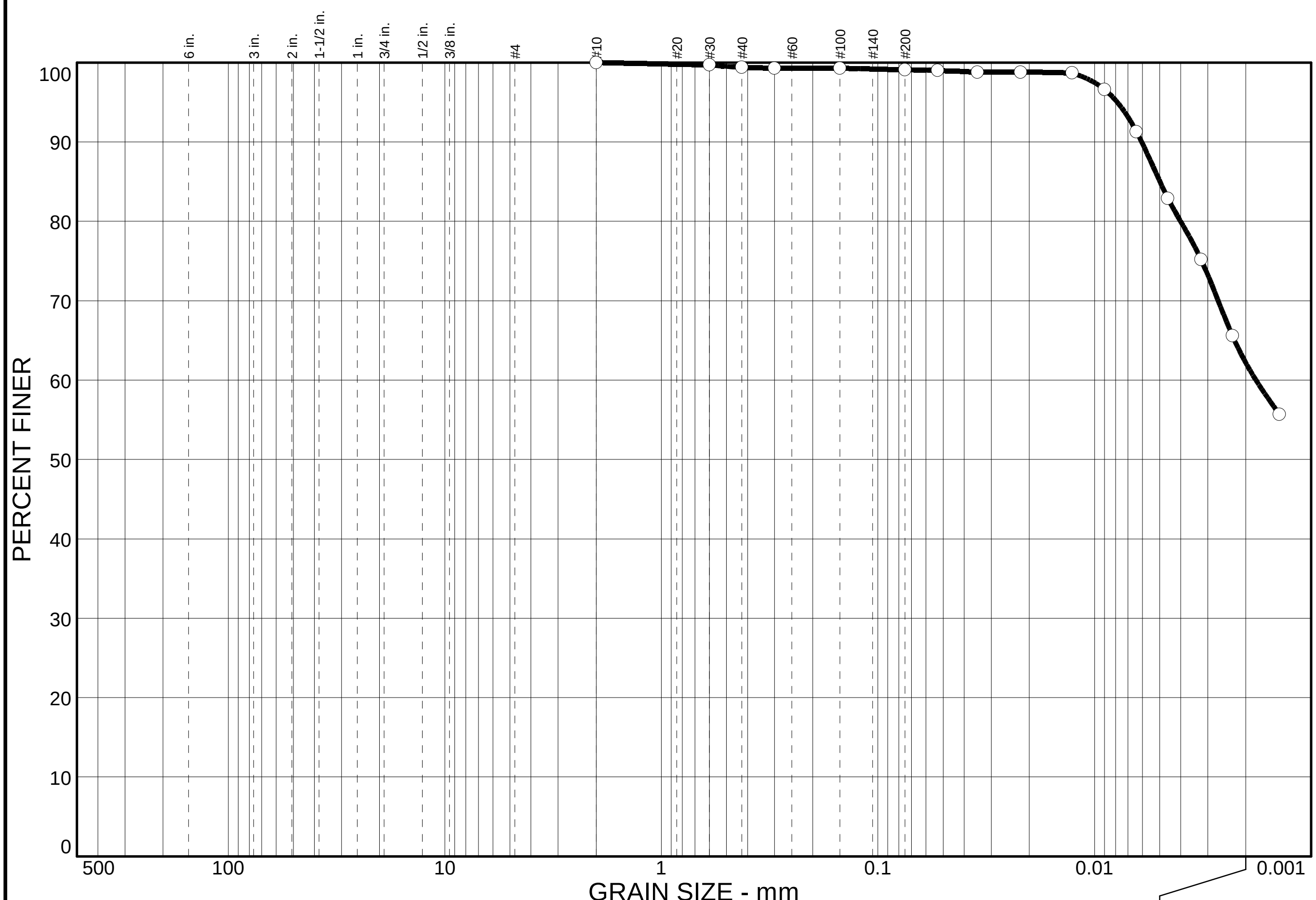
Sample No.: S-05 **Source of Sample:** BC-03 **Date:** 6/5/18
Location: **Elev./Depth:** 24.5'

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	0.9	37.0	62.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	99.7		
#40	99.4		
#50	99.3		
#100	99.3		
#200	99.1		
#270	99.0		
0.0347 mm.	98.8		
0.0219 mm.	98.8		
0.0127 mm.	98.7		
0.0090 mm.	96.6		
0.0064 mm.	91.3		
0.0046 mm.	82.9		
0.0032 mm.	75.2		
0.0023 mm.	65.6		
0.0014 mm.	55.7		

* (no specification provided)

Soil Description

Pale Brown Mottled Gray Elastic SILT

Atterberg Limits

PL= 85 LL= 120 PI= 35

Coefficients

D_{85}= 0.0050 D_{60}= 0.0018 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

Remarks

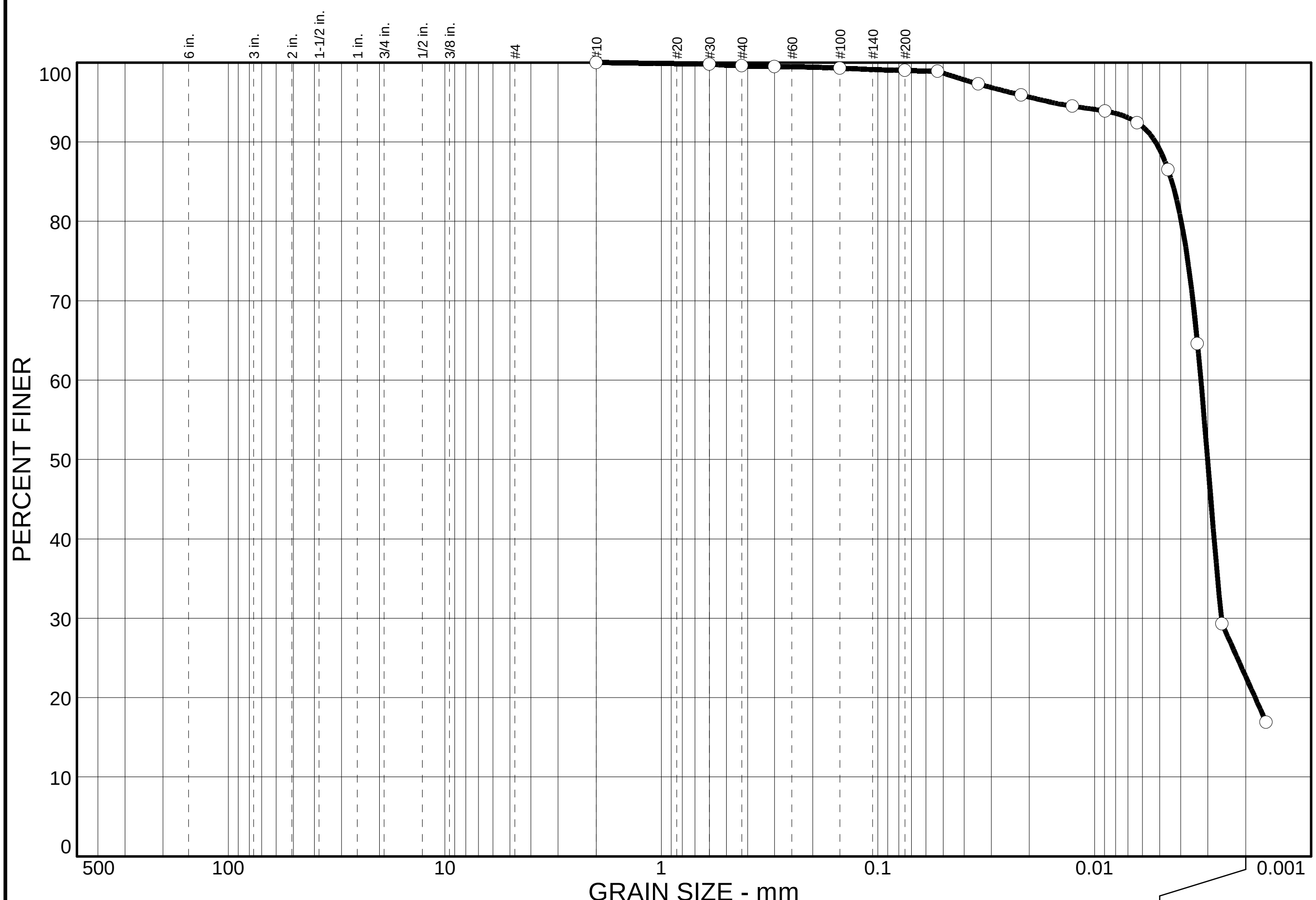
Sample No.: S-08 **Source of Sample:** BC-04 **Date:** 5/16/18
Location: **Elev./Depth:** 32.5(Tip-16")

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	1.0	76.4	22.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	99.8		
#40	99.6		
#50	99.5		
#100	99.3		
#200	99.0		
#270	98.9		
0.0343 mm.	97.3		
0.0218 mm.	95.9		
0.0126 mm.	94.5		
0.0089 mm.	93.9		
0.0063 mm.	92.4		
0.0046 mm.	86.5		
0.0034 mm.	64.6		
0.0026 mm.	29.3		
0.0016 mm.	16.9		

* (no specification provided)

Soil Description

Light Olive Brown Elastic SILT

Atterberg Limits

PL= 88 LL= 200 PI= 112

Coefficients

D_{85}= 0.0044 D_{60}= 0.0032 D_{50}= 0.0030
D_{30}= 0.0026 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

Remarks

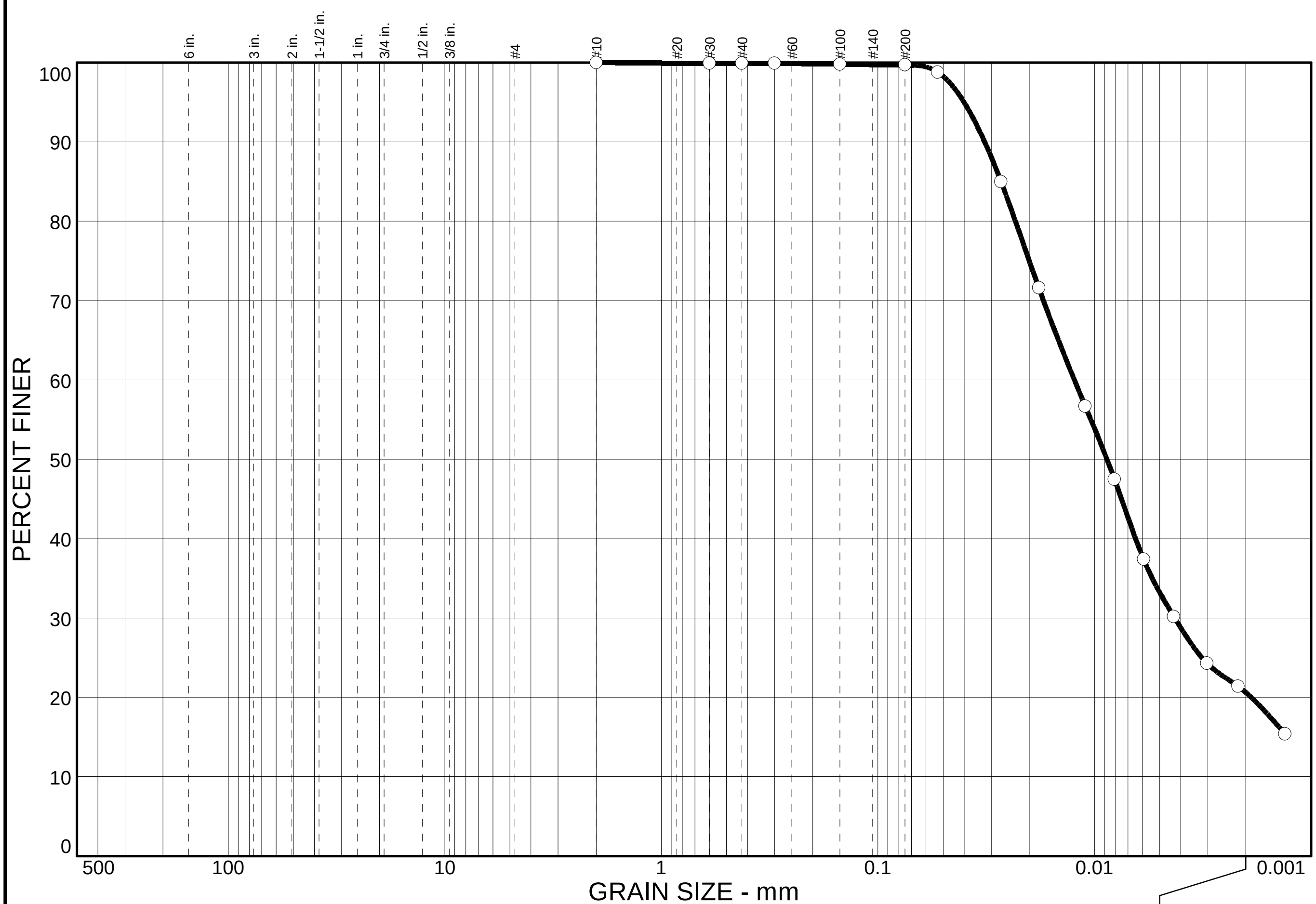
Sample No.: S-05 **Source of Sample:** BC-08A **Date:** 6/5/18
Location: **Elev./Depth:** 54'

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	0.3	79.1	20.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#30	99.9		
#40	99.9		
#50	99.9		
#100	99.8		
#200	99.7		
#270	98.8		
0.0270 mm.	85.0		
0.0181 mm.	71.6		
0.0110 mm.	56.7		
0.0081 mm.	47.5		
0.0059 mm.	37.4		
0.0043 mm.	30.2		
0.0030 mm.	24.3		
0.0022 mm.	21.4		
0.0013 mm.	15.4		

* (no specification provided)

Soil Description

Dark Gray Elastic SILT

Atterberg Limits

PL= 53 LL= 74 PI= 21

Coefficients

D_{85}= 0.0270 D_{60}= 0.0124 D_{50}= 0.0088
D_{30}= 0.0043 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= MH AASHTO=

Remarks

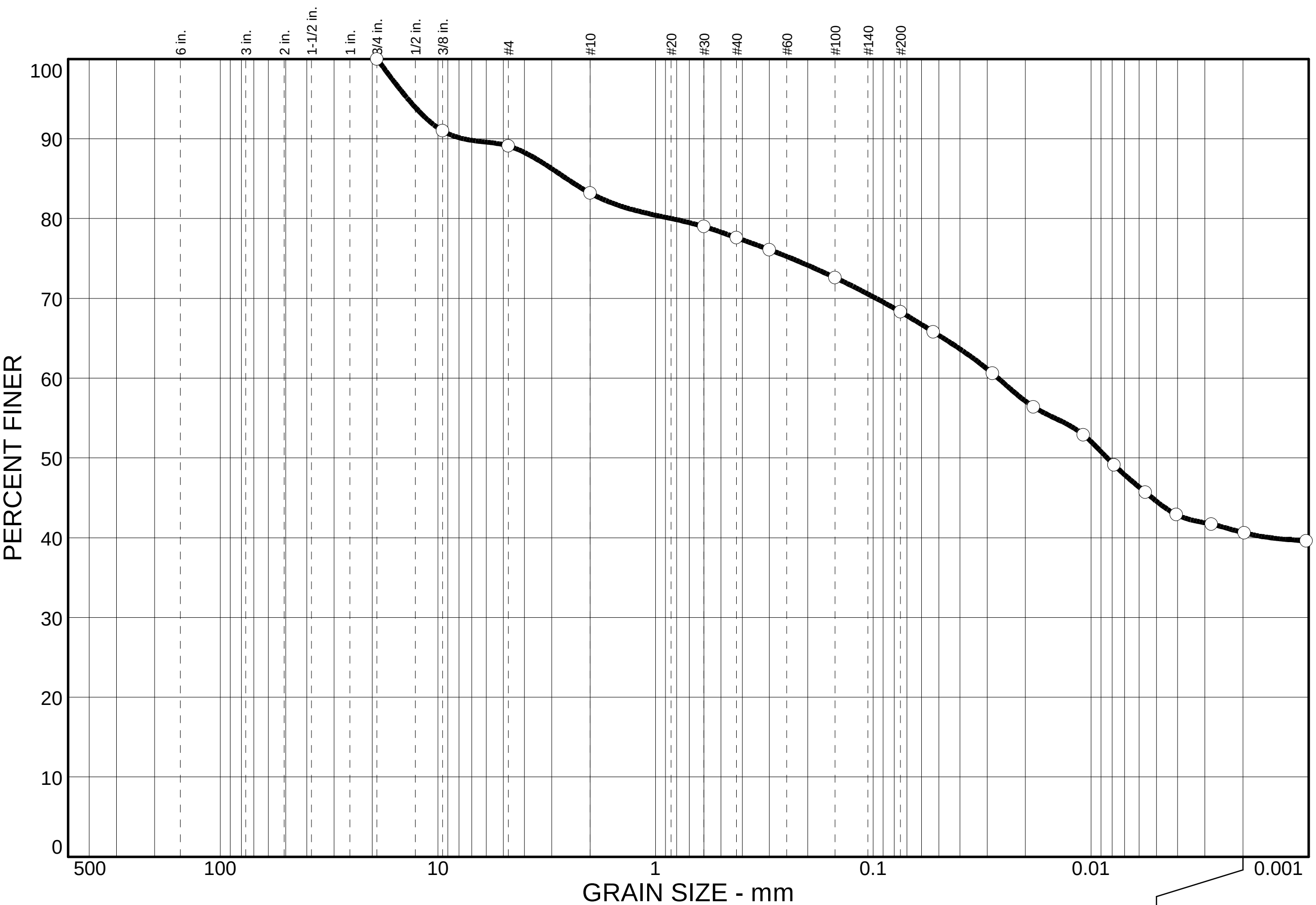
Sample No.: S-05 **Source of Sample:** BC-09 **Date:** 6/5/18
Location: **Elev./Depth:** 23(Tip-5")

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	10.9	20.8	27.7	40.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
3/8 in.	91.0		
#4	89.1		
#10	83.2		
#30	79.0		
#40	77.6		
#50	76.1		
#100	72.6		
#200	68.3		
#270	65.8		
0.0284 mm.	60.6		
0.0184 mm.	56.4		
0.0108 mm.	52.9		
0.0078 mm.	49.1		
0.0056 mm.	45.7		
0.0041 mm.	42.9		
0.0028 mm.	41.7		
0.0020 mm.	40.6		
0.0010 mm.	39.6		

* (no specification provided)

Soil Description

Dark Reddish Brown Sandy Fat CLAY

Atterberg Limits

PL= 28 LL= 78 PI= 50

Coefficients

D_{85}= 2.56 D_{60}= 0.0267 D_{50}= 0.0084
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

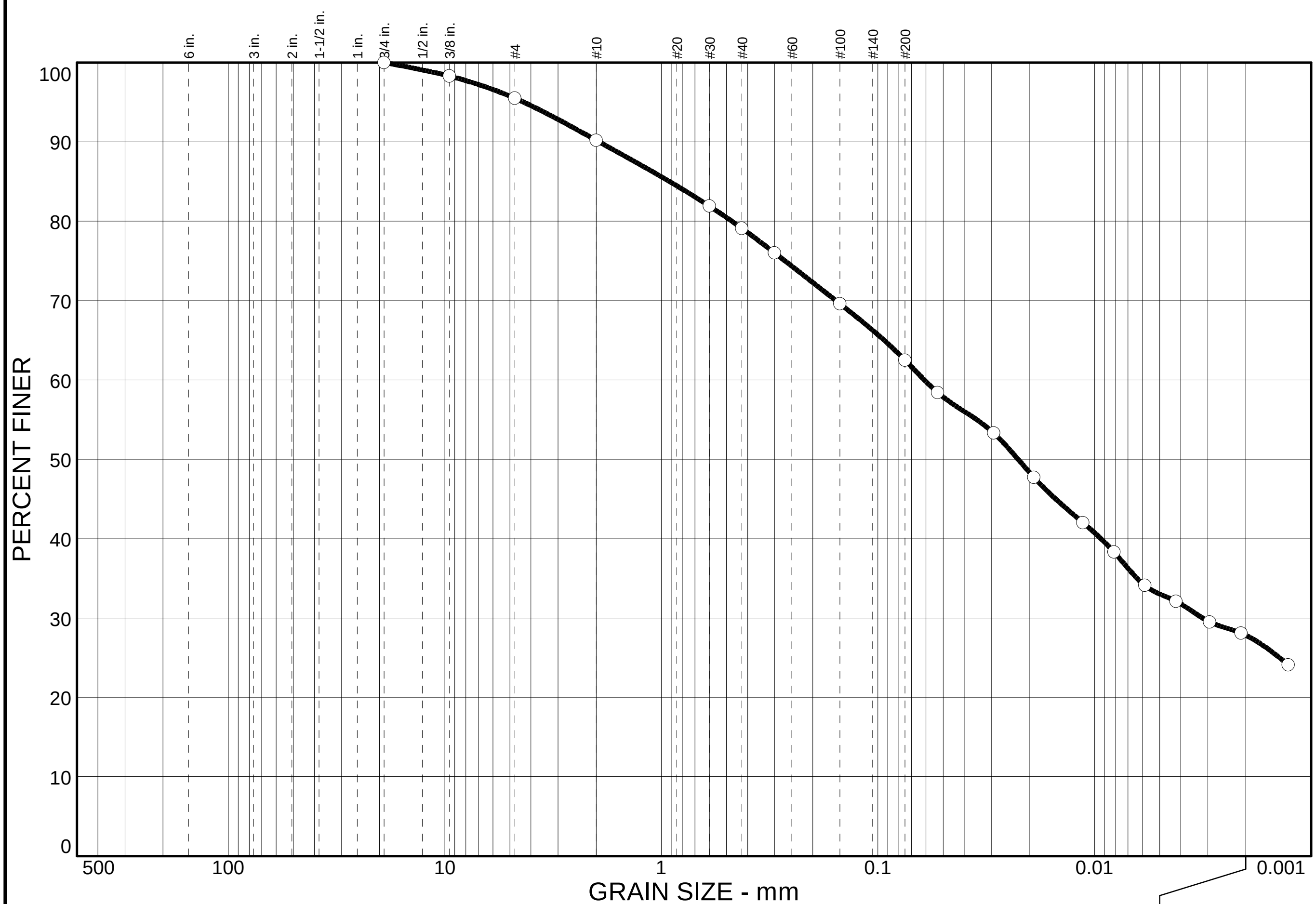
Sample No.: S-01 **Source of Sample:** BI-02 **Date:** 6/6/18
Location: **Elev./Depth:** 5'

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	4.5	33.0	34.7	27.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
3/8 in.	98.3		
#4	95.5		
#10	90.2		
#30	81.9		
#40	79.1		
#50	76.0		
#100	69.6		
#200	62.5		
#270	58.4		
0.0292 mm.	53.3		
0.0190 mm.	47.7		
0.0113 mm.	42.0		
0.0081 mm.	38.3		
0.0059 mm.	34.1		
0.0042 mm.	32.1		
0.0029 mm.	29.5		
0.0021 mm.	28.1		
0.0013 mm.	24.1		

* (no specification provided)

Soil Description

Yellowish Brown Sandy Fat CLAY

Atterberg Limits

PL= 28 LL= 58 PI= 30

Coefficients

D_{85}= 0.917 D_{60}= 0.0612 D_{50}= 0.0226
D_{30}= 0.0032 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

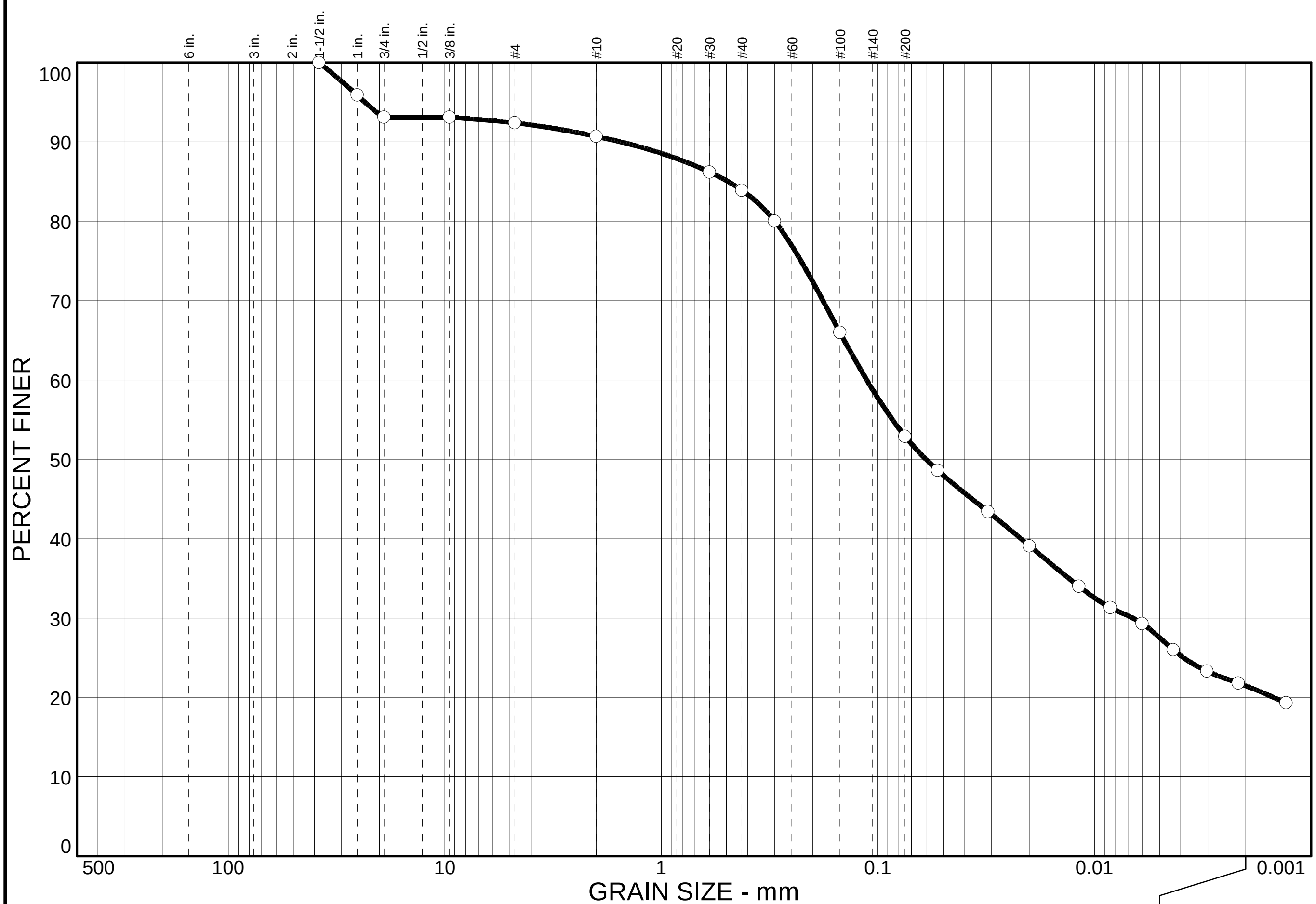
Sample No.: S-02 **Source of Sample:** BI-02 **Date:** 6/6/18
Location: **Elev./Depth:** 10'

COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	7.6	39.5	31.5	21.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5 in.	100.0		
1 in.	95.9		
3/4 in.	93.1		
3/8 in.	93.1		
#4	92.4		
#10	90.7		
#30	86.2		
#40	83.9		
#50	80.0		
#100	66.0		
#200	52.9		
#270	48.6		
0.0311 mm.	43.4		
0.0200 mm.	39.1		
0.0118 mm.	34.0		
0.0084 mm.	31.3		
0.0060 mm.	29.3		
0.0043 mm.	26.0		
0.0030 mm.	23.3		
0.0022 mm.	21.8		
0.0013 mm.	19.3		

* (no specification provided)

Soil Description

Yellowish Brown Sandy Fat CLAY

Atterberg Limits

PL= 27 LL= 51 PI= 24

Coefficients

D_{85}= 0.492 D_{60}= 0.113 D_{50}= 0.0601
D_{30}= 0.0067 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

Due to the small sample size, relative to the largest particle size, this data should be considered to be approximate.

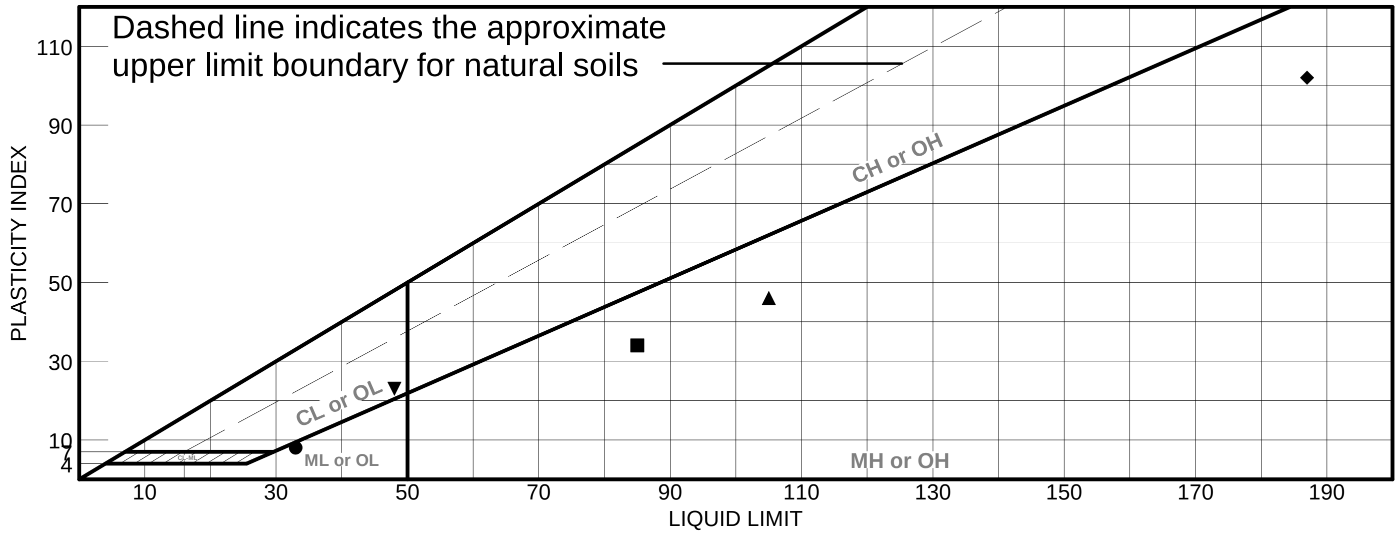
Sample No.: S-03 **Source of Sample:** BI-02 **Date:** 6/6/18
Location: **Elev./Depth:** 15'

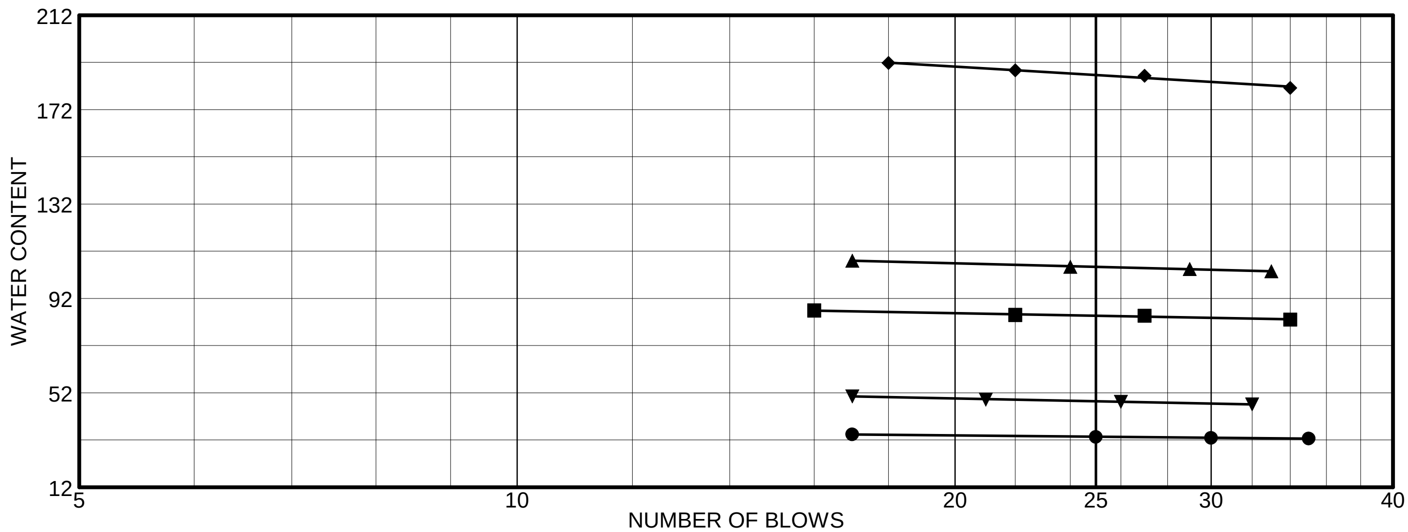
COOPER TESTING LABORATORY

Client: AECOM
Project: Klamath River Dam Removal Project - 60537920

Project No: 020-251 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark Olive Gray Sandy SILT	33	25	8			
■	Olive Gray Elastic SILT	85	51	34	99.9	99.0	MH
▲	Gray Elastic SILT	105	59	46	99.7	99.3	MH
◆	Gray Elastic SILT	187	85	102	99.6	99.5	MH
▼	Dark Olive Brown Sandy Lean CLAY	48	25	23			

Project No. 020-251 **Client:** AECOM

Project: Klamath River Dam Removal Project - 60537920

● **Source:** BC-01 **Sample No.:** S-02 **Elev./Depth:** 6.5'
■ **Source:** BC-01 **Sample No.:** S-04 **Elev./Depth:** 21.5'
▲ **Source:** BC-02 **Sample No.:** S-05 **Elev./Depth:** 14.5'
◆ **Source:** BC-02 **Sample No.:** S-09 **Elev./Depth:** 44.5'
▼ **Source:** BC-03 **Sample No.:** S-01 **Elev./Depth:** 1'

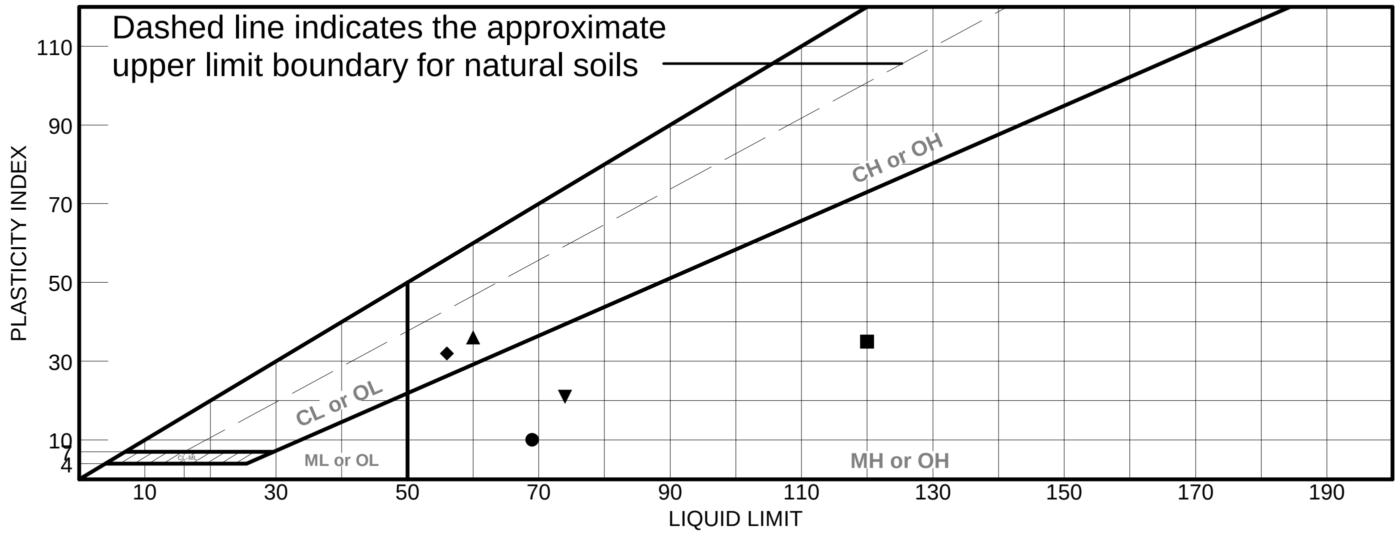
Remarks:
●
■
▲
◆
▼

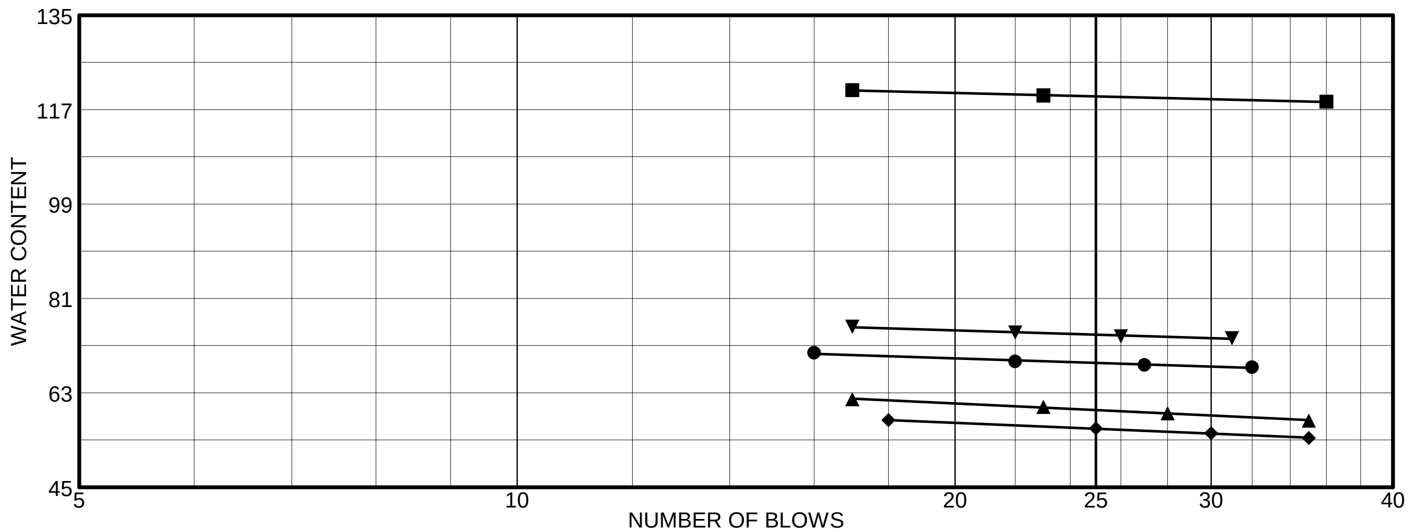
LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Light Olive Brown Elastic SILT	69	59	10	100.0	100.0	MH
■	Pale Brown Mottled Gray Elastic SILT	120	85	35	99.4	99.1	MH
▲	Very Dark Olive Brown Sandy Fat CLAY w/ Gravel	60	24	36			
◆	Dark Reddish Brown Sandy Fat CLAY	56	24	32			
▼	Dark Gray Elastic SILT	74	53	21	99.9	99.7	MH

Project No. 020-251 **Client:** AECOM

Project: Klamath River Dam Removal Project - 60537920

● **Source:** BC-03 **Sample No.:** S-05 **Elev./Depth:** 24.5'
■ **Source:** BC-04 **Sample No.:** S-08 **Elev./Depth:** 32.5(Tip-16")
▲ **Source:** BC-07 **Sample No.:** S02 **Elev./Depth:** 4-4.5'
◆ **Source:** BC-08 **Sample No.:** S-01 **Elev./Depth:** 3.0'
▼ **Source:** BC-09 **Sample No.:** S-05 **Elev./Depth:** 23(Tip-5")

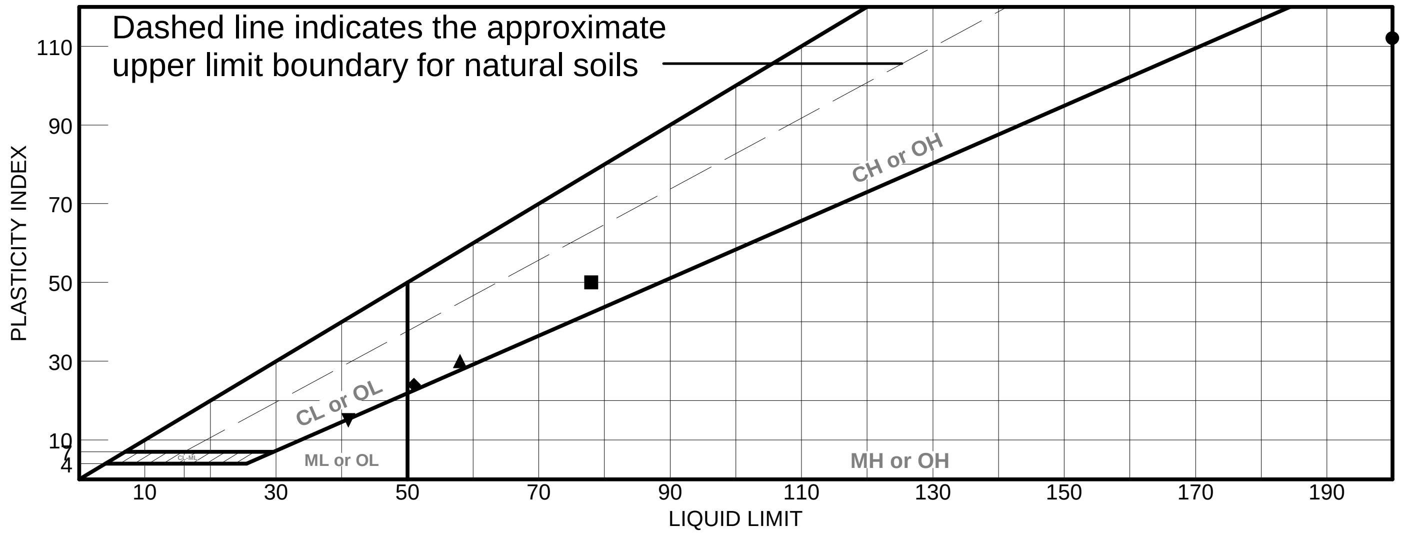
Remarks:
●
■
▲
◆
▼

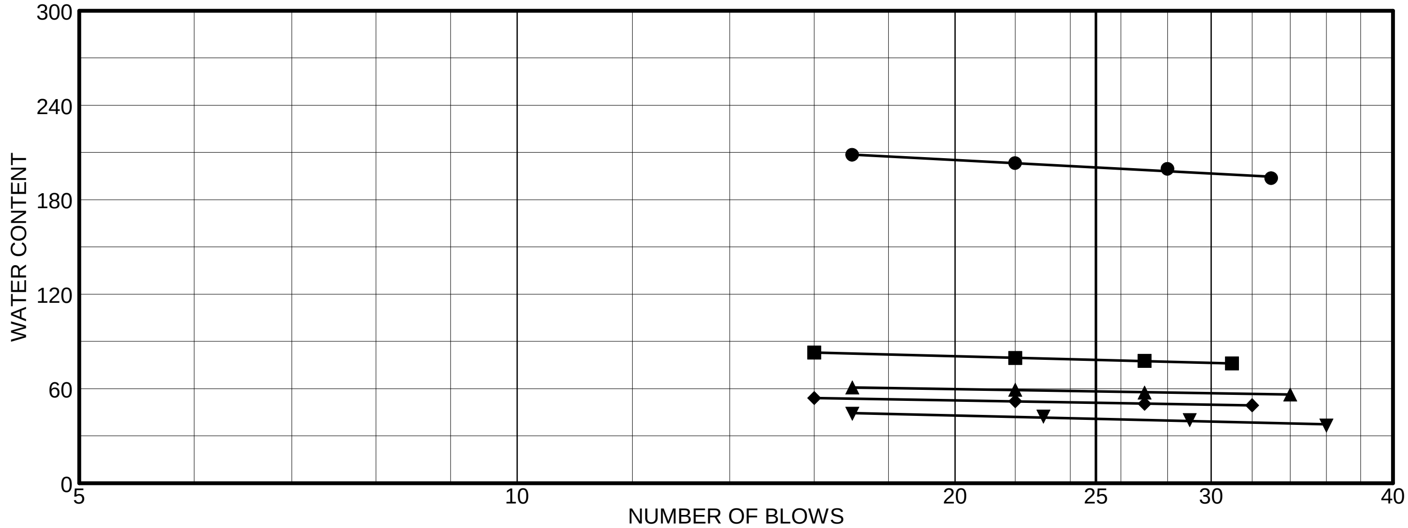
LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Light Olive Brown Elastic SILT	200	88	112	99.6	99.0	MH
■	Dark Reddish Brown Sandy Fat CLAY	78	28	50	77.6	68.3	CH
▲	Yellowish Brown Sandy Fat CLAY	58	28	30	79.1	62.5	CH
◆	Yellowish Brown Sandy Fat CLAY	51	27	24	83.9	52.9	CH
▼	Olive Gray Poorly Graded GRAVEL w/ Silt & Sand	41	26	15	15.9	9.0	GP-GM

Project No. 020-251 **Client:** AECOM

Project: Klamath River Dam Removal Project - 60537920

● **Source:** BC-08A **Sample No.:** S-05 **Elev./Depth:** 54'
■ **Source:** BI-02 **Sample No.:** S-01 **Elev./Depth:** 5'
▲ **Source:** BI-02 **Sample No.:** S-02 **Elev./Depth:** 10'
◆ **Source:** BI-02 **Sample No.:** S-03 **Elev./Depth:** 15'
▼ **Source:** BI-03 **Sample No.:** S-01 **Elev./Depth:** 3.5'

Remarks:
●
■
▲
◆
▼

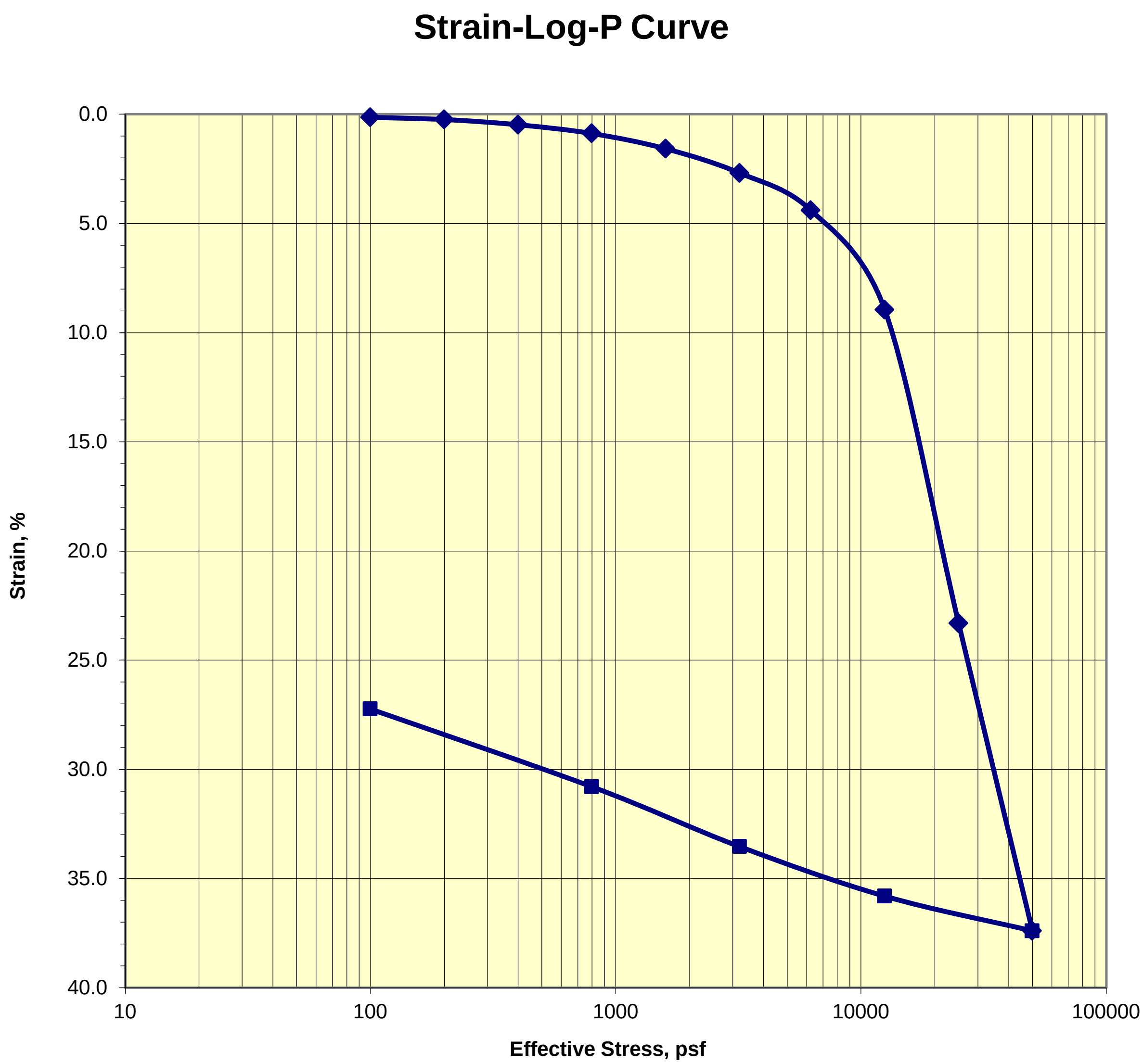
LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

Consolidation Test
ASTM D2435

Job No.:	020-251	**Boring:**	BC-04	**Run By:**	MD
Client:	AECOM	**Sample:**	S-08	**Reduced:**	PJ
Project:	60537920	**Depth, ft.:**	32.5(Tip-2")	**Checked:**	PJ/DC
Soil Type:	Pale Brown Mottled Gray Elastic SILT			**Date:**	6/1/2018

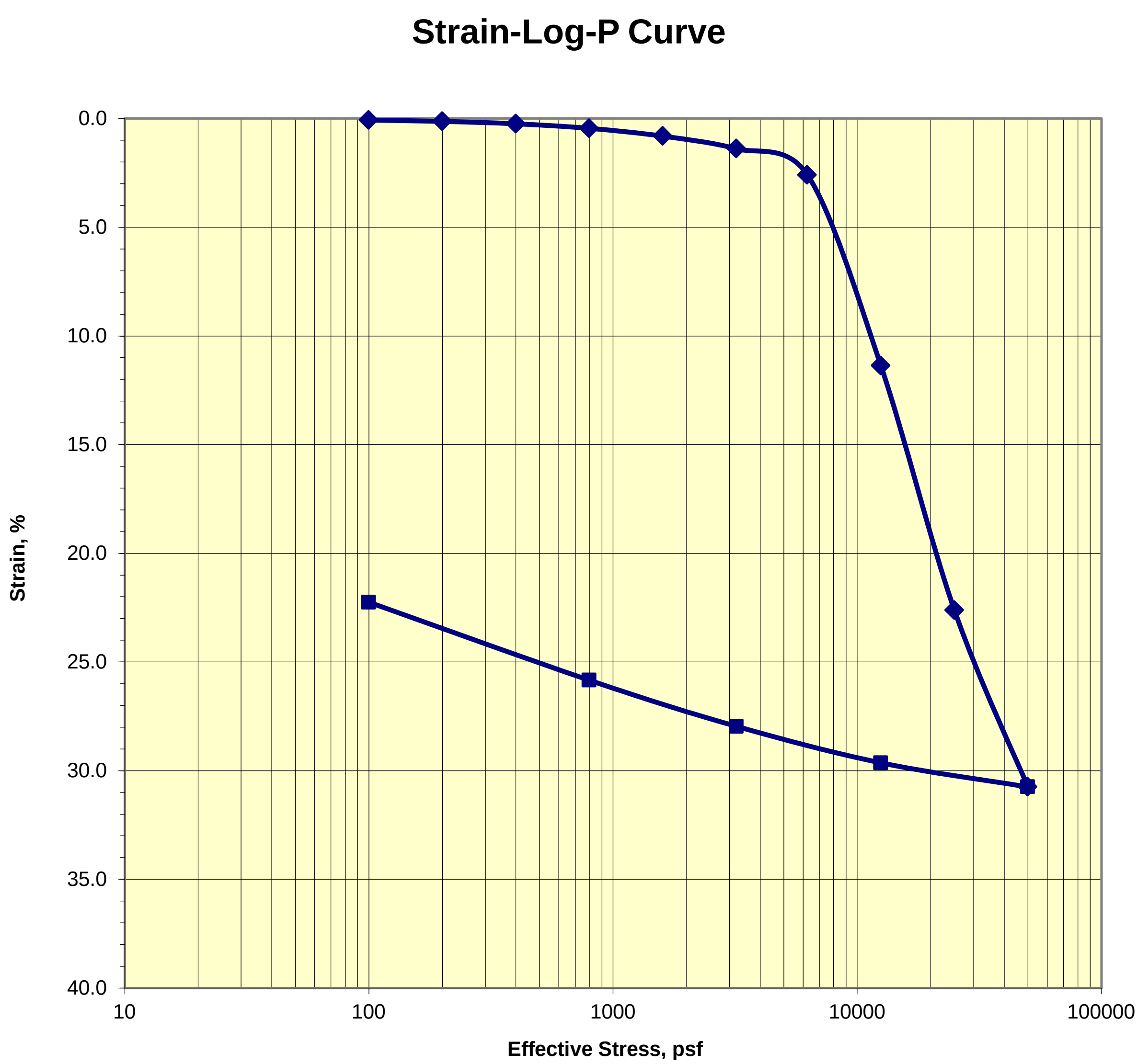


Assumed Gs 2.6	**Initial**	**Final**
Moisture %:	149.5	104.4
Dry Density, pcf:	32.1	43.7
Void Ratio:	4.058	2.715
% Saturation:	95.8	100.0

Remarks:

Consolidation Test
ASTM D2435

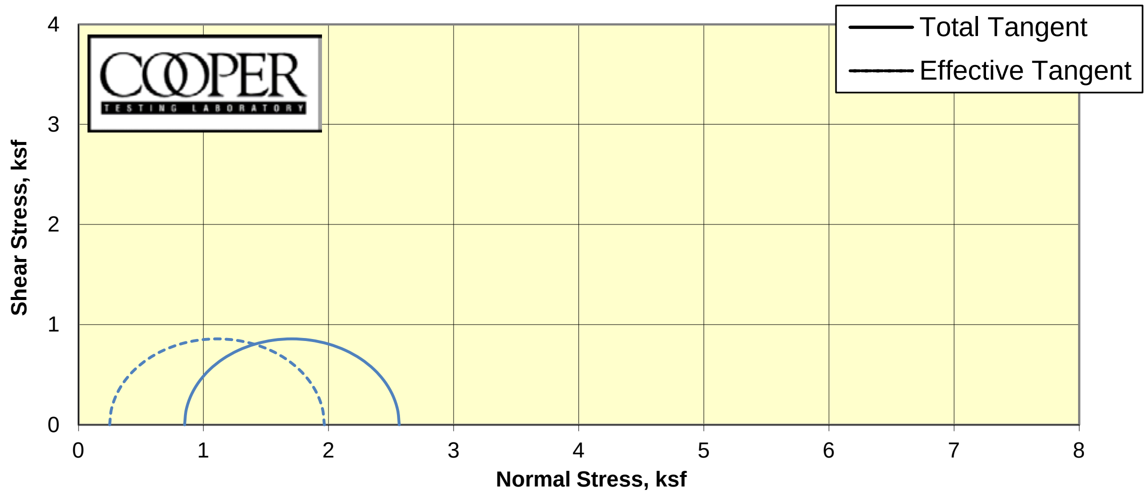
Job No.:	020-251	**Boring:**	BC-09	**Run By:**	MD
Client:	AECOM	**Sample:**	S-09	**Reduced:**	PJ
Project:	60537920	**Depth, ft.:**	68-70.5(Tip-20")	**Checked:**	PJ/DC
Soil Type:	Dark Greenish Gray CLAY (Silty)			**Date:**	6/1/2018

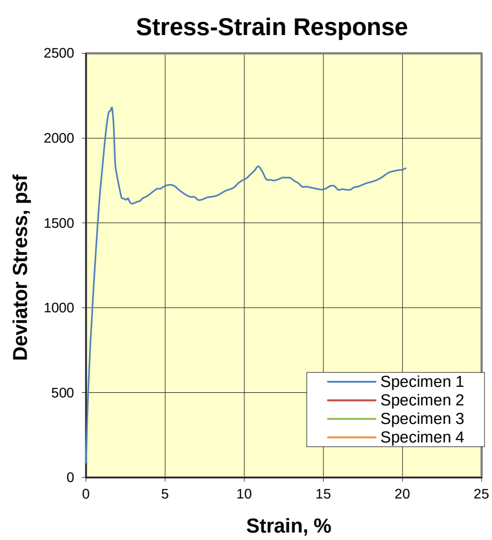


Assumed Gs 2.6	**Initial**	**Final**
Moisture %:	88.4	60.3
Dry Density, pcf:	48.6	63.2
Void Ratio:	2.340	1.568
% Saturation:	98.2	100.0

Remarks:

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767

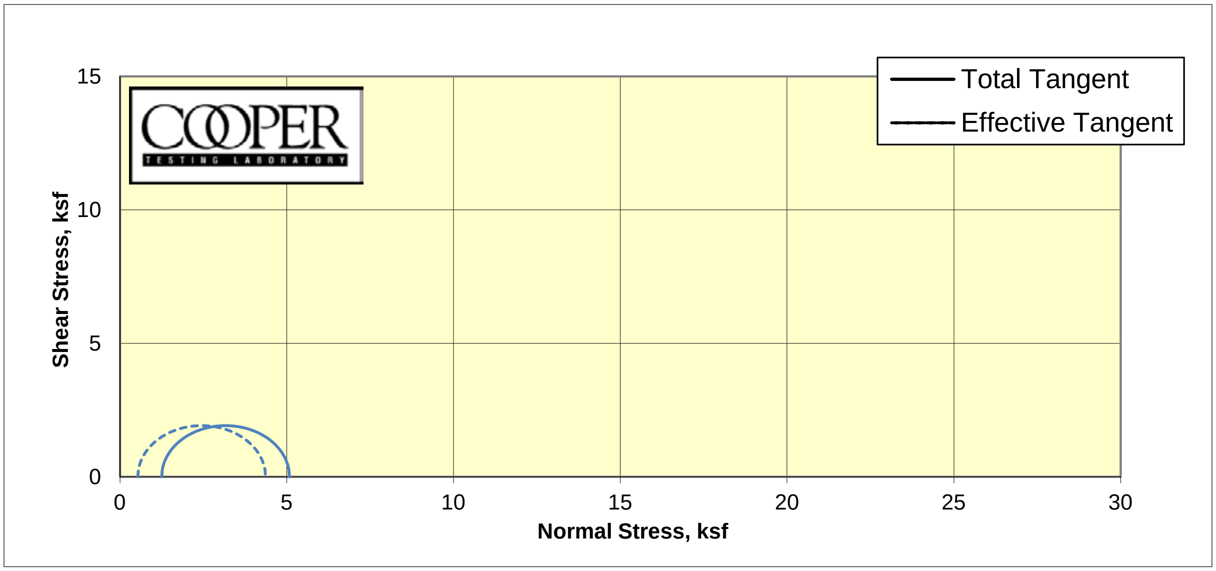


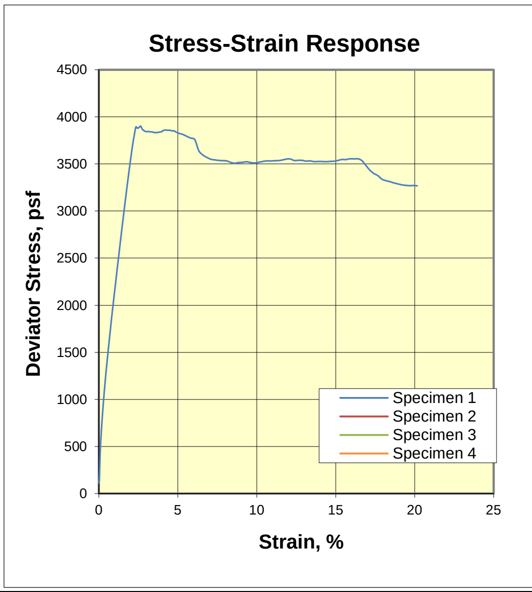


Specimen	1	2	3	4
Boring	BC-02			
Sample	S-06			
Depth	19.5(Tip-2")			
Visual Description	Gray CLAY (Silty)			
MC (%)	147.5			
Dry Density (pcf)	31.6			
Saturation (%)	92.6			
Void Ratio	4.139			
Diameter (in)	2.86			
Height (in)	6.07			
	Final			
MC (%)	147.6			
Dry Density (pcf)	33.6			
Saturation (%)	100.0			
Void Ratio	3.838			
Diameter (in)	2.79			
Height (in)	6.02			
Cell Pressure (psi)	86.4			
Back Pressure (psi)	80.5			
	Effective Stresses At:			
Strain (%)	5.0			
Deviator (ksf)	1.716			
Excess PP (psi)	4.2			
Sigma 1 (ksf)	1.966			
Sigma 3 (ksf)	0.250			
P (ksf)	1.108			
Q (ksf)	0.858			
Stress Ratio	7.869			
Rate (in/min)	0.0005			

CTL Number:	020-251		
Client Name:	AECOM		
Project Name:	Klamath River Dam Removal Project		
Project Number:	60537920		
Date:	5/30/2018	By:	MD/DC
Total C	#DIV/0!	ksf	
Total phi	#DIV/0!	degrees	
Eff. C	#DIV/0!	ksf	
Eff. Phi	#DIV/0!	degrees	©

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767

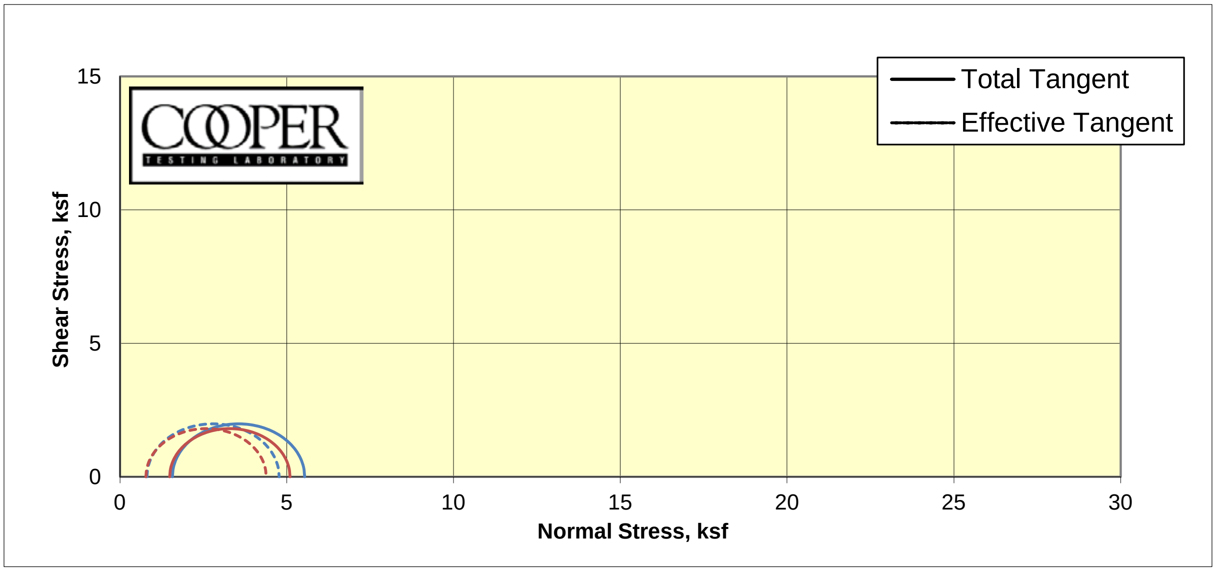


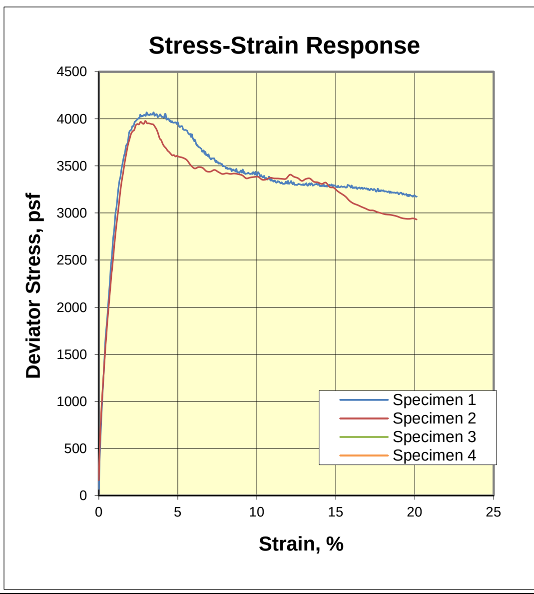


CTL Number:	020-251		
Client Name:	AECOM		
Project Name:	Klamath River Dam Removal Project		
Project Number:	60537920		
Date:	5/14/2018	By:	MD/DC
Total C	#DIV/0!	ksf	
Total phi	#DIV/0!	degrees	
Eff. C	#DIV/0!	ksf	
Eff. Phi	#DIV/0!	degrees	©

Specimen	1	2	3	4
Boring	BC-02			
Sample	S-08			
Depth	34.5(Tip-6")			
Visual Description	Pale Brown CLAY (Silty)			
MC (%)	148.8			
Dry Density (pcf)	32.7			
Saturation (%)	96.6			
Void Ratio	4.158			
Diameter (in)	2.87			
Height (in)	6.07			
	Final			
MC (%)	148.5			
Dry Density (pcf)	33.6			
Saturation (%)	100.0			
Void Ratio	4.010			
Diameter (in)	2.84			
Height (in)	6.02			
Cell Pressure (psi)	88.8			
Back Pressure (psi)	80.1			
	Effective Stresses At:			
Strain (%)	5.0			
Deviator (ksf)	3.832			
Excess PP (psi)	5.0			
Sigma 1 (ksf)	4.368			
Sigma 3 (ksf)	0.536			
P (ksf)	2.452			
Q (ksf)	1.916			
Stress Ratio	8.153			
Rate (in/min)	0.0005			

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767

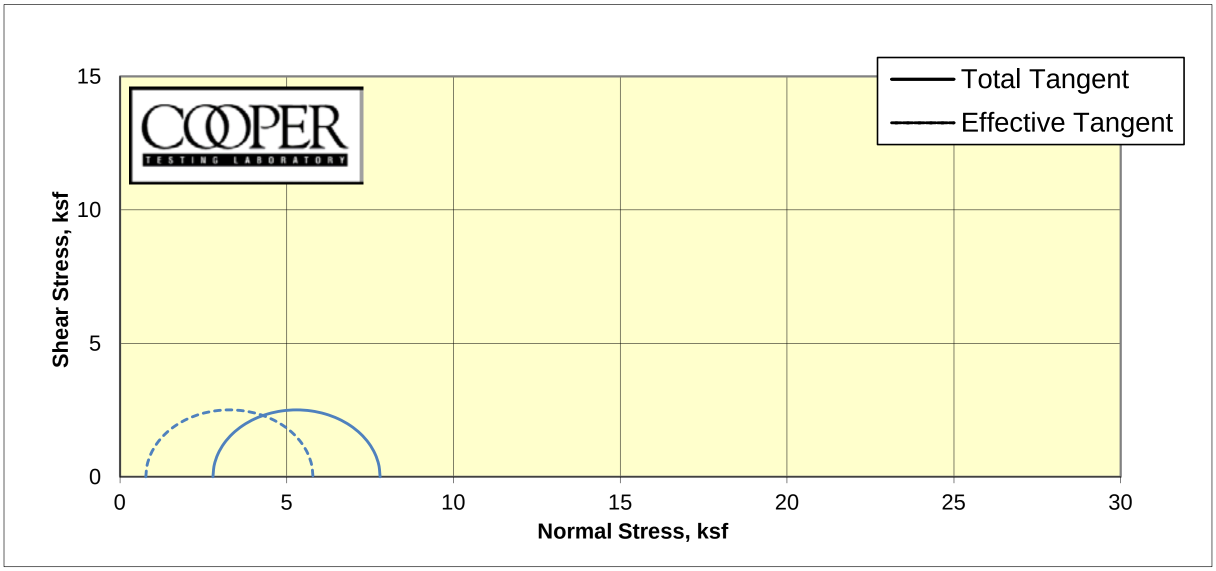


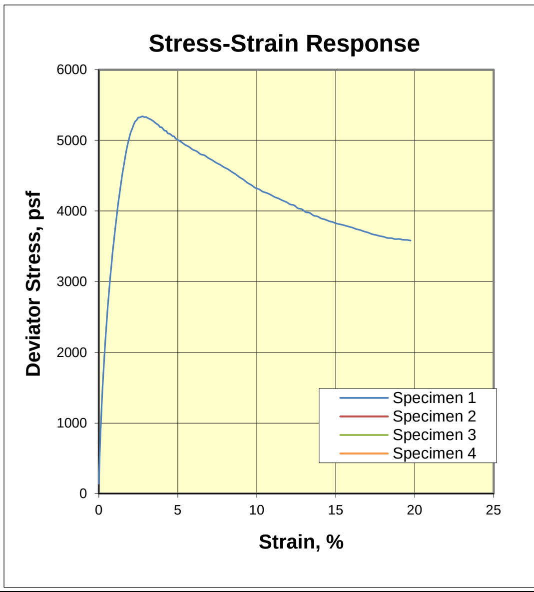


CTL Number:	020-251			
Client Name:	Klamath River Dam Removal Project			
Project Name:	60537920			
Project Number:	43237			
Date:	5/17/2018	By:	MD/DC	
Total C	#DIV/0!	ksf		
Total phi	#DIV/0!	degrees		
Eff. C	#DIV/0!	ksf		
Eff. Phi	#DIV/0!	degrees		©

Specimen	1	2	3	4
Boring	BC-03	BC-03		
Sample	S-06	S-06		
Depth	39.5-42(Tip-11")	39.5-42(Tip-4")		
Visual Description	Dark Gray CLAY (Silty)	Dark Gray CLAY		
MC (%)	84.9	90.1		
Dry Density (pcf)	50.2	47.7		
Saturation (%)	99.0	97.6		
Void Ratio	2.230	2.402		
Diameter (in)	2.87	2.87		
Height (in)	6.06	6.08		
	Final			
MC (%)	83.0	87.9		
Dry Density (pcf)	51.4	49.4		
Saturation (%)	100.0	100.0		
Void Ratio	2.158	2.285		
Diameter (in)	2.85	2.83		
Height (in)	6.02	6.04		
Cell Pressure (psi)	90.5	91.6		
Back Pressure (psi)	79.5	81.2		
	Effective Stresses At:			
Strain (%)	5.0	5.0		
Deviator (ksf)	3.966	3.607		
Excess PP (psi)	5.3	5.0		
Sigma 1 (ksf)	4.775	4.386		
Sigma 3 (ksf)	0.809	0.779		
P (ksf)	2.792	2.582		
Q (ksf)	1.983	1.804		
Stress Ratio	5.901	5.632		
Rate (in/min)	0.0005	0.0005		

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767

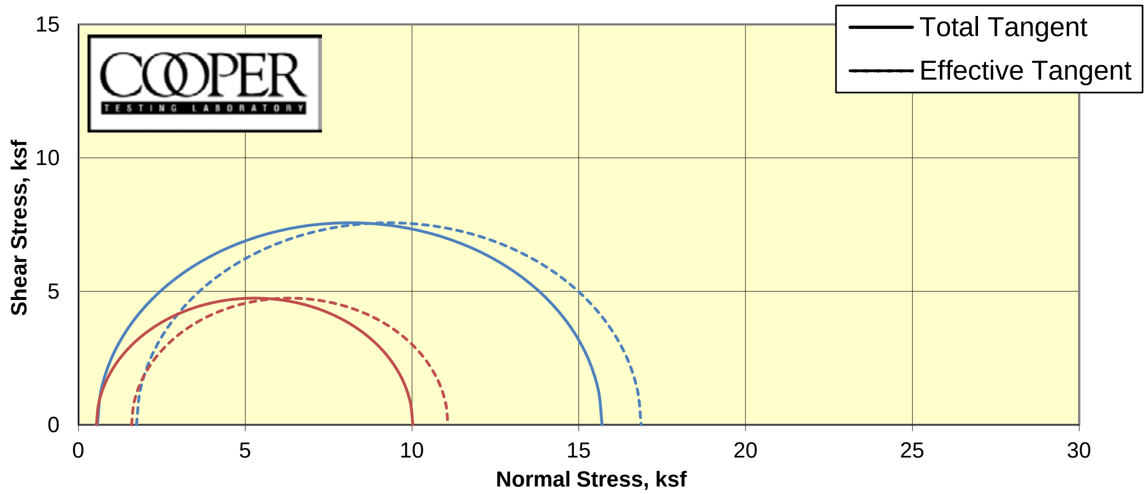


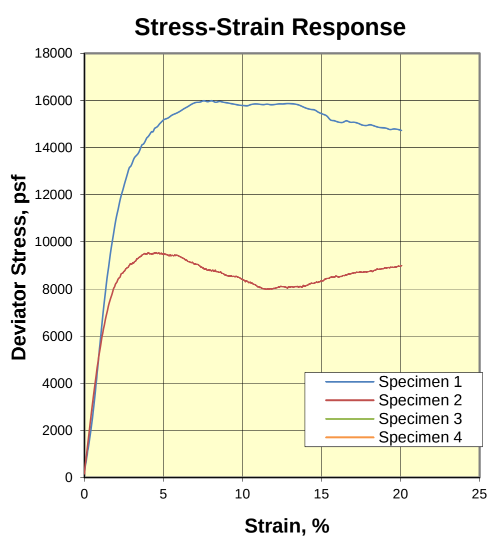


CTL Number:	020-251
Client Name:	AECOM
Project Name:	Klamath River Dam Removal Project
Project Number:	60537920
Date:	5/21/2018 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees ©

Specimen	1	2	3	4
Boring	BC-03			
Sample	S-10			
Depth	90(Tip-13")			
Visual Description	Dark Gray CLAY			
MC (%)	119.8			
Dry Density (pcf)	35.8			
Saturation (%)	88.1			
Void Ratio	3.533			
Diameter (in)	2.87			
Height (in)	6.08			
	Final			
MC (%)	116.3			
Dry Density (pcf)	40.3			
Saturation (%)	100.0			
Void Ratio	3.023			
Diameter (in)	2.69			
Height (in)	6.16			
Cell Pressure (psi)	99.9			
Back Pressure (psi)	80.5			
	Effective Stresses At:			
Strain (%)	5.0			
Deviator (ksf)	5.012			
Excess PP (psi)	14.0			
Sigma 1 (ksf)	5.788			
Sigma 3 (ksf)	0.777			
P (ksf)	3.283			
Q (ksf)	2.506			
Stress Ratio	7.452			
Rate (in/min)	0.0005			

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767

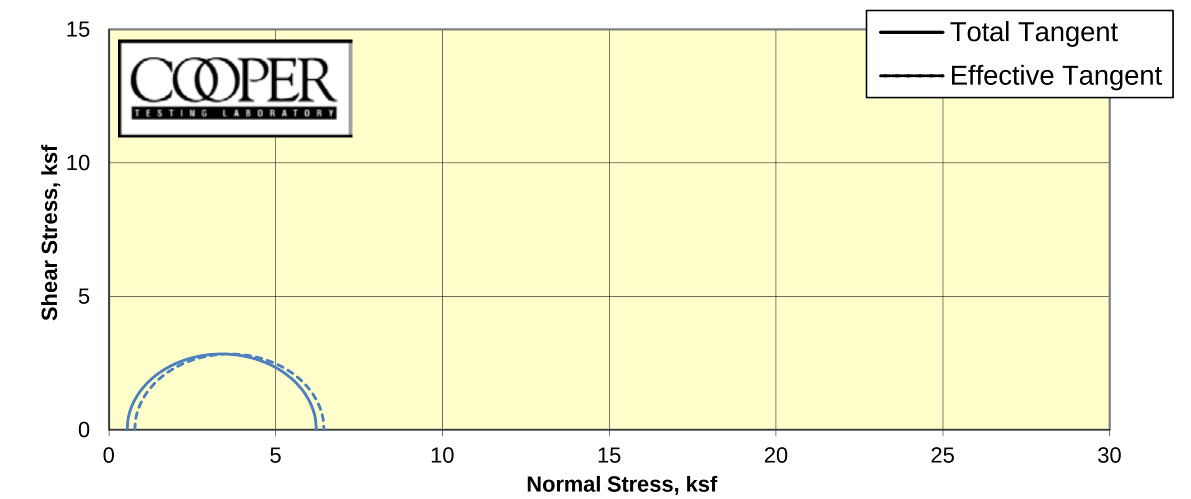


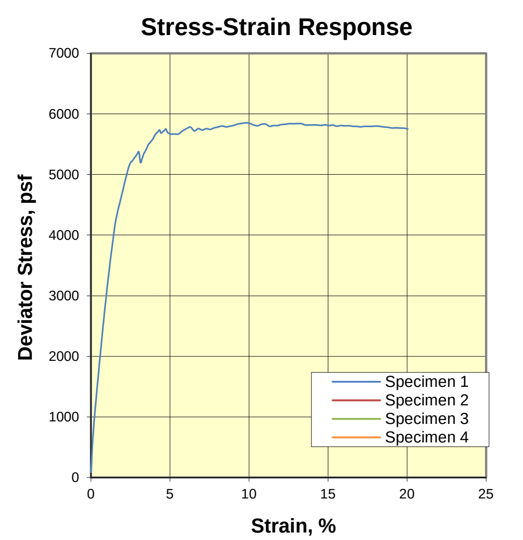


Specimen	1	2	3	4
Boring	BC-04	BC-04		
Sample	S-04	S-04		
Depth	12.5-14(Tip-15")	12.5-14.5(Tip-4")		
Visual Description	Brown Weathered Rock	Dark Brown Clayey GRAVEL (Weathered Rock)		
MC (%)	60.8	53.9		
Dry Density (pcf)	59.2	65.0		
Saturation (%)	90.8	93.7		
Void Ratio	1.740	1.497		
Diameter (in)	2.87	2.86		
Height (in)	6.06	6.06		
	Final			
MC (%)	61.4	54.7		
Dry Density (pcf)	62.5	67.0		
Saturation (%)	100.0	100.0		
Void Ratio	1.597	1.422		
Diameter (in)	2.80	2.82		
Height (in)	6.04	6.04		
Cell Pressure (psi)	83.2	82.9		
Back Pressure (psi)	79.2	79.1		
	Effective Stresses At:			
Strain (%)	5.0	5.0		
Deviator (ksf)	15.130	9.485		
Excess PP (psi)	-8.1	-7.3		
Sigma 1 (ksf)	16.872	11.080		
Sigma 3 (ksf)	1.741	1.594		
P (ksf)	9.306	6.337		
Q (ksf)	7.565	4.743		
Stress Ratio	9.688	6.949		
Rate (in/min)	0.0005	0.0005		

CTL Number:	020-251		
Client Name:	AECOM		
Project Name:	Klamath River Dam Removal Project		
Project Number:	60537920		
Date:	6/6/2018	By:	MD/DC
Total C	#DIV/0!	ksf	
Total phi	#DIV/0!	degrees	
Eff. C	#DIV/0!	ksf	
Eff. Phi	#DIV/0!	degrees	©

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767

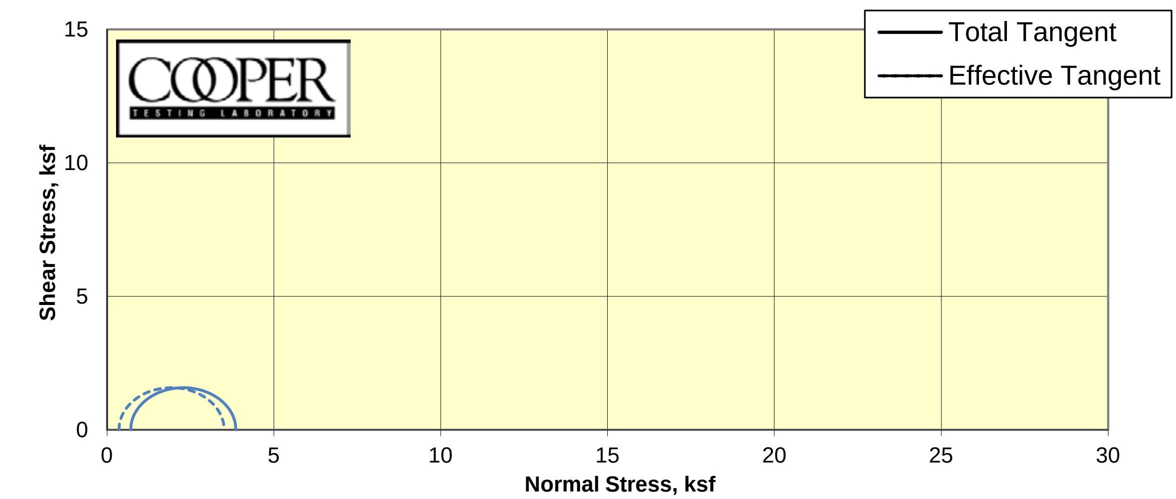


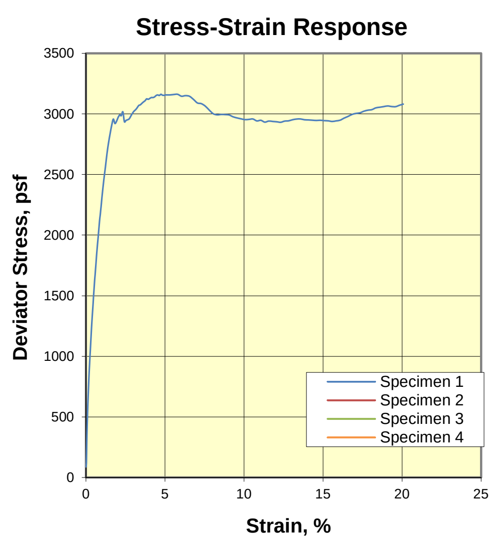


CTL Number:	020-251		
Client Name:	AECOM		
Project Name:	Klamath River Dam Removal Project		
Project Number:	60537920		
Date:	5/14/2018	By:	MD/DC
Total C	#DIV/0!	ksf	
Total phi	#DIV/0!	degrees	
Eff. C	#DIV/0!	ksf	
Eff. Phi	#DIV/0!	degrees	©

Specimen	1	2	3	4
Boring	BC-04			
Sample	S-5			
Depth	17.5(Tip-6")			
Visual Description	Light Gray CLAY			
MC (%)	104.7			
Dry Density (pcf)	42.1			
Saturation (%)	94.2			
Void Ratio	3.000			
Diameter (in)	2.87			
Height (in)	6.08			
	Final			
MC (%)	105.4			
Dry Density (pcf)	43.8			
Saturation (%)	100.0			
Void Ratio	2.846			
Diameter (in)	2.82			
Height (in)	6.07			
Cell Pressure (psi)	84.0			
Back Pressure (psi)	80.2			
	Effective Stresses At:			
Strain (%)	5.0			
Deviator (ksf)	5.677			
Excess PP (psi)	-1.6			
Sigma 1 (ksf)	6.450			
Sigma 3 (ksf)	0.774			
P (ksf)	3.612			
Q (ksf)	2.838			
Stress Ratio	8.336			
Rate (in/min)	0.0005			

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767

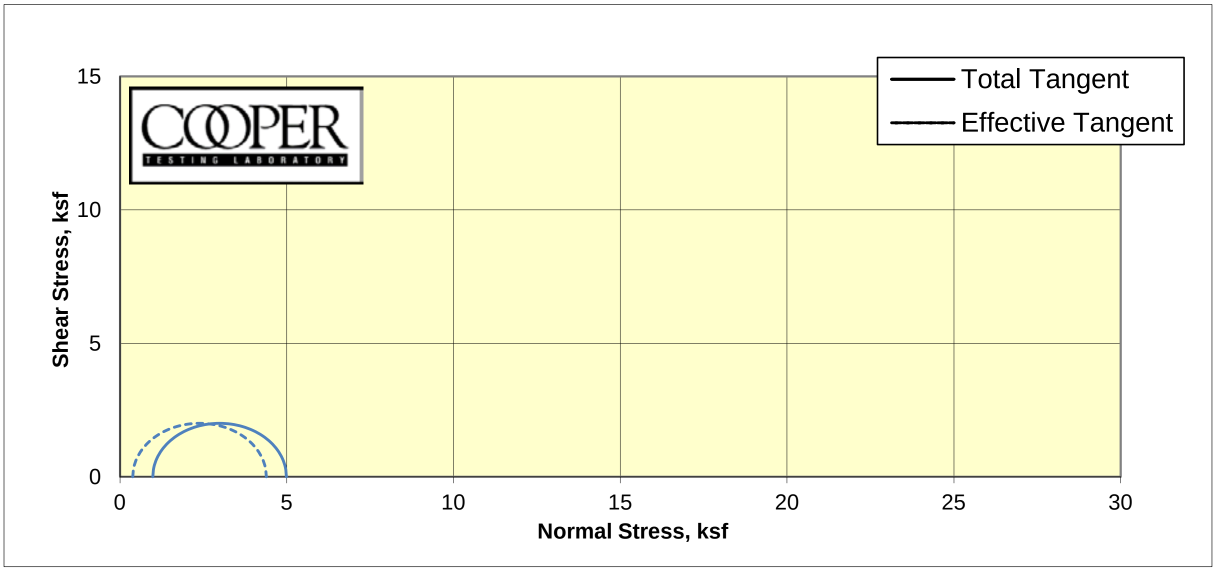


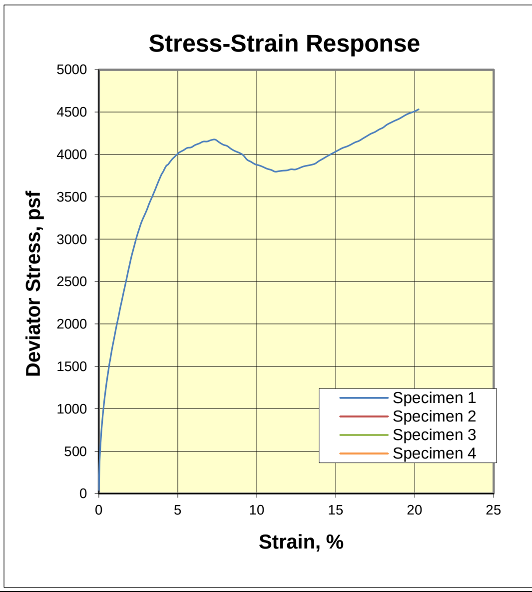


CTL Number:	020-251		
Client Name:	AECOM		
Project Name:	Klamath River Dam Removal Project		
Project Number:	60537920		
Date:	5/30/2018	By:	MD/DC
Total C	#DIV/0!	ksf	
Total phi	#DIV/0!	degrees	
Eff. C	#DIV/0!	ksf	
Eff. Phi	#DIV/0!	degrees	©

Specimen	**1**	**2**	**3**	**4**
Boring	BC-04			
Sample	S-06			
Depth	22.5(Tip-2")			
Visual Description	Greenish Gray CLAY (Silty)/ SILT (slightly plastic)			
MC (%)	154.6			
Dry Density (pcf)	31.7			
Saturation (%)	97.4			
Void Ratio	4.127			
Diameter (in)	2.87			
Height (in)	6.07			
	Final			
MC (%)	152.8			
Dry Density (pcf)	32.6			
Saturation (%)	100.0			
Void Ratio	3.974			
Diameter (in)	2.83			
Height (in)	6.05			
Cell Pressure (psi)	85.0			
Back Pressure (psi)	80.1			
	Effective Stresses At:			
Strain (%)	5.0			
Deviator (ksf)	3.153			
Excess PP (psi)	2.5			
Sigma 1 (ksf)	3.511			
Sigma 3 (ksf)	0.358			
P (ksf)	1.935			
Q (ksf)	1.576			
Stress Ratio	9.796			
Rate (in/min)	0.0005			

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767

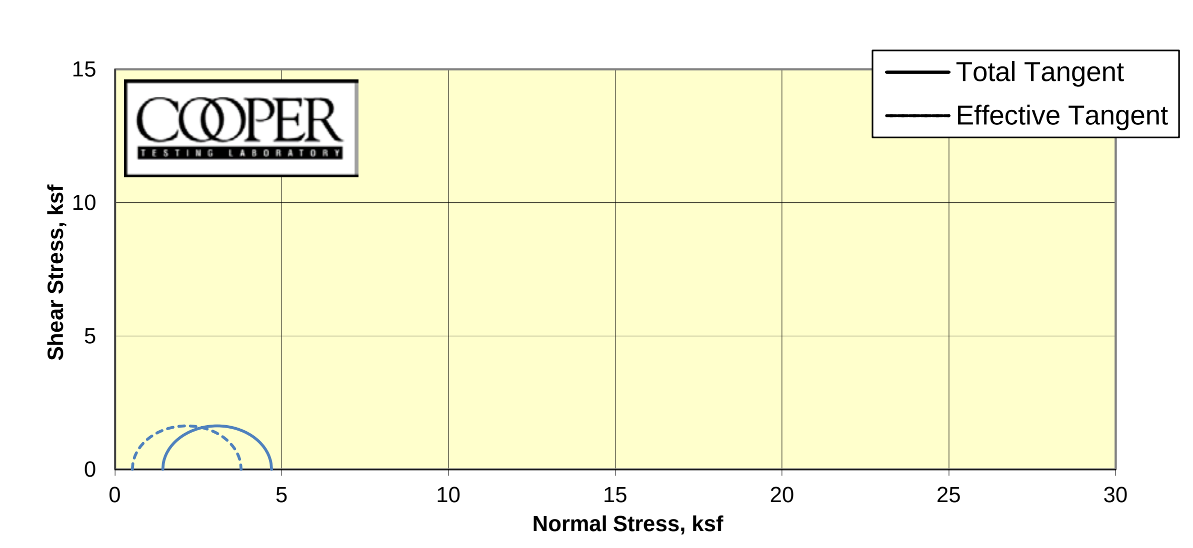


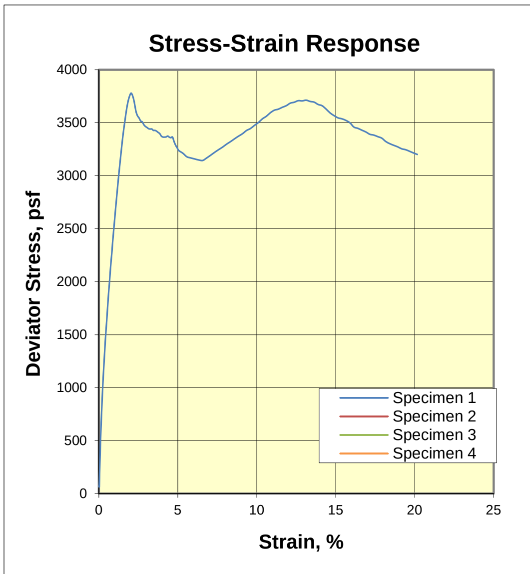


CTL Number:	020-251		
Client Name:	AECOM		
Project Name:	Klamath River Dam Removal Project		
Project Number:	60537920		
Date:	5/17/2018	By:	MD/DC
Total C	#DIV/0!	ksf	
Total phi	#DIV/0!	degrees	
Eff. C	#DIV/0!	ksf	
Eff. Phi	#DIV/0!	degrees	©

Specimen	1	2	3	4
Boring	BC-04			
Sample	S-08			
Depth	32.5(Tip-10")			
Visual Description	Pale Brown Mottled Gray Elastic SILT			
MC (%)	117.2			
Dry Density (pcf)	36.9			
Saturation (%)	89.7			
Void Ratio	3.397			
Diameter (in)	2.87			
Height (in)	6.08			
	Final			
MC (%)	115.5			
Dry Density (pcf)	40.5			
Saturation (%)	100.0			
Void Ratio	3.004			
Diameter (in)	2.76			
Height (in)	6.01			
Cell Pressure (psi)	86.8			
Back Pressure (psi)	80.0			
	Effective Stresses At:			
Strain (%)	5.0			
Deviator (ksf)	4.005			
Excess PP (psi)	4.2			
Sigma 1 (ksf)	4.390			
Sigma 3 (ksf)	0.385			
P (ksf)	2.388			
Q (ksf)	2.003			
Stress Ratio	11.403			
Rate (in/min)	0.0005			

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767

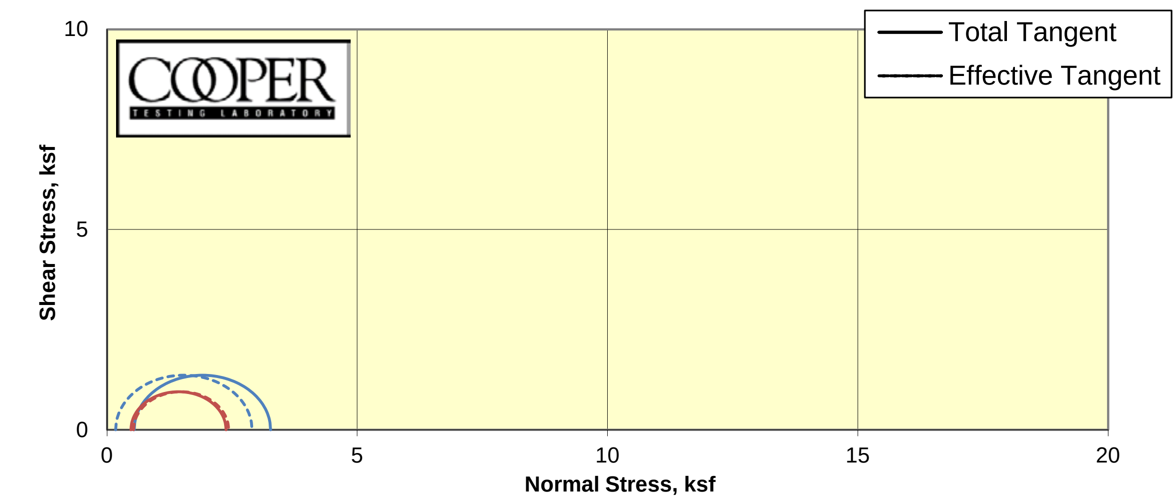


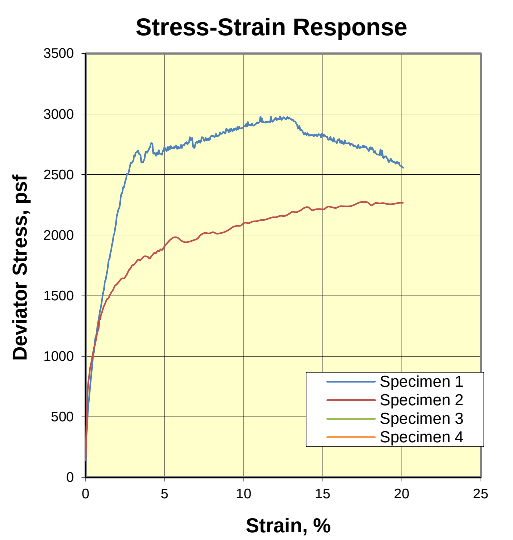


CTL Number:	020-251
Client Name:	AECOM
Project Name:	Klamath River Dam Removal Project
Project Number:	60537920
Date:	5/25/2018 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees ©

Specimen	1	2	3	4
Boring	BC-04			
Sample	S-10			
Depth	52.5(Tip-4")			
Visual Description	Bluish Gray CLAY (Silty)/ SILT (slightly plastic)			
MC (%)	153.6			
Dry Density (pcf)	32.1			
Saturation (%)	97.9			
Void Ratio	4.156			
Diameter (in)	2.87			
Height (in)	6.08			
	Final			
MC (%)	151.2			
Dry Density (pcf)	33.0			
Saturation (%)	100.0			
Void Ratio	4.007			
Diameter (in)	2.84			
Height (in)	6.03			
Cell Pressure (psi)	90.6			
Back Pressure (psi)	80.6			
	Effective Stresses At:			
Strain (%)	5.0			
Deviator (ksf)	3.260			
Excess PP (psi)	6.3			
Sigma 1 (ksf)	3.784			
Sigma 3 (ksf)	0.523			
P (ksf)	2.154			
Q (ksf)	1.630			
Stress Ratio	7.229			
Rate (in/min)	0.0005			

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767

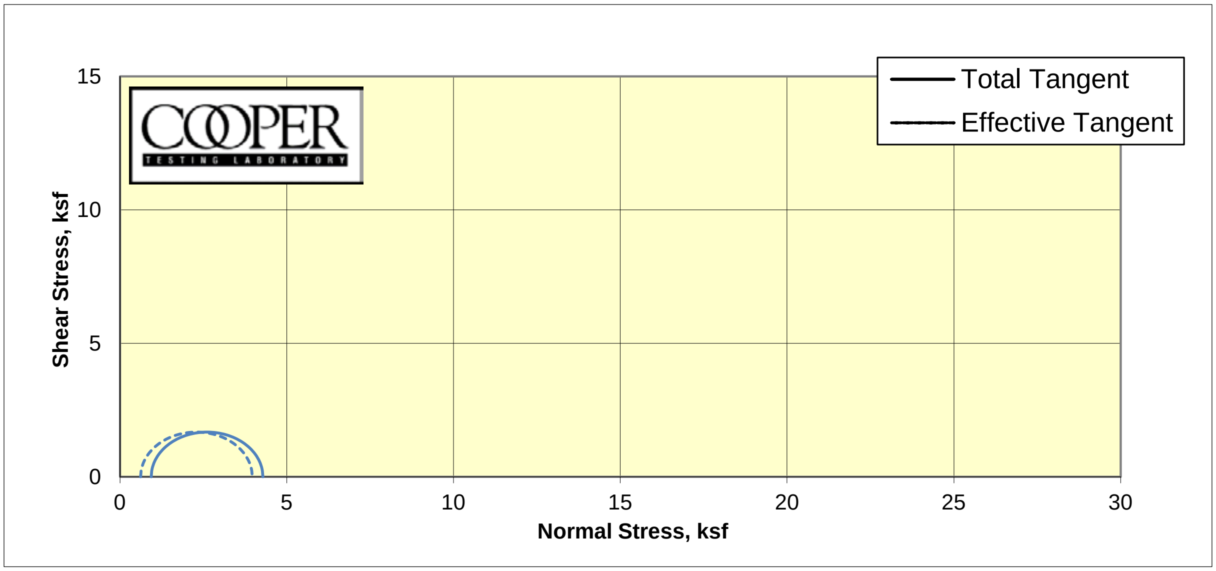


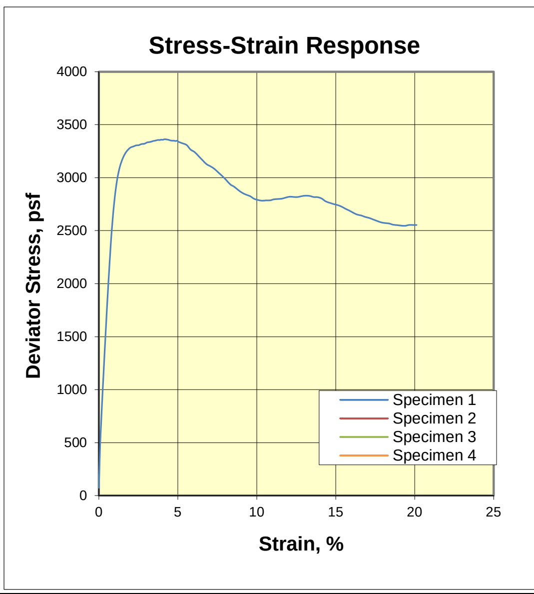


Specimen	1	2	3	4
Boring	BC-05	BC-05		
Sample	S-04	S-04		
Depth	14.5(Tip-16")	14.5(Tip-1")		
Visual Description	Olive CLAY (Silty)/SILT (slightly plastic)	Olive Mottled Yellow Clayey SAND/ Sandy CLAY		
MC (%)	135.1	30.0		
Dry Density (pcf)	35.4	92.8		
Saturation (%)	97.0	99.2		
Void Ratio	3.760	0.816		
Diameter (in)	2.87	2.87		
Height (in)	5.83	6.09		
	Final			
MC (%)	135.4	29.8		
Dry Density (pcf)	36.2	93.4		
Saturation (%)	100.0	100.0		
Void Ratio	3.656	0.805		
Diameter (in)	2.85	2.87		
Height (in)	5.80	6.07		
Cell Pressure (psi)	84.2	84.1		
Back Pressure (psi)	80.4	80.8		
	Effective Stresses At:			
Strain (%)	5.0	5.0		
Deviator (ksf)	2.725	1.900		
Excess PP (psi)	2.6	-0.4		
Sigma 1 (ksf)	2.899	2.431		
Sigma 3 (ksf)	0.173	0.531		
P (ksf)	1.536	1.481		
Q (ksf)	1.363	0.950		
Stress Ratio	16.726	4.577		
Rate (in/min)	0.0005	0.0005		

CTL Number:	020-251		
Client Name:	AECOM		
Project Name:	Klamath River Dam Removal Project		
Project Number:	60537920		
Date:	5/24/2018	By:	MD/DC
Total C	#DIV/0!	ksf	
Total phi	#DIV/0!	degrees	
Eff. C	#DIV/0!	ksf	
Eff. Phi	#DIV/0!	degrees	©

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767



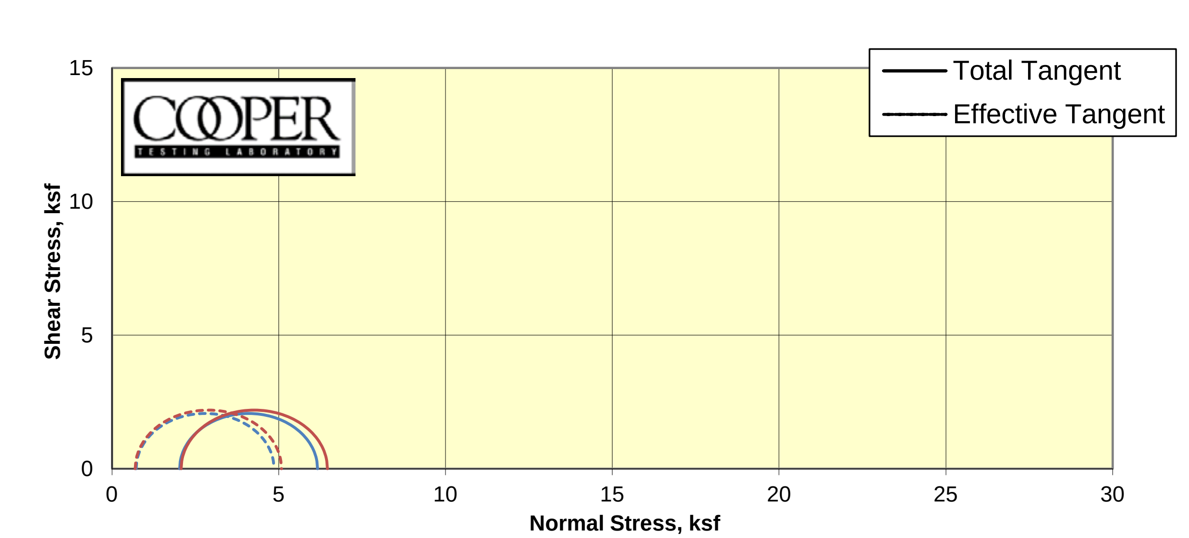


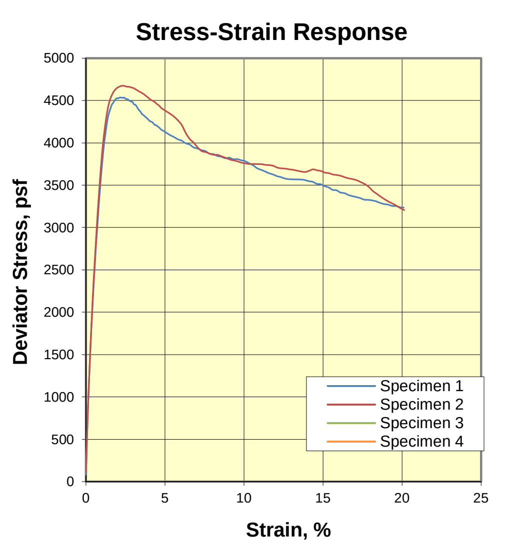
CTL Number:	020-251
Client Name:	AECOM
Project Name:	Klamath River Dam Removal Project
Project Number:	60537920
Date:	5/30/2018 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees

©

Specimen	1	2	3	4
Boring	BC-09			
Sample	S-05			
Depth	23(Tip-5")			
Visual Description	Dark Gray Elastic SILT			
MC (%)	79.5			
Dry Density (pcf)	51.9			
Saturation (%)	97.1			
Void Ratio	2.130			
Diameter (in)	2.87			
Height (in)	6.07			
	Final			
MC (%)	79.4			
Dry Density (pcf)	53.0			
Saturation (%)	100.0			
Void Ratio	2.065			
Diameter (in)	2.85			
Height (in)	6.04			
Cell Pressure (psi)	86.8			
Back Pressure (psi)	80.3			
	Effective Stresses At:			
Strain (%)	5.0			
Deviator (ksf)	3.348			
Excess PP (psi)	2.2			
Sigma 1 (ksf)	3.969			
Sigma 3 (ksf)	0.621			
P (ksf)	2.295			
Q (ksf)	1.674			
Stress Ratio	6.396			
Rate (in/min)	0.0005			

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767



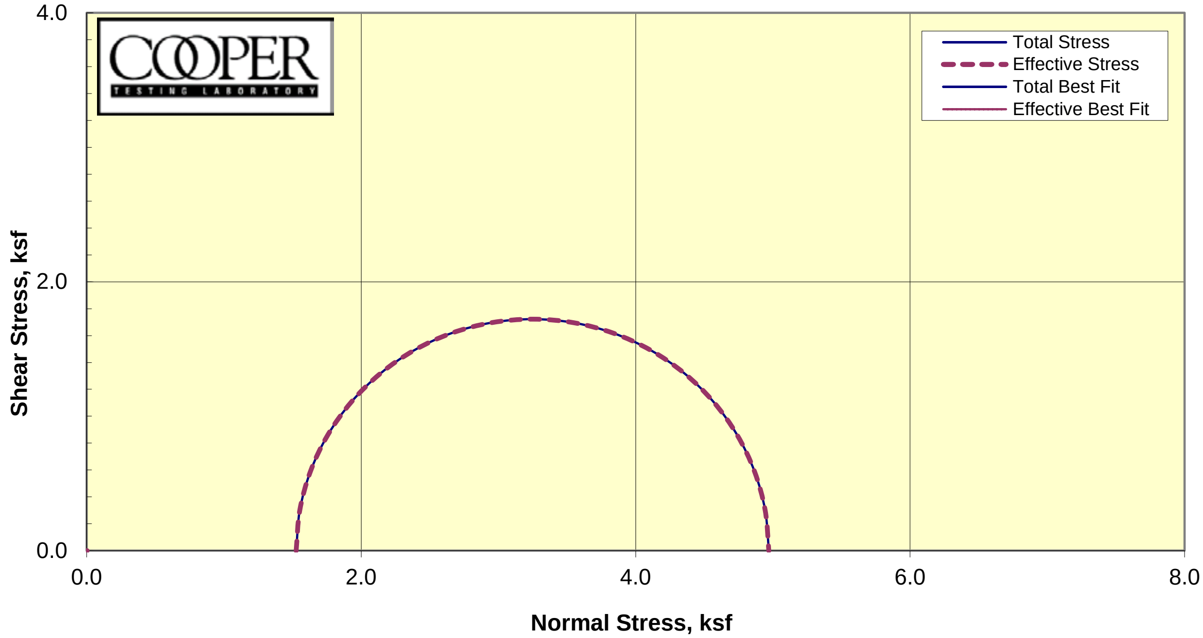


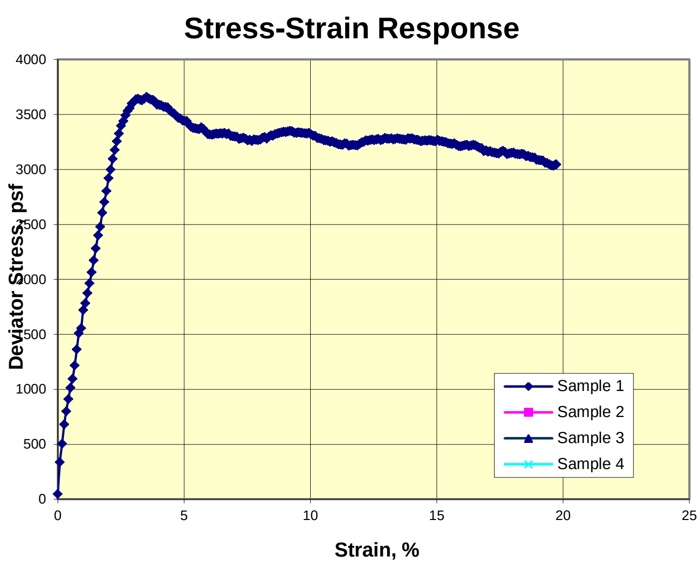
CTL Number:	020-251
Client Name:	AECOM
Project Name:	Klamath River Dam Removal Project
Project Number:	60537920
Date:	6/6/2018 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees

Specimen	1	2	3	4
Boring	BC-09	BC-09		
Sample	S-09	S-09		
Depth	68-70.5(Tip-10")	68-70.5(Tip-4")		
Visual Description	Dark Greenish Gray CLAY (Silty)/ SILT (slightly plastic)	Dark Greenish Gray CLAY (Silty)/ SILT (slightly plastic)		
MC (%)	92.0	95.5		
Dry Density (pcf)	47.2	46.1		
Saturation (%)	98.2	98.5		
Void Ratio	2.436	2.520		
Diameter (in)	2.87	2.87		
Height (in)	6.06	6.06		
	Final			
MC (%)	90.6	93.7		
Dry Density (pcf)	48.4	47.2		
Saturation (%)	100.0	100.0		
Void Ratio	2.355	2.436		
Diameter (in)	2.84	2.85		
Height (in)	6.03	6.02		
Cell Pressure (psi)	94.2	94.1		
Back Pressure (psi)	80.1	79.7		
	Effective Stresses At:			
Strain (%)	5.0	5.0		
Deviator (ksf)	4.134	4.387		
Excess PP (psi)	9.1	9.6		
Sigma 1 (ksf)	4.860	5.084		
Sigma 3 (ksf)	0.726	0.697		
P (ksf)	2.793	2.891		
Q (ksf)	2.067	2.194		
Stress Ratio	6.693	7.293		
Rate (in/min)	0.0005	0.0005		

Triaxial Unconsolidated-Undrained

(ASTM D2850m)





Sample:	1	2	3	4
MC, %	160.5			
Dry Dens, pcf	30.5			
Sat. %	95.9			
Void Ratio	4.519			
Diameter in	2.87			
Height, in	6.08			
	Final			
MC, %	163.5			
Dry Dens, pcf	31.1			
Sat. %	100.0			
Void Ratio	4.414			
Diameter, in	2.84			
Height, in	6.08			
Cell, psi	49.1			
BP, psi	38.5			
	Effective Stresses At:			
Strain, %	5.0			
Deviator ksf	3.444			
Excess PP	0.000			
Sigma 1	4.970			
Sigma 3	1.526			
P, ksf	3.248			
Q, ksf	1.722			
Stress Ratio	3.256			
Rate in/min	0.0588			
Total C	N/A	ksf		
Total Phi	N/A	Degrees		
Eff. C	N/A	ksf		
Eff. Phi	N/A	Degrees		

Job No.: 020-251 **Date:** 5/24/2018

Client: AECOM BY:MD/DC

Project: 60537920

Sample 1) BC-04_S-10 @ 52.5(Tip-18") Bluish Gray CLAY (Silty)

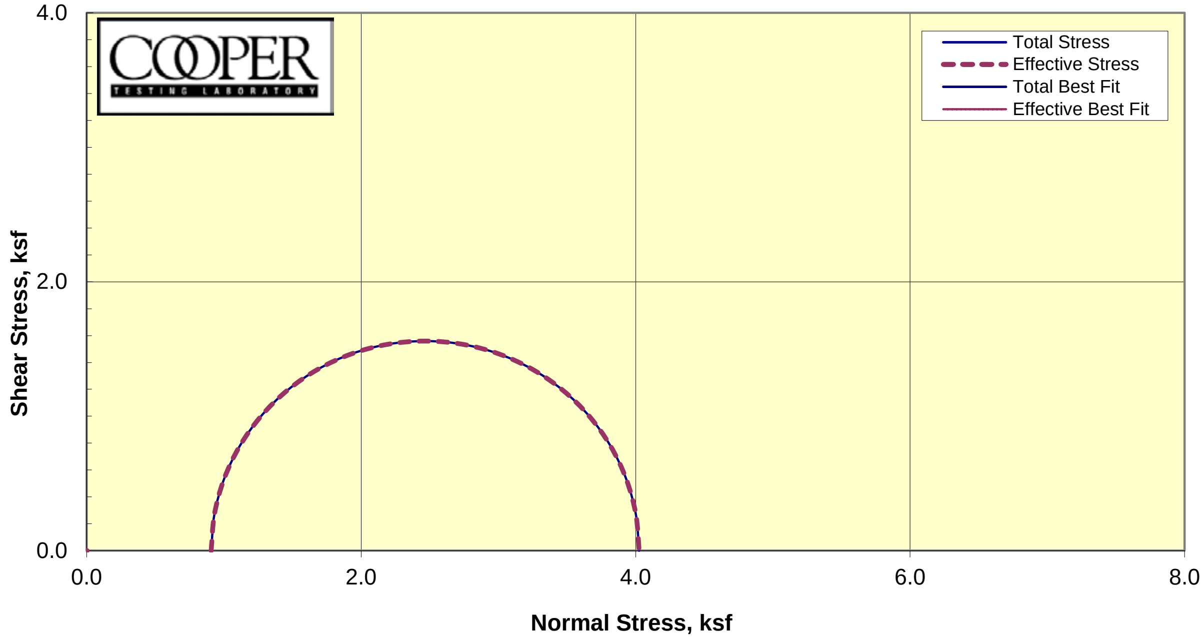
Sample 2)

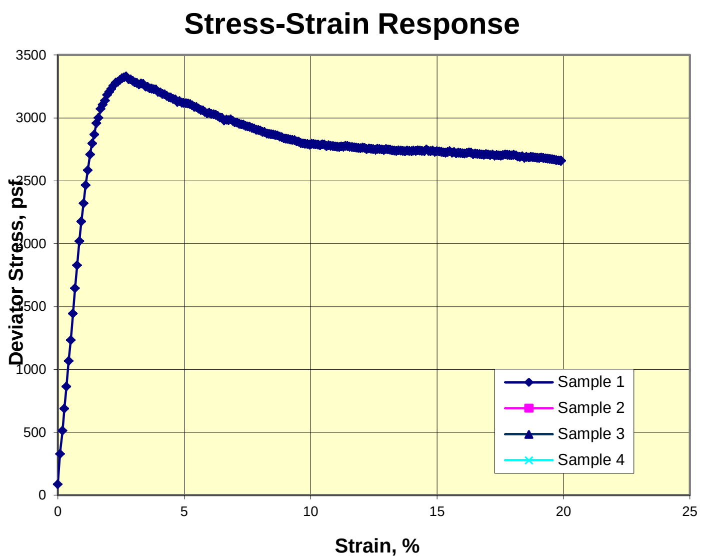
Sample 3)

Sample 4)

REMARKS: Strengths picked at 5% strain.
*Sample was back-pressure saturated prior to shear.

Triaxial Unconsolidated-Undrained
(ASTM D2850m)



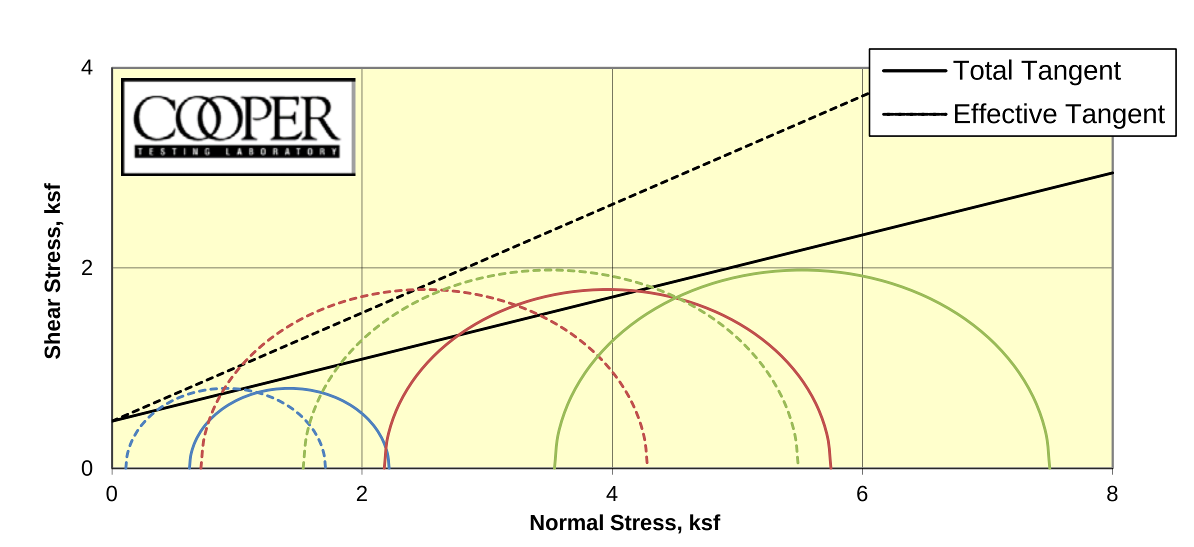


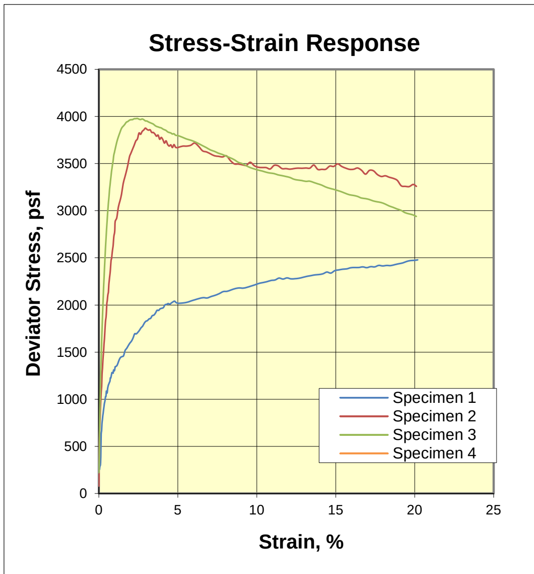
Sample:	1	2	3	4
MC, %	76.3			
Dry Dens, pcf	54.0			
Sat. %	97.1			
Void Ratio	2.121			
Diameter in	2.87			
Height, in	6.05			
	Final			
MC, %	76.6			
Dry Dens, pcf	54.9			
Sat. %	100.0			
Void Ratio	2.068			
Diameter, in	2.85			
Height, in	6.03			
Cell, psi	54.8			
BP, psi	48.5			
	Effective Stresses At:			
Strain, %	5.0			
Deviator ksf	3.118			
Excess PP	0.000			
Sigma 1	4.025			
Sigma 3	0.907			
P, ksf	2.466			
Q, ksf	1.559			
Stress Ratio	4.437			
Rate in/min	0.0588			
Total C	N/A	ksf		
Total Phi	N/A	Degrees		
Eff. C	N/A	ksf		
Eff. Phi	N/A	Degrees		

Job No.: 020-251 **Date:** 5/25/2018
Client: AECOM BY:MD/DC
Project: 60537920
Sample 1) BC-09_S-05 @ 23(Tip-13") Dark Gray Elastic SILT
Sample 2)
Sample 3)
Sample 4)

REMARKS: Strengths picked at 5% strain.
*Sample was back-pressure saturated prior to shear.

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767





CTL Number:	020-232		
Client Name:	AECOM		
Project Name:	Klamath		
Project Number:	60537920		
Date:	9/25/2017	By:	MD/DC
Total C	**0.470**	**ksf**	
Total phi	**17.2**	**degrees**	
Eff. C	**0.470**	**ksf**	
Eff. Phi	**28.4**	**degrees**	©

Remarks: The sample was delivered as singular 13" x 16" block. The specimens were trimmed into a brass tube 2" x 4". The orientation of the outcrop block was unknown. All samples were trimmed in the same approximate orientation. The material is highly structured and cemented. It disperses when exposed to water. All three specimens behaved differently during shear.

Specimen	**1**	**2**	**3**	**4**
Boring	Outcrop #1	Outcrop #1	Outcrop #1	
Sample				
Depth				
Visual Description	Pale Brown Siltstone (Diatomite)	Pale Brown Siltstone (Diatomite)	Pale Brown Siltstone (Diatomite)	
MC (%)	8.2	7.1	5.9	
Dry Density (pcf)	53.1	56.9	58.0	
Saturation (%)	10.2	9.7	8.4	
Void Ratio	2.176	1.961	1.907	
Diameter (in)	1.86	1.86	1.85	
Height (in)	4.00	4.00	4.00	
	Final			
MC (%)	78.4	73.5	71.9	
Dry Density (pcf)	54.1	56.5	57.3	
Saturation (%)	100.0	100.0	100.0	
Void Ratio	2.116	1.984	1.942	
Diameter (in)	1.85	1.87	1.87	
Height (in)	3.96	3.98	3.98	
Cell Pressure (psi)	124.0	135.0	144.9	
Back Pressure (psi)	119.7	119.8	120.4	
	Effective Stresses At:			
Strain (%)	2.0	2.0	2.0	
Deviator (ksf)	1.596	3.571	3.959	
Excess PP (psi)	3.5	10.2	14.0	
Sigma 1 (ksf)	1.708	4.282	5.488	
Sigma 3 (ksf)	0.111	0.712	1.529	
P (ksf)	0.909	2.497	3.509	
Q (ksf)	0.798	1.785	1.980	
Stress Ratio	15.338	6.018	3.589	
Rate (in/min)	0.0003	0.0003	0.0003	

POINT LOAD TEST RESULTS
BI-02 and BI-03

Test Number	Test Order	Depth of Test	Boring Number	Date	Depth Interval		Rock Type[1]	Diameter (D)		Distance Between Contact Points (cm)	Distance Between Contact Points (in)	Length - Contact Points to End of Sample, L (in)	L/D[2]	Test Type[3]	Failure Load, P (kN)[4]	Uncorrected Point Load, I_S (Mpa)[5]	Size Correction Factor, F[6]	Point Load, $I_{S(50)}$ (MPa)[7]	Uniaxial Compressive Strength, s_c (Mpa)[8]	Uniaxial Compressive Strength, psi	Weathering	Notes
					Bottom	Top		(mm)	(in)													
BI02-1-22.1	1	22.1	BI-02	4/11/2018	22.6	21.9	Volcanic Breccia	59.94	2.36	6.00	2.36	1.97	0.83	d	0.51	0.14	1.09	0.15	3	504	MW/SW	Bottom 3.5" broke on preexisting fracture plane prior to test. Sample broke on preexisting fracture plane during testing.
BI02-2-28.2	2	28.2	BI-02	4/11/2018	28.6	27.9	Volcanic Breccia	59.94	2.36	6.00	2.36	3.54	1.50	d	1.99	0.55	1.09	0.60	14	1968	MW/SW	Fractured between platens (see photo)
BI02-3-32.8	3	32.8	BI-02	4/11/2018	33.4	32.2	Volcanic Breccia	59.94	2.36	6.00	2.36	7.01	2.97	d	2.59	0.72	1.09	0.78	18	2561	MW/SW	Fractured between platens (see photo). Other breaks from rock core falling on table after testing.
BI02-4-37.4	4	37.4	BI-02	4/11/2018	37.7	37.2	Volcanic Breccia	59.94	2.36	6.00	2.36	2.68	1.13	d	2.53	0.70	1.09	0.76	17	2502	MW/SW	Fractured between platens (see photo)
BI02-5-42.8	5	42.8	BI-02	4/11/2018	43.1	42.5	Volcanic Breccia	59.94	2.36	6.00	2.36	3.86	1.63	d	2.00	0.56	1.09	0.60	14	1978	MW/SW	Fractured between platens (see photo). 1" long fracture propagated along the length of sample from the point load application.
BI02-7-55	7	55.0	BI-02	4/11/2018	55.4	54.7	Volcanic Breccia	59.94	2.36	6.00	2.36	3.74	1.58	d	1.41	0.39	1.09	0.43	10	1394	MW/SW	Fractured between platens (see photo). Platen penetrated into rock 3mm at failure.
BI02-8-57.3	8	57.3	BI-02	4/11/2018	57.6	57.0	Volcanic Breccia	59.94	2.36	6.00	2.36	3.23	1.37	d	1.5-2.0		1.09				MW/SW	Peak load not recorded. One of the broken halfs was retested in test BI02-9-57.1.
BI02-9-57.1	9	57.1	BI-02	4/11/2018	57.6	57.0	Volcanic Breccia	59.94	2.36	6.00	2.36	1.69	0.72	d	1.80	0.50	1.09	0.54	12	1780	MW/SW	Fractured between platens (see photo)
BI02-10-64.2	10	64.2	BI-02	4/11/2018	64.7	63.7	Volcanic Breccia	59.94	2.36	6.00	2.36	6.10	2.59	d	1.05	0.29	1.09	0.32	7	1038	MW/SW	Fractured between platens (see photo)
BI03-11-10.3	11	10.3	BI-03	4/11/2018	10.5	10.1	Volcanic Breccia	59.94	2.36	6.00	2.36	2.17	0.92	d	0.60	0.17	1.09	0.18	4	593	MW	Fractured between platens (see photo)
BI03-12-17.2	12	17.2	BI-03	4/11/2018	17.4	17.0	Volcanic Breccia	59.94	2.36	6.00	2.36	2.17	0.92	d	0.56	0.16	1.09	0.17	4	554	MW	Fractured between platens (see photo)
BI03-13-21.3	13	21.3	BI-03	4/11/2018	21.5	21.0	Volcanic Breccia	59.94	2.36	6.00	2.36	2.56	1.08	d	0.76	0.21	1.09	0.23	5	752	MW	Fractured between platens (see photo)
BI03-14-29.8	14	29.8	BI-03	4/11/2018	30.1	29.5	Volcanic Breccia	59.94	2.36	6.00	2.36	3.54	1.50	d	0.73	0.20	1.09	0.22	5	722	MW	Fractured between platens (see photo)
BI03-15-32.7	15	32.7	BI-03	4/11/2018	33.5	32.0	Volcanic Breccia	59.94	2.36	6.00	2.36	8.58	3.64	d	0.77	0.21	1.09	0.23	5	761	MW	Fractured between platens (see photo)

Notes:
1. Based on Drill Logs
2. ASTM D5731 calls for L/D > 0.5 for diametral test.
3. d = diametral, a = axial, b = block, ir = irregular lump
4. Reading from testing apparatus
5. $I_S = P/D^2$ (ASTM D5731 - for diametral test)
6. $F = (D/50)^{0.45}$ (ASTM D5731 - for diametral test)
7. $I_{S(50)} = I_S \times F$ (ASTM D5731)
8. $s_c = I_S \times K$; I_s is uncorrected point load index; K=24.5 for ~60 mm diameter cores (ASTM D5731)

F	Fresh
SW	Slightly Weathered
MW	Moderately Weathered
HW	Highly Weathered
CW	Completely Weathered

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-1
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 48.9-50.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/30/2018

Distance, D		Load, P		Corrected Point Load Index $(D/50)^{0.45}$ P/D^2		Direction of Loading	
mm	in	kN	lbf	MPa	psi	A	B
60.86	2.40	0.74	166.352	0.22	31.66	1	
62.20	2.45	1.65	370.92	0.47	68.24		1
47.58	1.87	0.98	220.304	0.42	61.40	1	
79.15	3.12	3.23	726.104	0.63	91.95		1
82.44	3.25	3.00	674.4	0.55	80.18		1
39.71	1.56	0.86	193.328	0.49	71.31	1	

Average Point Load Strength in Direction A	0.38 MPa	54.79 psi
Average Point Load Strength in Direction B	0.55 MPa	80.12 psi

Point Load Strength Anisotropy Index
1.46

A = Parallel to core axis

B = Orthogonal to core axis

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

Uniaxial Compression Test without Stress-Strain Curves and Moduli
ASTM D7012 - 14e1

COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV GL = ISO 9001 =

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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-1-1
Report Date	5/17/2018
Drill hole and Depth	BI-02; 27-27.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Stress Rate	0.5 MPa/s	
Diameter of Specimen	60.54 mm	2.38 in
Height of Specimen	97.72 mm	3.85 in
Load at Peak	16.69 kN	3,752 lbf
Unconfined Compressive Strength	5.80 MPa	841 psi
Type of Failure	Non-Structural	

Note: The provided sample had a height-to-diameter ratio less than 2

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo Before Test	Photo After Test
	

Tested by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

2028 E Ben White BLVD #240-2660
Austin, TX 78741

Laboratory Director: Dr. Fulvio Tonon, P.E., Ph.D.
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Picture of the sample upon arrival at Tonon USA Laboratory: no core piece allowed preparation of a specimen with a height-to-diameter ratio between 2 and 2.5.

2028 E Ben White BLVD #240-2660
Austin, TX 78741

Laboratory Director: Dr. Fulvio Tonon, P.E., Ph.D.
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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-1-2
Report Date	5/17/2018
Drill hole and Depth	BI-02; 48.9-50.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Stress Rate	0.5 MPa/s	
Diameter of Specimen	60.85 mm	2.40 in
Height of Specimen	127.87 mm	5.03 in
Load at Peak	34.80 kN	7,823 lbf
Unconfined Compressive Strength	11.97 MPa	1,736 psi
Type of Failure	Non-Structural	

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo Before Test

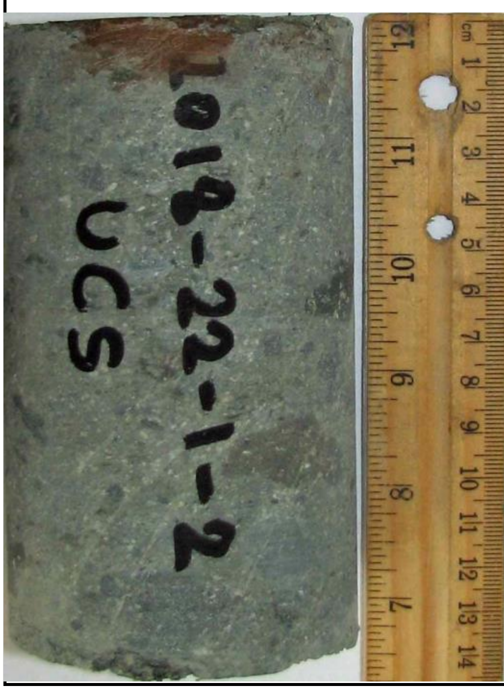


Photo After Test

Tested by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-1-3
Report Date	5/17/2018
Drill hole and Depth	BI-02; 55.4-56.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Stress Rate	0.5 MPa/s	
Diameter of Specimen	60.68 mm	2.39 in
Height of Specimen	128.33 mm	5.05 in
Load at Peak	45.59 kN	10,248 lbf
Unconfined Compressive Strength	15.77 MPa	2,288 psi
Type of Failure	Non-Structural	

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo Before Test

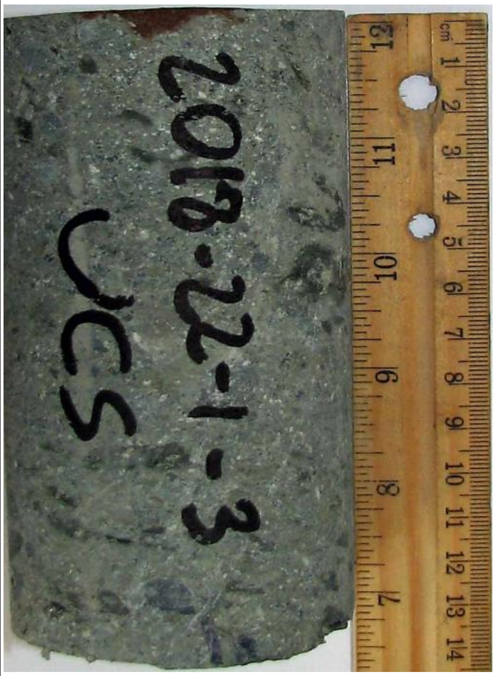
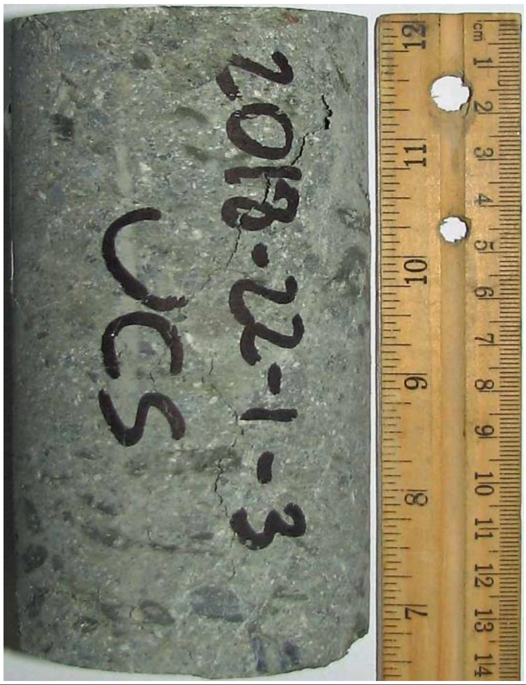


Photo After Test



Tested by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-1-4
Report Date	5/17/2018
Drill hole and Depth	BI-03; 17.4-18.4 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Stress Rate	0.5 MPa/s	
Diameter of Specimen	60.59 mm	2.39 in
Height of Specimen	129.81 mm	5.11 in
Load at Peak	4.39 kN	987 lbf
Unconfined Compressive Strength	1.52 MPa	221 psi
Type of Failure	Non-Structural	

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 5/4/2018

Photo Before Test

Photo After Test

Tested by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Tonon USA:
Engineering, Measuraments and Testing, LLC

Web: tononeng.com

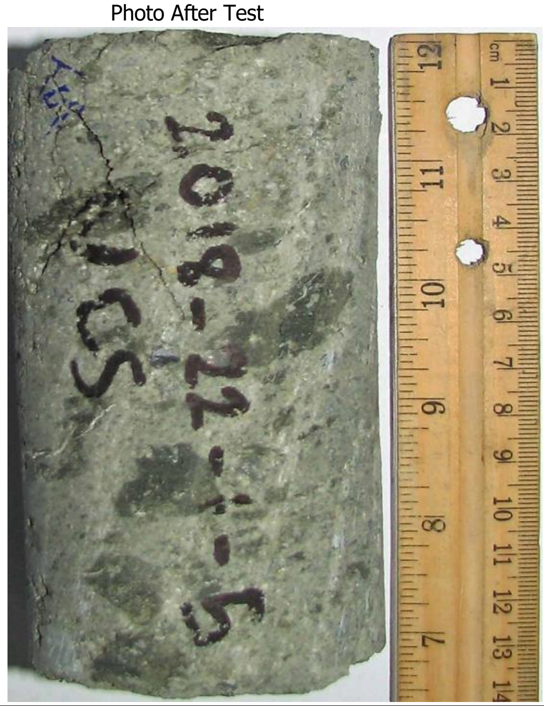
Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-1-5
Report Date	5/17/2018
Drill hole and Depth	BI-03; 21.5-22.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Stress Rate	0.5 MPa/s	
Diameter of Specimen	60.58 mm	2.39 in
Height of Specimen	125.67 mm	4.95 in
Load at Peak	6.99 kN	1,571 lbf
Unconfined Compressive Strength	2.43 MPa	352 psi
Type of Failure	Non-Structural	

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo Before Test

Photo After Test



Tested by: Dr. Fulvio Tonon, P.E., Ph.D.

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Laboratory Director: Dr. Fulvio Tonon, P.E., Ph.D.
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Brazilian Tensile Strength Test
ASTM D3967 - 16

COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV GL = ISO 9001 =

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Project Name	Klamath River Dam Removal	Rate of loading (0.05-0.35 MPa/s or 500-3,000 psi/min)	0.11 MPa/sec	957 psi/min
Location	Klamath River	Diameter (D)	60.94 mm	2.40 in
Client	Klamath River Renewal Corporation	Thickness (t)	22.88 mm	0.90 in
Client Project No.	60537920	Maximum Load (P)	6.53 kN	1,468 lbf
Registry No.	2018-22	Tensile strength (flat platens) $\sigma_t = 2P/\pi t D$	N/A	N/A
Report No.	2018-22-2-1	Tensile strength (curved platens) $\sigma_t = 1.272P/\pi t D$	1.90 MPa	275 psi
Report Date	5/17/2018	Direction of Loading	Orthogonal to the Borehole Axis	
Drill Hole and Depth	BI-02; 47-48.9 ft	Type of Failure	Non-Structural	
Rock Type	Volcanic Breccia	Conformance to dimensional Requirements $0.2 \le \frac{t}{D} \le 0.75$	$\frac{t}{D} =$ 0.38	OK
Geologic Unit	N/A			
Moisture Condition	As-received			

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo Before Test

Photo After Test

Tested by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

2028 E Ben White BLVD #240-2660
Austin, TX 78741

Laboratory Director: Dr. Fulvio Tonon, P.E., Ph.D.
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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-2-2
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 52-54.7 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Rate of loading (0.05-0.35 MPa/s or 500-3,000 psi/min)	0.11 MPa/sec	957 psi/min
Diameter (D)	60.84 mm	2.40 in
Thickness (t)	24.67 mm	0.97 in
Maximum Load (P)	5.25 kN	1,180 lbf
Tensile strength (flat platens) $\sigma_t = 2P/\pi tD$	N/A	N/A
Tensile strength (curved platens) $\sigma_t = 1.272P/\pi tD$	1.42 MPa	206 psi
Direction of Loading	Orthogonal to the Borehole Axis	
Type of Failure	Non-Structural	
Conformance to dimensional Requirements $0.2 \le \frac{t}{D} \le 0.75$	$\frac{t}{D} =$ 0.41	OK

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo Before Test

Photo After Test

Tested by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

2028 E Ben White BLVD #240-2660
Austin, TX 78741

Laboratory Director: Dr. Fulvio Tonon, P.E., Ph.D.
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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-2-3
Report Date	5/17/2018
Drill Hole and Depth	BI-03; 18.4-20.1 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Rate of loading (0.05-0.35 MPa/s or 500-3,000 psi/min)	0.11 MPa/sec	957 psi/min
Diameter (D)	60.74 mm	2.39 in
Thickness (t)	26.84 mm	1.06 in
Maximum Load (P)	1.51 kN	339 lbf
Tensile strength (flat platens) $\sigma_t = 2P / \pi tD$	N/A	N/A
Tensile strength (curved platens) $\sigma_t = 1.272P / \pi tD$	0.38 MPa	54 psi
Direction of Loading	Orthogonal to the Borehole Axis	
Type of Failure	Non-Structural	
Conformance to dimensional Requirements $0.2 \leq \frac{t}{D} \leq 0.75$	$\frac{t}{D} =$ 0.44	OK

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo Before Test

Photo After Test

Tested by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

Project Name	Klamath River Dam Removal	Rate of loading (0.05-0.35 MPa/s or 500-3,000 psi/min)	0.11 MPa/sec	957 psi/min
Location	Klamath River	Diameter (D)	60.26 mm	2.37 in
Client	Klamath River Renewal Corporation	Thickness (t)	33.83 mm	1.33 in
Client Project No.	60537920	Maximum Load (P)	0.55 kN	124 lbf
Registry No.	2018-22	Tensile strength (flat platens) $\sigma_t = 2P/\pi tD$	N/A	N/A
Report No.	2018-22-2-4	Tensile strength (curved platens) $\sigma_t = 1.272P/\pi tD$	0.11 MPa	16 psi
Report Date	5/17/2018	Direction of Loading	Orthogonal to the Borehole Axis	
Drill Hole and Depth	BI-03; 22.9-24.2 ft	Type of Failure	Non-Structural	
Rock Type	Volcanic Breccia	Conformance to dimensional Requirements $0.2 \le \frac{t}{D} \le 0.75$	$\frac{t}{D} =$ 0.56	OK
Geologic Unit	N/A			
Moisture Condition	As-received			

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo Before Test

Photo After Test

Tested by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV GL = ISO 9001 =

Tonon USA
Engineering, Measurements and Testing, LLC

Web: tononeng.com

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-3-1
Report Date	5/17/2018
Drill Hole and Depth (ft)	BI-02; 27-27.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/30/2018

Diameter	Length	Weight	Bulk Density	Bulk Density
(mm)	(mm)	(g)	(kN/m^3)	(pcf)
60.54	97.72	637.28	22.22	141.42

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

2028 E Ben White BLVD #240-2660
Austin, TX 78741

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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-3-2
Report Date	5/17/2018
Drill Hole and Depth (ft)	BI-02; 48.9-50.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/30/2018

Diameter	Length	Weight	Bulk Density	Bulk Density
(mm)	(mm)	(g)	(kN/m^3)	(pcf)
60.85	127.87	891.59	23.51	149.67

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

2028 E Ben White BLVD #240-2660
Austin, TX 78741

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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-3-3
Report Date	5/17/2018
Drill Hole and Depth (ft)	BI-02; 55.4-56.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/30/2018

Diameter	Length	Weight	Bulk Density	Bulk Density
(mm)	(mm)	(g)	(kN/m^3)	(pcf)
60.68	128.33	882.58	23.32	148.46

Performed by: Dr. Fulvio Tonon, P.E., Ph.D. Checked by: Gloria Tonon-Kozma, P.E.

COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV GL = ISO 9001 =

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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-3-4
Report Date	5/17/2018
Drill Hole and Depth (ft)	BI-03; 17.4-18.4 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/30/2018

Diameter	Length	Weight	Bulk Density	Bulk Density
(mm)	(mm)	(g)	(kN/m^3)	(pcf)
60.59	129.81	830.07	21.75	138.44

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-3-5
Report Date	5/17/2018
Drill Hole and Depth (ft)	BI-03; 21.5-22.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/30/2018

Diameter	Length	Weight	Bulk Density	Bulk Density
(mm)	(mm)	(g)	(kN/m^3)	(pcf)
60.58	125.67	783.13	21.20	134.96

Performed by: Dr. Fulvio Tonon, P.E., Ph.D. Checked by: Gloria Tonon-Kozma, P.E.

2028 E Ben White BLVD #240-2660
Austin, TX 78741

Laboratory Director: Dr. Fulvio Tonon, P.E.
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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-4-1
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 27-27.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/27-30/2018

Method A: Caliper

Diameter (mm)	Length (mm)	Initial Weight (g)	Dry Weight (g)
		202.50	193.13

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**
4.85				

Method B: Buoyancy

Weight (g)	Saturated Weight (g)	Suspended Weight (g)	Dry Weight (g)

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Laboratory Director: Dr. Fulvio Tonon, P.E., Ph.D.
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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-4-2
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 48.9-50.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/27-30/2018

Method A: Caliper

Diameter (mm)	Length (mm)	Initial Weight (g)	Dry Weight (g)
		180.47	169.63

Moisture Content (%)	Unit Weight (kN/m^3)	Unit Weight (pcf)	Dry Unit Weight (kN/m^3)	Dry Unit Weight (pcf)
6.39				

Method B: Buoyancy

Weight (g)	Saturated Weight (g)	Suspended Weight (g)	Dry Weight (g)

Moisture Content (%)	Unit Weight (kN/m^3)	Unit Weight (pcf)	Dry Unit Weight (kN/m^3)	Dry Unit Weight (pcf)

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Laboratory Director: Dr. Fulvio Tonon, P.E., Ph.D.
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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-4-3
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 55.4-56.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/27-30/2018

Method A: Caliper

Diameter (mm)	Length (mm)	Initial Weight (g)	Dry Weight (g)
		175.36	165.73

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**
5.81				

Method B: Buoyancy

Weight (g)	Saturated Weight (g)	Suspended Weight (g)	Dry Weight (g)

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Austin, TX 78741

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COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV GL = ISO 9001 =

Tonon USA
Engineering, Measurements and Testing, LLC

Web: tononeng.com

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-4-4
Report Date	5/17/2018
Drill Hole and Depth	BI-03; 17.4-18.4 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/27-30/2018

Method A: Caliper

Diameter (mm)	Length (mm)	Initial Weight (g)	Dry Weight (g)
		84.27	74.93

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**
12.46				

Method B: Buoyancy

Weight (g)	Saturated Weight (g)	Suspended Weight (g)	Dry Weight (g)

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV GL = ISO 9001 =

Tonon USA
Engineering, Measurements and Testing, LLC

Web: tononeng.com

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-4-5
Report Date	5/17/2018
Drill Hole and Depth	BI-03; 21.5-22.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date Received: 4/24/2018	Date Opened: 4/24/2018	Date Tested: 4/27-30/2018

Method A: Caliper

Diameter (mm)	Length (mm)	Initial Weight (g)	Dry Weight (g)
		177.06	160.77

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**
10.13				

Method B: Buoyancy

Weight (g)	Saturated Weight (g)	Suspended Weight (g)	Dry Weight (g)

Moisture Content (%)	**Unit Weight (kN/m^3)**	**Unit Weight (pcf)**	**Dry Unit Weight (kN/m^3)**	**Dry Unit Weight (pcf)**

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Tonon USA:
Engineering, Measurements and Testing, LLC

Web: tononeng.com

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-5-1
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 51.3-51.7 ft
Rock Type	Volcanic Breccia
Formation	N/A
Surface Condition	Cut by Slab Saw

Apparatus, Pin R.-H.	West Cerchar, 55/56	
Direction of Scratch	Perpendicular to Core Axis	
Pin Wear (mm)	0.156	0.145
	0.142	0.124
	0.144	0.133
	0.162	0.129
	0.150	0.140
Average (mm)	0.143	
CAIs	**1.43**	
CAI	**1.89**	
Classification	**Medium Abrasiveness**	

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo After Test

Tested by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-5-2
Report Date	5/17/2018
Drill Hole and Depth	BI-03; 25.1-26.1 ft
Rock Type	Volcanic Breccia
Formation	N/A
Surface Condition	Cut by Slab Saw

Apparatus, Pin R.-H.	West Cerchar, 55/56	
Direction of Scratch	Perpendicular to Core Axis	
Pin Wear (mm)	0.046	0.037
	0.083	0.069
	0.104	0.090
	0.087	0.098
	0.100	0.093
Average (mm)	0.081	
CAIs	**0.81**	
CAI	**1.28**	
Classification	**Medium Abrasiveness**	

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/30/2018

Photo After Test

Tested by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Project Name	Klamath River Dam Removal
Project location	Klamath River
Client	Klamath River Renewal Corporation
Client's Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-7-1
Report Date	5/17/2018
Borehole and Depth	BI-02; 51.7-52 ft
Studied by	Lidia Scavo and Fulvio Tonon
Reviewed by	Gloria Tonon-Kozma

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 5/17/2018

A sample from borehole BI-02; 51.7-52 ft was analyzed under the polarized microscope to determine its mineralogical composition from a 25 X 40 mm (0.9 X 1.58 in) thin section.

Visual inspection of the sample suggests an igneous origin.

ROCK NAME: **BRECCIATED-ALTERED BASALT** (according to EN 12670).

Fig. 1 - Aspect of the studied sample (hand specimen).

Hand specimen – Visual inspection: It is a mafic, greenish and dusty material with a very weak behavior. It is composed of a dark and very fine groundmass with phenocrysts that are millimetric in size, and light to dark colored.

According to the Rock-Color Chart of the Geological Society of America, the groundmass color is Grayish Green (5G 5/2), and the phenocrysts are Grayish Green (10G 4/2) to Light Bluish Gray (5B 7/1).

The rock fizzes under hydrochloric acid, and it can be scratched by a metal tip.

Probable Origin: It is an altered Plagioclase-rich basaltic rock.

Mineralogy: Plagioclase, Clay Minerals, Olivine, Opaque Minerals, Volcanic Glass, Carbonates

Textures: The rock has a porphyric texture with a very fine and dark groundmass, in which there are Plagioclase crystals, rare Olivine crystals, Opaque Minerals, and many alteration Clay Minerals (predominantly Phyllosilicates such as Chlorite).

Plagioclase is the most common mineral phase: crystals are quite large and well zoned. Because of their golden color, clay minerals can be hardly distinguished from the groundmass, except for Chlorite that can be locally seen in amorphous greenish individuals.

Opaque Minerals are mainly made up of Oxides of the Hematite group.

Spotted Carbonates may be also identified.

Alteration and Mineral Suturing Condition: The rock is highly altered: even the largest phenocrysts show traces of intense alteration acted upon by clayey minerals; Plagioclase crystals are intensively fractured. These fractures are commonly filled with secondary clayey material in a "quasi-stylolithic" pattern.

Discontinuities: The rock shows a very pervasive fracture system: many of these fractures have not been filled with secondary mineralization, and they predominantly cross the groundmass. Fractures crossing phenocrysts are instead filled with clay minerals.

Description of Individual Minerals:

Minerals	Mineral Content (%)	Mohs Hardness	Grain Size (mm)	Description and Comments
Plagioclase	33.3	6	1.10	As individual crystals
Chlorite	1.67	2.5	0.05	Very variable in size, alteration single crystals
Oxides	6.67	5.5	0.02-0.8	Spotted Hematite individuals
Glass	50	5	Sub-micrometric	Makes up the groundmass
Clay	8.33	4	Sub-micrometric	Phyllosilicates, unresolvable at a microscopic scale
Weighted Average:		4.2	-	

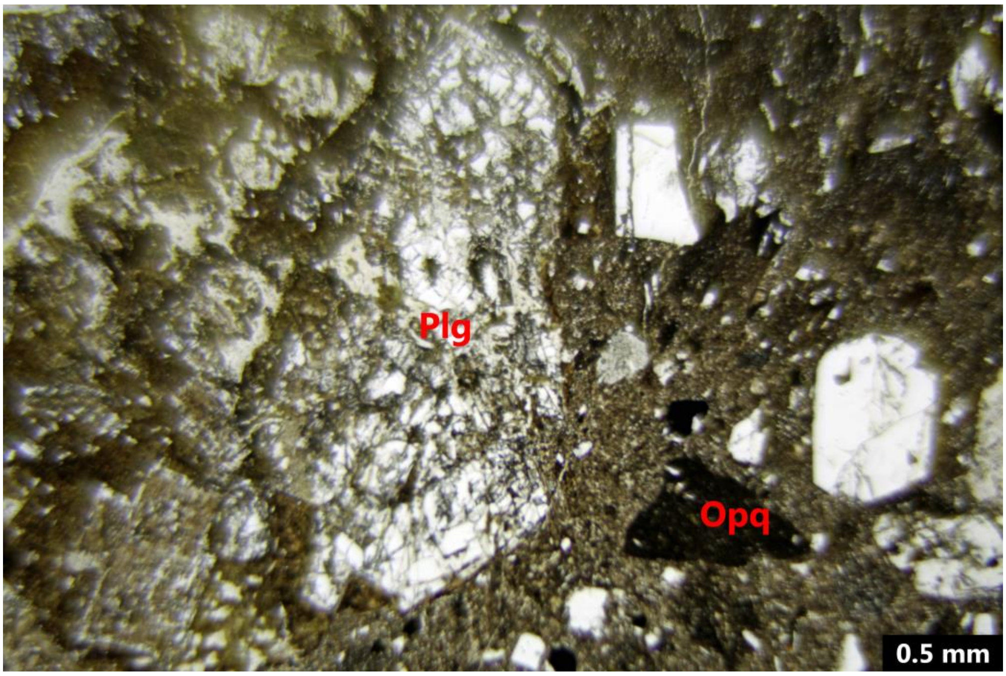

Fig. 2 - Plane polarized light. Field of view = 4 mm wide (magnification 4X). A view of the studied sample, showing an altered Plagioclase (Plg) crystal near to a big Hematite crystal (Opq).

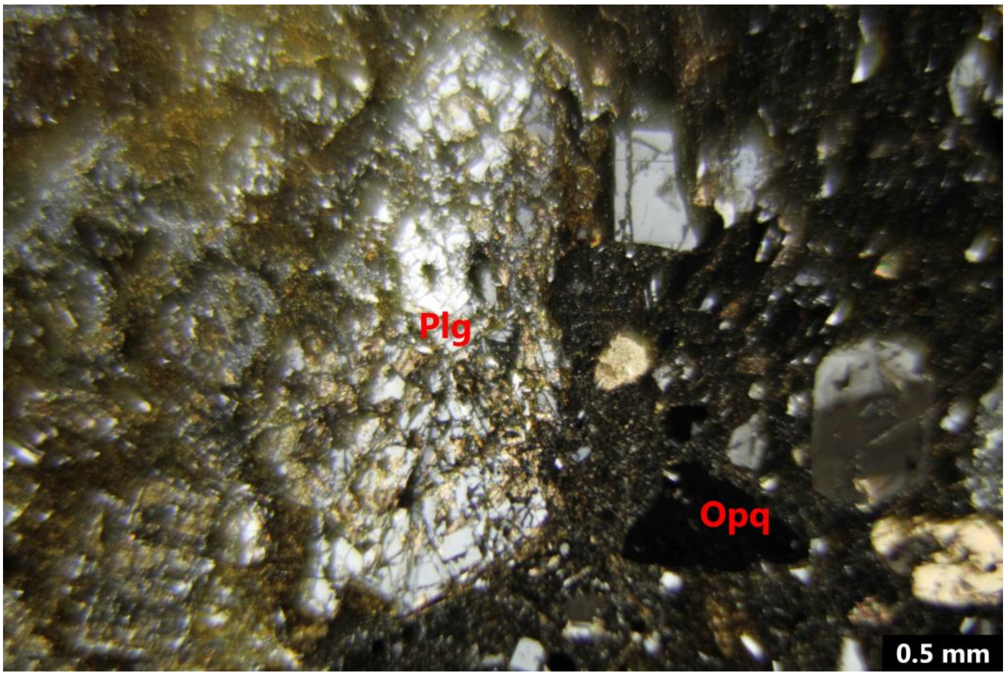

Fig. 3 - Cross polarized light. Field of view = 4 mm wide (magnification 4X). Same as Figure 2, but under crossed polars.

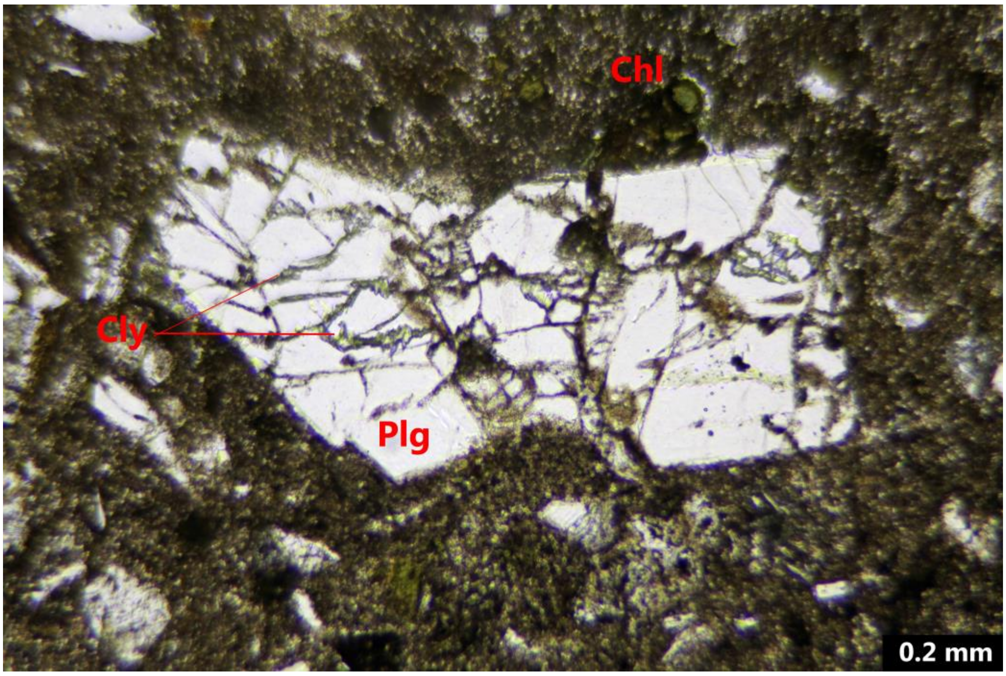

Fig. 4 - Plane polarized light. Field of view = 1.7 mm wide (magnification 10X). A detail of a Plagioclase grain, crossed by many fractures, all filled with Clay Minerals (Cly). Some Chlorite individuals (Chl) may be identified in the upper part of the picture.

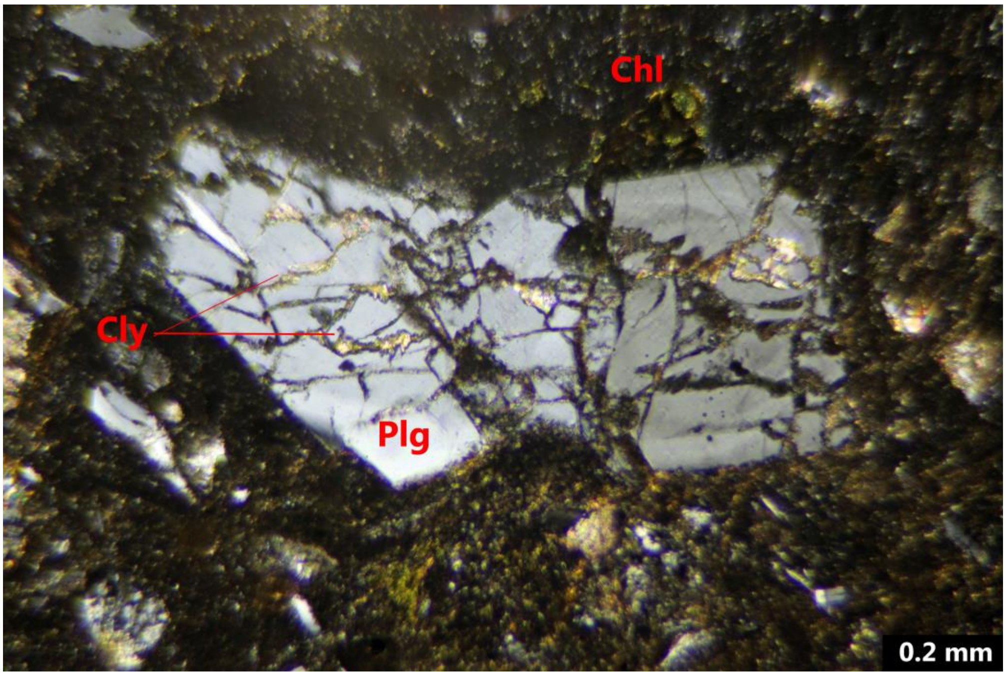

Fig. 5 - Cross polarized light. Field of view = 1.7 mm wide (magnification 10X). Same as Figure 4, but under crossed polars.

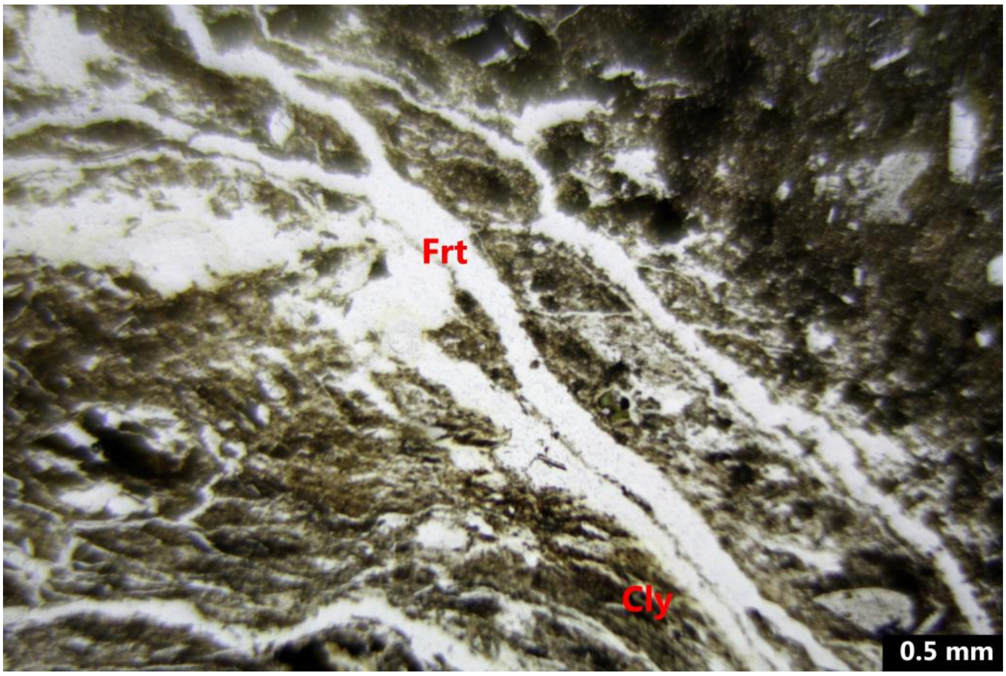

Fig. 6 - Plane polarized light. Field of view = 4 mm wide (magnification 4X). A selected area of the section with a well-developed fracture system (Frt).

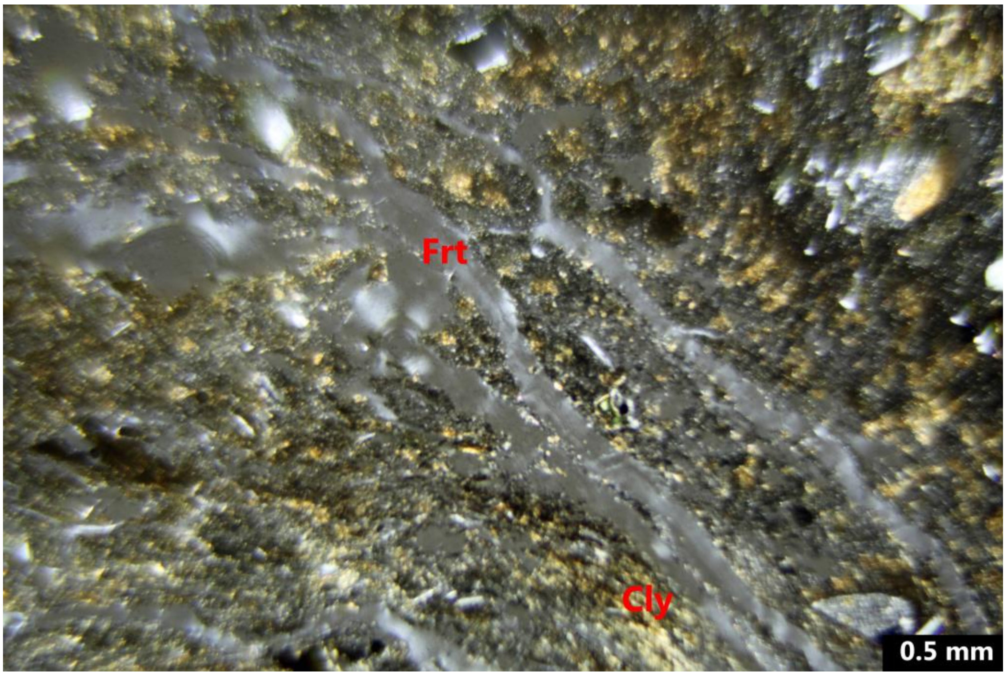

Fig. 7 - Cross polarized light. Field of view = 4 mm wide (magnification 4X). Same as Figure 6, but under crossed polars.

Project Name	Klamath River Dam Removal
Project location	Klamath River
Client	Klamath River Renewal Corporation
Client's Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-7-2
Report Date	5/17/2018
Borehole and Depth	BI-03; 20.8-21 ft
Studied by	Lidia Scavo and Fulvio Tonon
Reviewed by	Gloria Tonon-Kozma

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 5/17/2018

A sample from borehole BI-03; 20.8-21 ft was analyzed under the polarized microscope to determine its mineralogical composition from a 25 X 40 mm (0.9 X 1.58 in) thin section.

Visual inspection of the sample suggests an igneous origin.

ROCK NAME: **ALTERED VOLCANIC BRECCIA** (according to EN 12670).

Fig. 1 - Aspect of the studied sample (hand specimen).

Hand specimen – Visual inspection: It is a greenish mafic rock. It appears to be very weak, and it shows a dusty appearance. It is composed of a dark green groundmass with spotted whitish to bluish phenocrysts.

According to the Rock-Color Chart of the Geological Society of America, the groundmass color is Grayish Green (5G 5/2); clasts have colors ranging from Dark Greenish Gray (4G 4/1) to Light Bluish Gray (5B 7/1). The matter also shows alterations that are Dark Greenish Yellow (10Y 6/6).

The rock fizzes under hydrochloric acid, and it can be scratched by a metal tip.

Probable Origin: It is an altered volcanic breccia.

Mineralogy: Plagioclase, Volcanic Glass, Pyroxene, Chlorite, Clay Minerals, Opaque Minerals, Carbonates.

Textures: It is a mafic porphyritic rock with a chaotic structure: no preferred orientation may be identified.
Plagioclase is the most common constituent mineral: its crystals range from sub-millimetric in size to glassy and are usually well shaped. Zonation is irregular.
Some of the clasts are made up of extraneous volcanic clasts; they can be easily identified because of their color variation when compared to the rest of the thin section: these clasts display a different mafic content.
Secondary mineral phases are made up of rare Augite-Pyroxene, Chlorite, Carbonates and Opaque Minerals.
Very common, but not resolvable at a microscopic observation scale, are Volcanic Glass and Clay Minerals. Clay Minerals also represent the main alteration substance of the rock, which affects both the groundmass and the clasts.

Alteration and Mineral Suturing Condition: The sample shows a substaintial clayey alteration, with clear Chlorite individuals associated with very fine-grained Clay Minerals. Spotted secondary Carbonates can be found as fracture filling material.
Crystals in this thin section have well defined rims, but they are also affected by pervasive fractures both within the crystals and all around their boundaries.

Discontinuities: The rock is heavily fractured, with two classes of discontinuities: a first one made up of empty cracks crossing the groundmass and the crystals, and a second one made up of Carbonate-filled fractures, sometimes surrounding single crystals or clasts.

Description of Individual Minerals:

Minerals	Mineral Content (%)	Mohs Hardness	Grain Size (mm)	Description and Comments
Plagioclase	28.33	6	0.6	As single individuals or as the main part of many external clast groundmass
Chlorite	1.67	2	0.3	As individuals of secondary crystallization
Opaque Minerals	5	5.5	0.1	Spotted individuals of Hematite
Glass	41.67	5	Sub-micrometric	Makes up the groundmass
Pyroxene	1.67	5.5	0.2	Rare sub-euhedral crystals
Carbonates	5	4	0.06	As fracture filling material
Clay Minerals	16.67	2	Sub-micrometric	Phyllosilicates of secondary alteration
Weighted Average:		4.3	-	

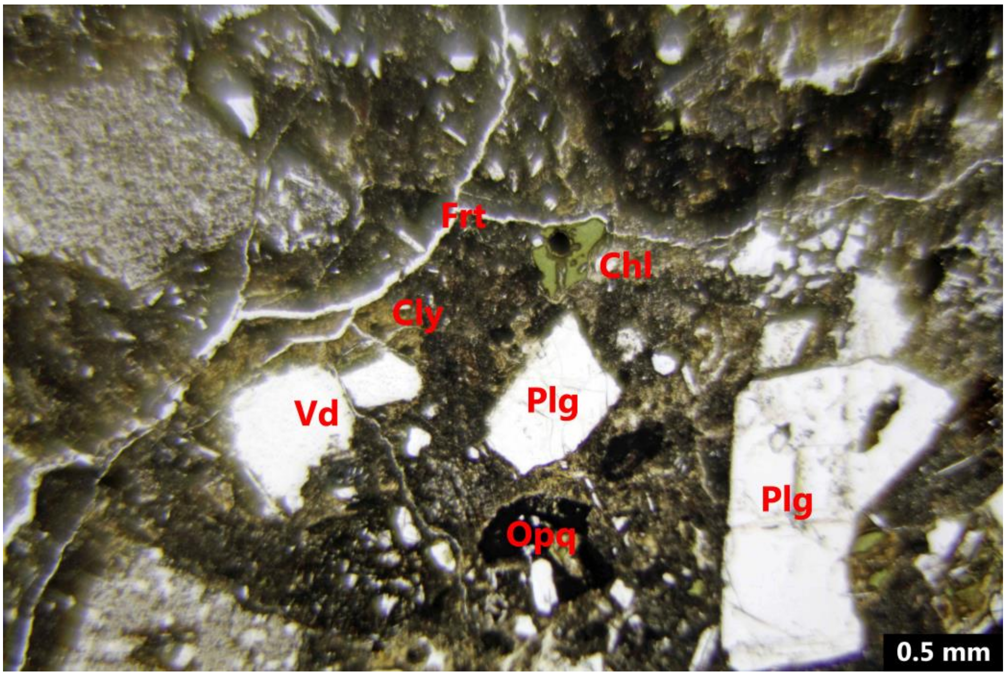

Fig. 2 - Plane polarized light. Field of view = 4 mm wide (magnification 4X). A view of the studied sample. The most common minerals are: Plagioclase (Plg), Clay Minerals (Cly), Opaque Minerals (Opq), and Chlorite (Chl). Also highlighted here are some structural features, such as fractures (Frt) and voids (Vd).

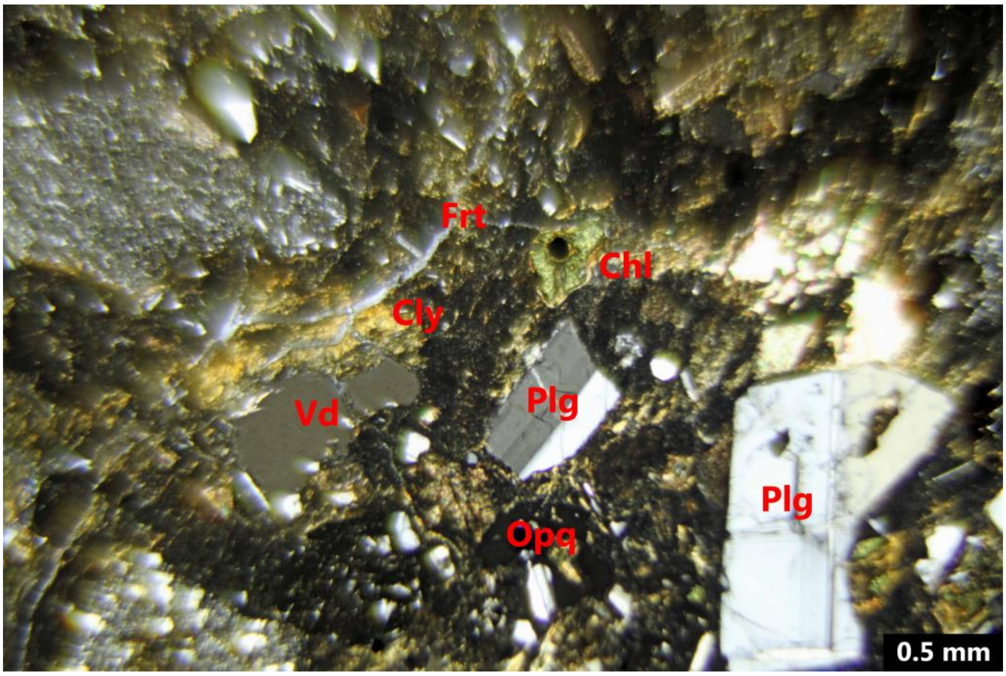

Fig. 3 - Cross polarized light. Field of view = 4 mm wide (magnification 4X). Same as Figure 2, but under crossed polars.

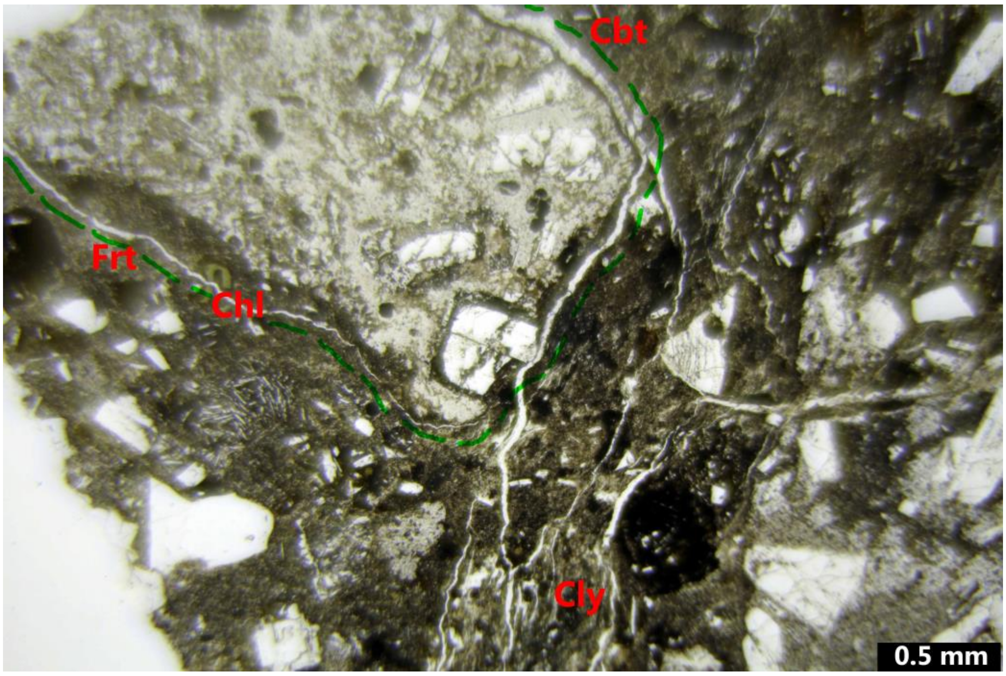

Fig. 4 - Plane polarized light. Field of view = 4 mm wide (magnification 4X). A view of a volcanic clast. A common feature of all the clasts in this thin section is the presence of fractures surrounding clast boundaries (follow the green dashed line). In this case the fracture is filled with secondary Carbonates (Cbt).

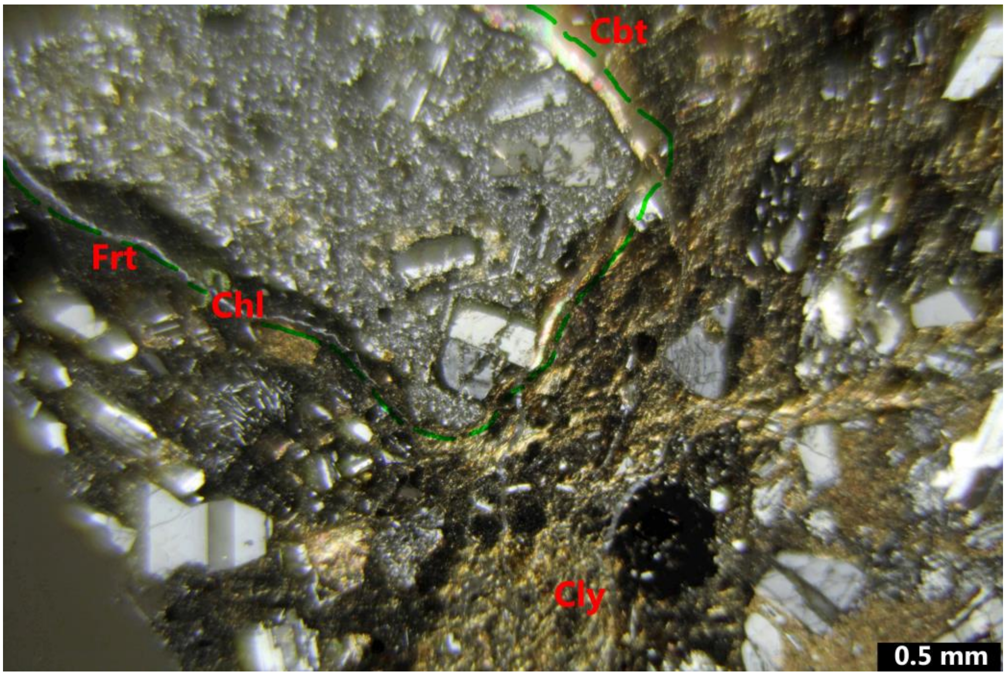

Fig. 5 - Cross polarized light. Field of view = 4 mm wide (magnification 4X). Same as Figure 4, but under crossed polars.

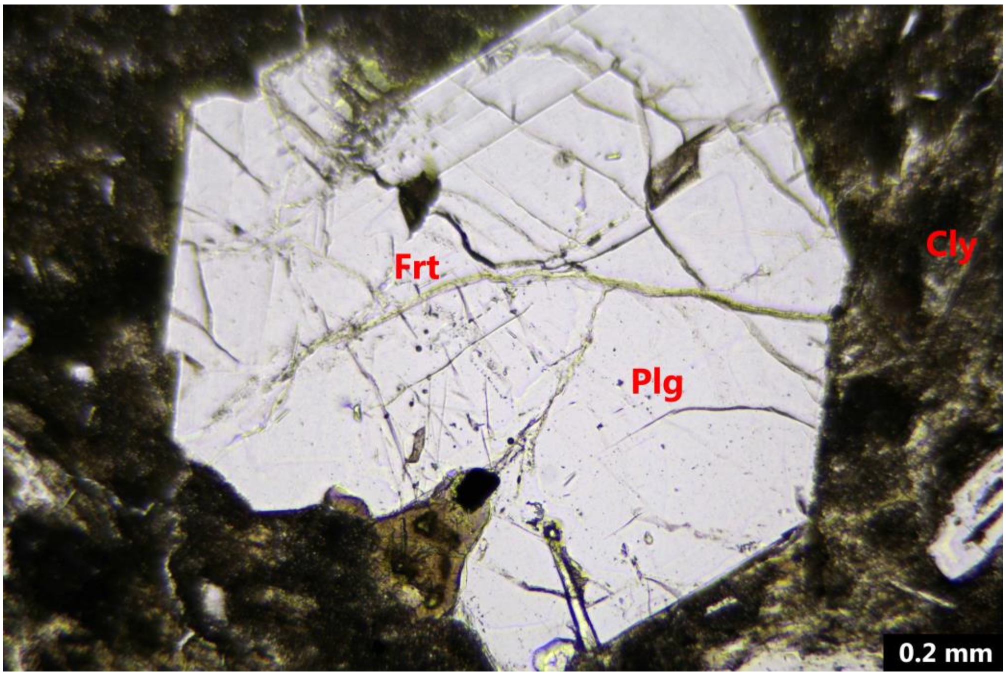

Fig. 6 - Plane polarized light. Field of view = 1.7 mm wide (magnification 10X). A detail of a Plagioclase crystal, showing grain alteration and suturing features: fractures cross the crystal and are also filled with Clay Minerals.

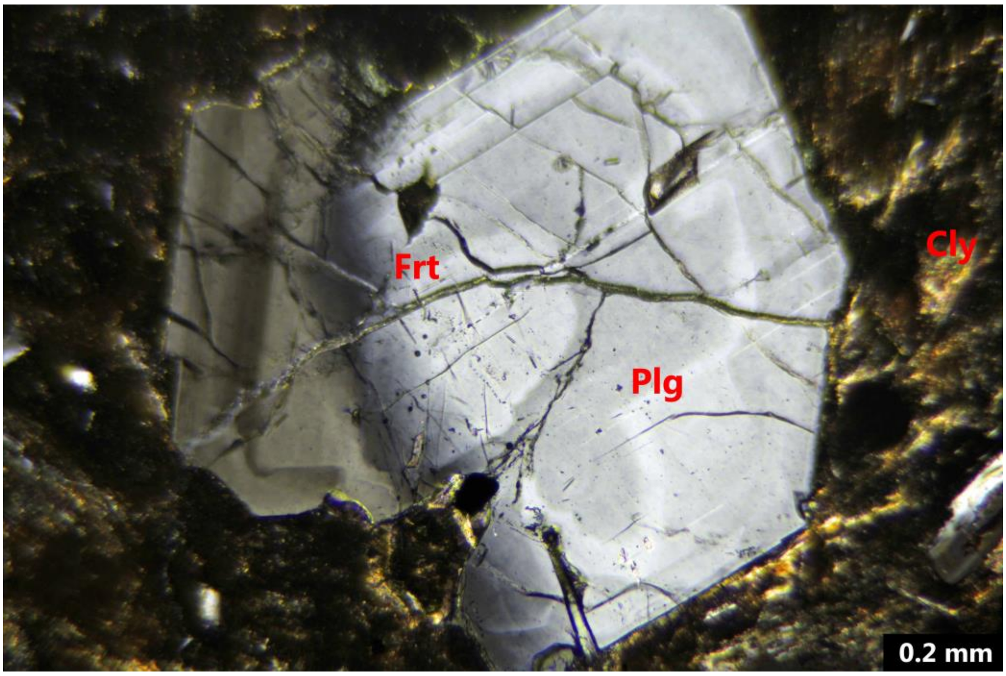

Fig. 7 - Cross polarized light. Field of view = 1.7 mm wide (magnification 10X). Same as Figure 6, but under crossed polars.

COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV GL = ISO 9001 =

Tonon USA
Engineering, Measurements and Testing, LLC

Web: tononeng.com

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-8-1
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 27-27.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/24/2018

Mohs Hardness
3

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Austin, TX 78741

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COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV GL = ISO 9001 =

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Web: tononeng.com

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-8-2
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 48.9-50.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/24/2018

Mohs Hardness
3

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

2028 E Ben White BLVD #240-2660
Austin, TX 78741

Laboratory Director:Dr. Fulvio Tonon, P.E., Ph.D.
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COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV GL = ISO 9001 =

Tonon USA
Engineering, Measurements and Testing, LLC

Web: tononeng.com

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-8-3
Report Date	5/17/2018
Drill Hole and Depth	BI-02; 55.4-56.3 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/24/2018

Mohs Hardness
3

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

2028 E Ben White BLVD #240-2660
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COMPANY WITH QUALITY SYSTEM CERTIFIED BY DNV GL = ISO 9001 =

Tonon USA
Engineering, Measurements and Testing, LLC

Web: tononeng.com

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-8-4
Report Date	5/17/2018
Drill Hole and Depth	BI-03; 17.4-18.4 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/24/2018

Mohs Hardness
3

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

2028 E Ben White BLVD #240-2660
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Tonon USA
Engineering, Measurements and Testing, LLC

Web: tononeng.com

Project Name	Klamath River Dam Removal
Location	Klamath River
Client	Klamath River Renewal Corporation
Client Project No.	60537920
Registry No.	2018-22
Report No.	2018-22-8-5
Report Date	5/17/2018
Drill Hole and Depth	BI-03; 21.5-22.9 ft
Rock Type	Volcanic Breccia
Geologic Unit	N/A
Moisture Condition	As-received

Date received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 4/24/2018

Mohs Hardness
3

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Project Name	Klamath River Dam Removal	Penetration rate	0.001 in/sec			
Location	Klamath River	Diameter of specimen	60.65	mm	2.39	in
Client	Klamath River Renewal Corporation	Height of specimen	64.62	mm	2.54	in
Client Project No.	60537920	Load at peak	27.81	kN	6,251	lbf
Registry No.	2018-22	45 Degree (Standard) Index	175			
Report No.	2018-22-8-1	Peak Slope Index	39			
Report Date	5/17/2018					
Drill Hole and Depth	BI-02; 50.3-51.3 ft					
Rock Type	Volcanic Breccia					
Geologic Unit	N/A					
Moisture Condition	As-received					

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 5/4/2018

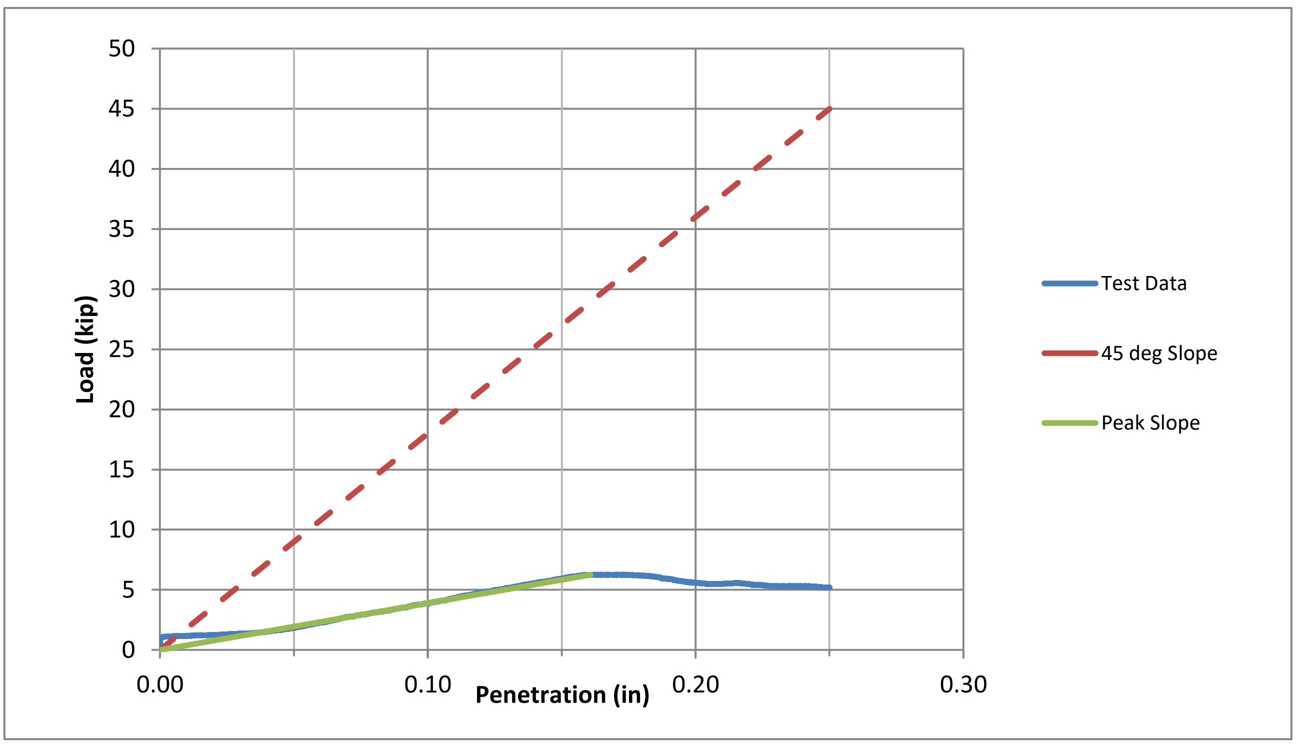

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Photo After Test

Performed by: Dr. Fulvio Tonon, P.E., Ph.D.

Checked by: Gloria Tonon-Kozma, P.E.

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Austin, TX 78741

Laboratory Director: Dr. Fulvio Tonon, P.E., Ph.D.
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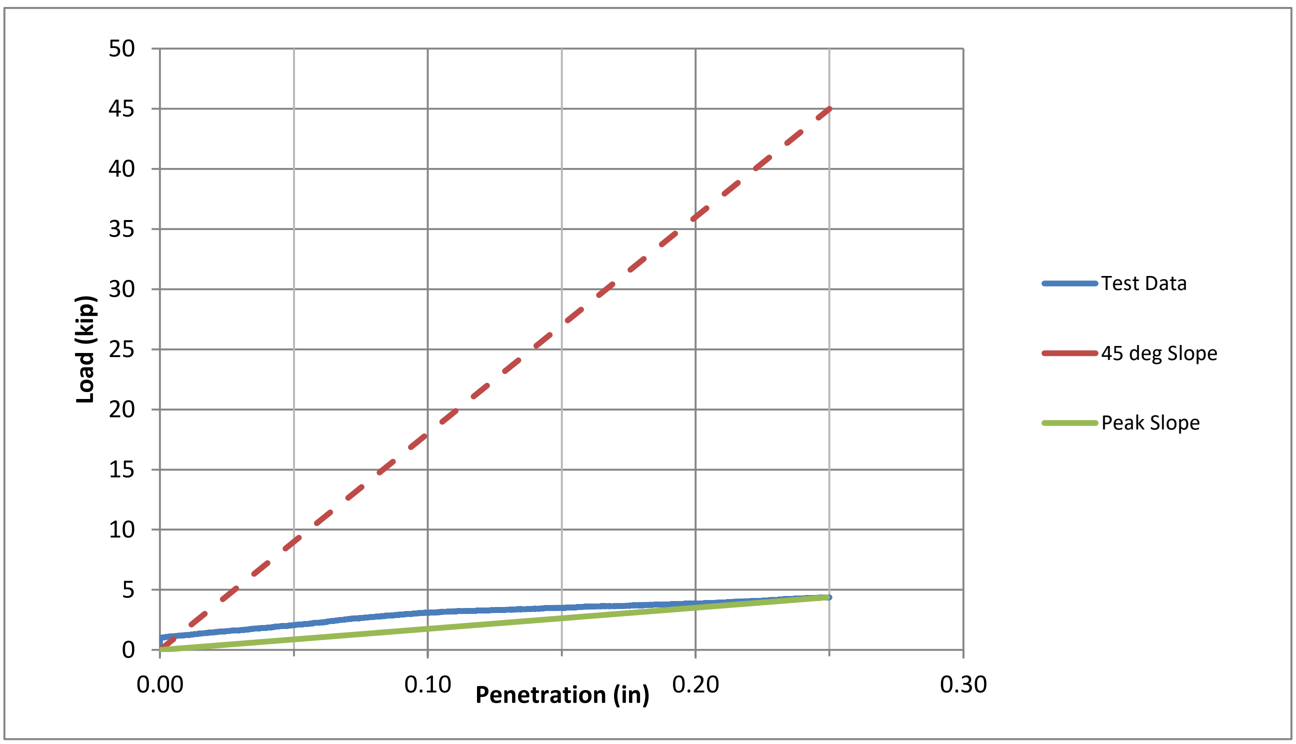
Project Name	Klamath River Dam Removal	Penetration rate	0.001 in/sec			
Location	Klamath River	Diameter of specimen	60.4	mm	2.38	in
Client	Klamath River Renewal Corporation	Height of specimen	67.53	mm	2.66	in
Client Project No.	60537920	Load at peak	19.46	kN	4,373	lbf
Registry No.	2018-22	45 Degree (Standard) Index	175			
Report No.	2018-22-8-2	Peak Slope Index	18			
Report Date	5/17/2018					
Drill Hole and Depth	BI-03; 24.2-25.1 ft					
Rock Type	Volcanic Breccia					
Geologic Unit	N/A					
Moisture Condition	As-received					

Date Received : 4/24/2018	Date Opened : 4/24/2018	Date Tested: 5/4/2018



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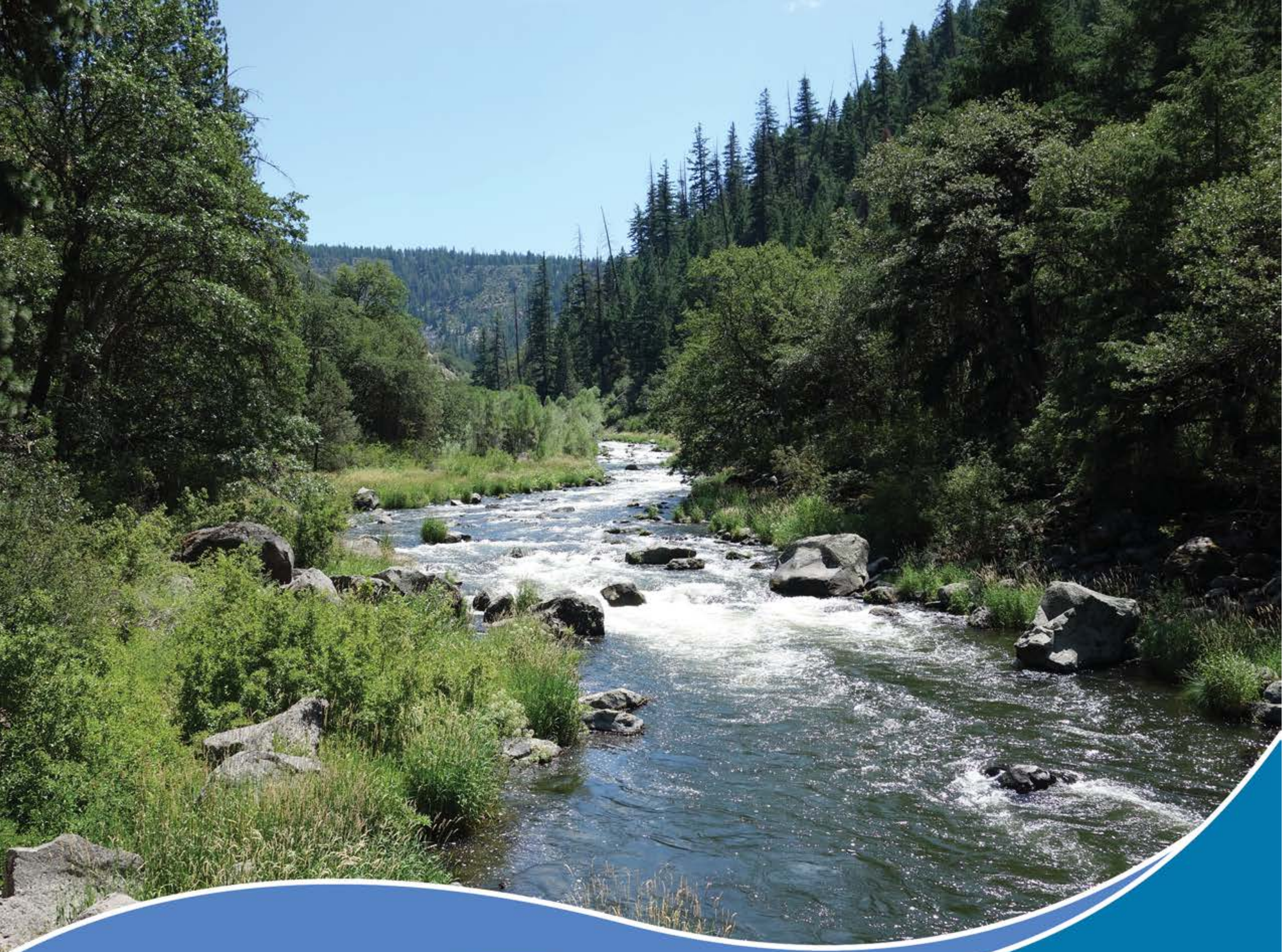

Definite Plan for the Lower Klamath Project

Appendix F - Reservoir Drawdown Modeling Output

KLAMATH
RIVER RENEWAL
CORPORATION

June 2018

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Prepared for:

Klamath River Renewal Corporation

Prepared by:

KRRC Technical Representative:

AECOM Technical Services, Inc.
300 Lakeside Drive, Suite 400
Oakland, California 94612

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Chapter 1: Drawdown Analysis

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1. DRAWDOWN ANALYSIS

KRRC conducted detailed analysis of the proposed drawdown using the USACE Hydrologic Engineering Center River Analysis System (HEC-RAS) model (version 5.0.3). KRRC used the model to calculate flows and water levels due to the drawdown of J.C. Boyle Reservoir, Copco Lake, and Iron Gate Reservoir. For modeling stability purposes, KRRC divided the Klamath River into two modeling reaches. Reach 1 covers the J.C. Boyle Reservoir and extends from approximately 1 mile upstream of J.C. Boyle Reservoir to approximately 0.4 miles downstream of J.C. Boyle Dam. Reach 2 extends from approximately 1.5 miles upstream of Copco Lake to approximately 0.6 miles downstream of Iron Gate Dam.

The HEC-RAS model requires inputs for topography/bathymetry, inflow rates, and rating curves for dam outlets. The following sections discuss input sources and data.

1.1 Topography/Bathymetry

KRRC generally obtained the cross-section bathymetry in the HEC-RAS model from the SRH1-D model provided by the U.S. Bureau of Reclamation (USBR). The data were representative of Scenario 8 in USBR (2012). The bathymetry data extended from above J.C. Boyle to the ocean; however, KRRC only used the data for Reach 1 and Reach 2 as described above.

Stage-storage relationships were determined using output from the HEC-RAS model for each of the three large reservoirs, Iron Gate Reservoir, Copco Lake, and J.C. Boyle Reservoir. KRRC compared the HEC-RAS storage curves to the stage-storage curves provided in Attachment B of the Detailed Plan (USBR 2012b). The results from the initial model output showed higher capacities than specified in the Detailed Plan. Therefore, KRRC adjusted (shifted up) the cross-section elevations upstream of each of the dams until the stage-storage relationships in the HEC-RAS model matched the stage-storage curves from the Detailed Plan.

1.2 Inflow Rate

Inflow data based on the Klamath Basin Restoration Agreement (KBRA) flows were used as upstream river flows (Keno flows) [1] for both J.C. Boyle and Copco No. 1. KRRC obtained these flows from the SRH1-D model input files (USBR 2012c). The data were compared to the measured flows at the USGS gage at Keno (gage no. 11509500, Klamath River at Keno, OR). Definite Plan Section 4.6.1 provides a comparison between the USGS measured data at Keno and the SRH1-D data used in the model. Flow was increased upstream of Iron Gate dam using the “Copco to Iron Gate Gains” from the SRH1-D input file to account for tributary inflow.

[1] The 2013 Joint Biological Opinion for USBR’s Klamath Project (NMFS and USFWS 2013) modified the flows from the 2010 KBRA. The 2013 Joint Biological Opinion slightly increases the annual average water supply by about 9 thousand acre feet when compared with the KBRA Flows, and it maintains higher minimum summer flows in dry years. The changes to flows in January and February (during drawdown) are negligible. The small changes to flows in the 2013 Joint Biological Opinion will not affect the drawdown of the reservoirs, nor the level of flows released during drawdown. NMFS and USFWS are working on a new Joint Biological Opinion to be released in 2019, which may again alter flows released by USBR’s Klamath Project.

KRRC simulated water years 1961 through 2009 in the model. KRRC determined the maximum 15-day total flow volume for each water year so that the years could be ranked based on hydrologic conditions (Table 1-1).

Table 1-1: Water Years between 1961 and 2009 ranked by SRH1-D Keno Flow Volume

Water Year	Maximum 15-day Flow Volume between January and May (acre-feet)	Rank
1966*	5,194,887	1
1997	4,572,024	2
1972	4,529,358	3
2006	4,138,916	4
1996	3,965,633	5
1983	3,940,625	6
1986	3,239,955	7
1974	3,166,176	8
1999	3,061,339	9
1982	2,927,194	10
1970	2,897,662	11
1971	2,845,658	12
1989	2,813,797	13
1978	2,723,380	14
1969	2,563,472	15
1984	2,516,746	16
1998	2,471,870	17
1993	2,384,182	18
1975	2,361,555	19
1985	1,710,804	20
2000	1,633,487	21
1968	1,622,059	22
1995	1,540,547	23
1980	1,394,132	24
1973	1,390,825	25
1964	1,294,327	26
2008	1,194,776	27
1976	1,177,407	28

Water Year	Maximum 15-day Flow Volume between January and May (acre-feet)	Rank
2004	1,075,804	29
1963	1,054,977	30
2007	1,054,187	31
1962	1,044,193	32
1987	1,019,283	33
1967	948,459	34
1988	900,774	35
1965	874,920	36
2003	801,979	37
1979	772,021	38
1990	711,287	39
1981	695,542	40
2002	674,728	41
2001	634,014	42
2009	627,011	43
1961	620,286	44
1977	586,748	45
1994	416,661	46
1991	396,980	47
2005	377,839	48
1992	370,748	49

* Corresponds to water year 1965 in historical flow record.

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Chapter 2: J.C. Boyle Reservoir

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2. J.C. BOYLE RESERVOIR

The drawdown procedure included in the HEC-RAS model for J.C. Boyle is summarized below:

1. Simulations started on January 1, 2021 by making releases through the gated spillway (crest elevation 3785.2) and the power intake (invert elevation 3771.7). The three spillway gates and the gate for the power intake were set fully open. The maximum flow through the power intake is about 2,800 cubic feet per second (cfs). About 25 percent of years have an average flow in January greater than 2,800 cfs and almost 40 percent have a maximum flow greater than 2,800 cfs. Flows above about 2,800 cfs go over the spillway.
2. After two weeks (set to January 14), KRRC assumed that the concrete stoplogs on the first 9.5- by 10-foot diversion culvert will be removed and the culvert will open.
3. Drawdown would continue using the single diversion culvert until the end of January.
4. On February 1, the second 9.5- by 10-foot diversion culvert will be opened by removing the concrete stoplogs.
5. The power intake gate was closed once the reservoir was drawn down below the power intake invert or when the second bay of the diversion culvert was opened, whichever was earlier.

2.1 Results

Figures 2-1 through 2-49 show results from the simulations of J.C. Boyle. Because of the small size of the J.C. Boyle Reservoir, the reservoir will refill partially or completely during a storm until dam removal is complete. The capacity of the two diversion culverts for water levels below the spillway elevation is about 5,700 cfs. The historical hydrology record shows about 15 percent of the years have a maximum January or February flow that exceeds 5,000 cfs and would result in reservoir refilling and associated flows over the spillway.

During representative drier years (for example 1973 and 1979), the reservoir was easily drawn down in January, and it did not refill after that point.

During the wetter years (for example 2006 and 1986), J.C. Boyle Reservoir was completely drawn down early (January to mid-February), but quickly refilled later in the year when storms occurred. The majority of the accumulated sediment would mobilize during the initial drawdown, and subsequent reservoir filling and drawdown is expected to cause only moderate increases in high suspended sediment (relative to background) (USBR 2012c).

For all water years, any increase in peak flows with drawdown compared to peak flows without drawdown is small due to the relatively limited amount of attenuation associated with the existing reservoir.

KRRC does not anticipate that sediment concentrations resulting from the proposed drawdown procedure and associated hydraulics would differ from those previously estimated (USBR 2012c).

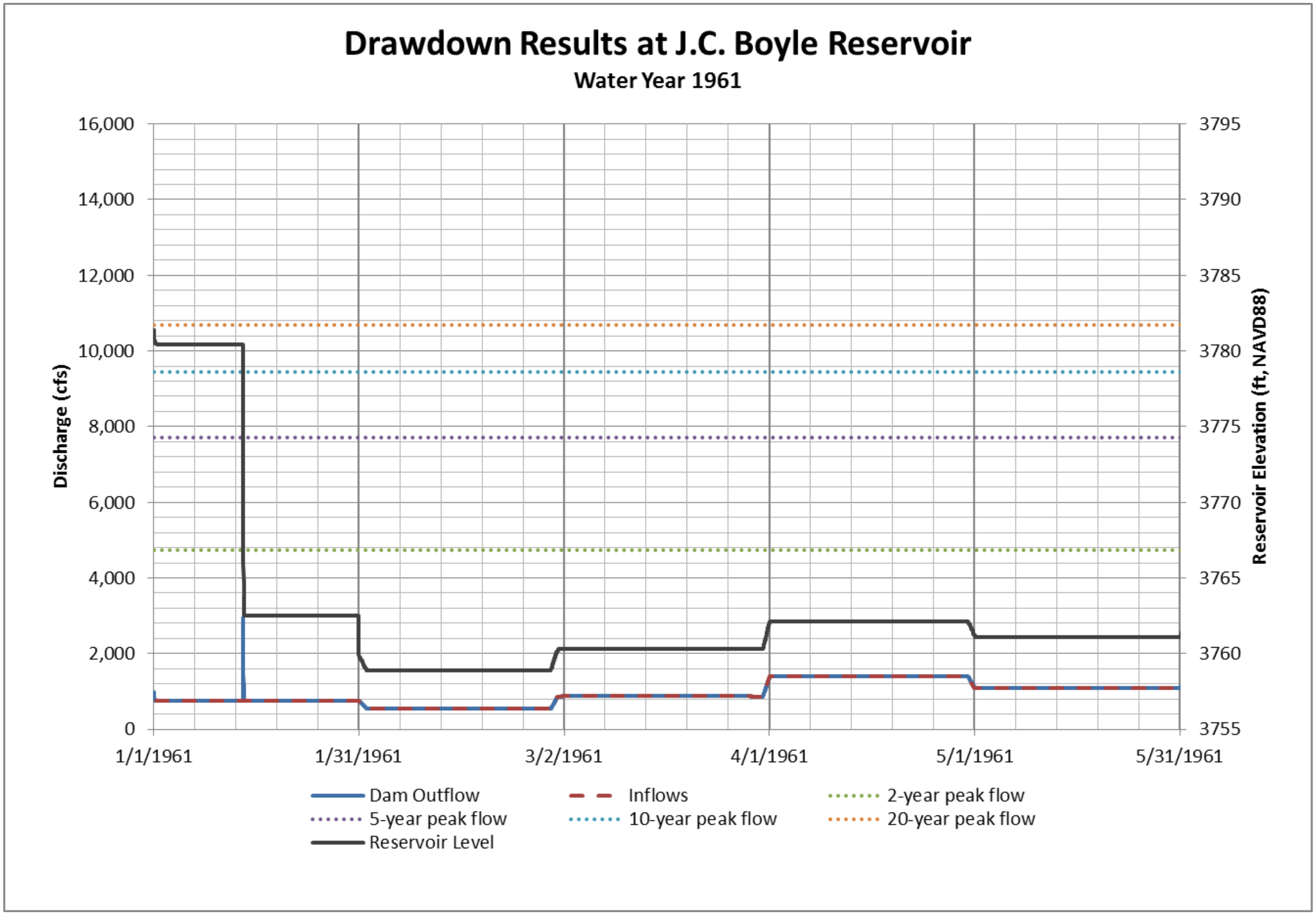

Figure 2-1 J.C. Boyle Reservoir Drawdown, Water Year 1961

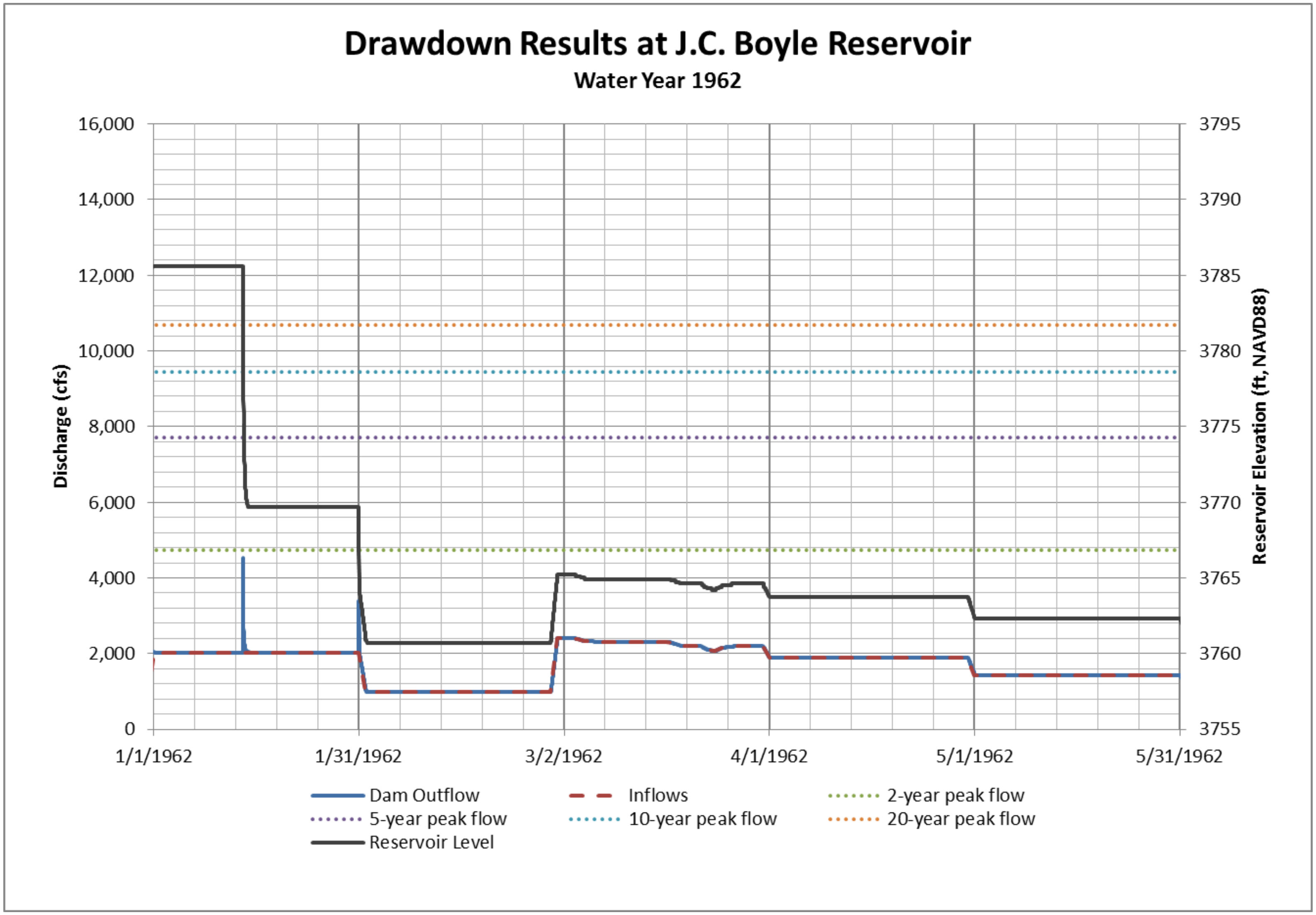

Figure 2-2 J.C. Boyle Reservoir Drawdown, Water Year 1962

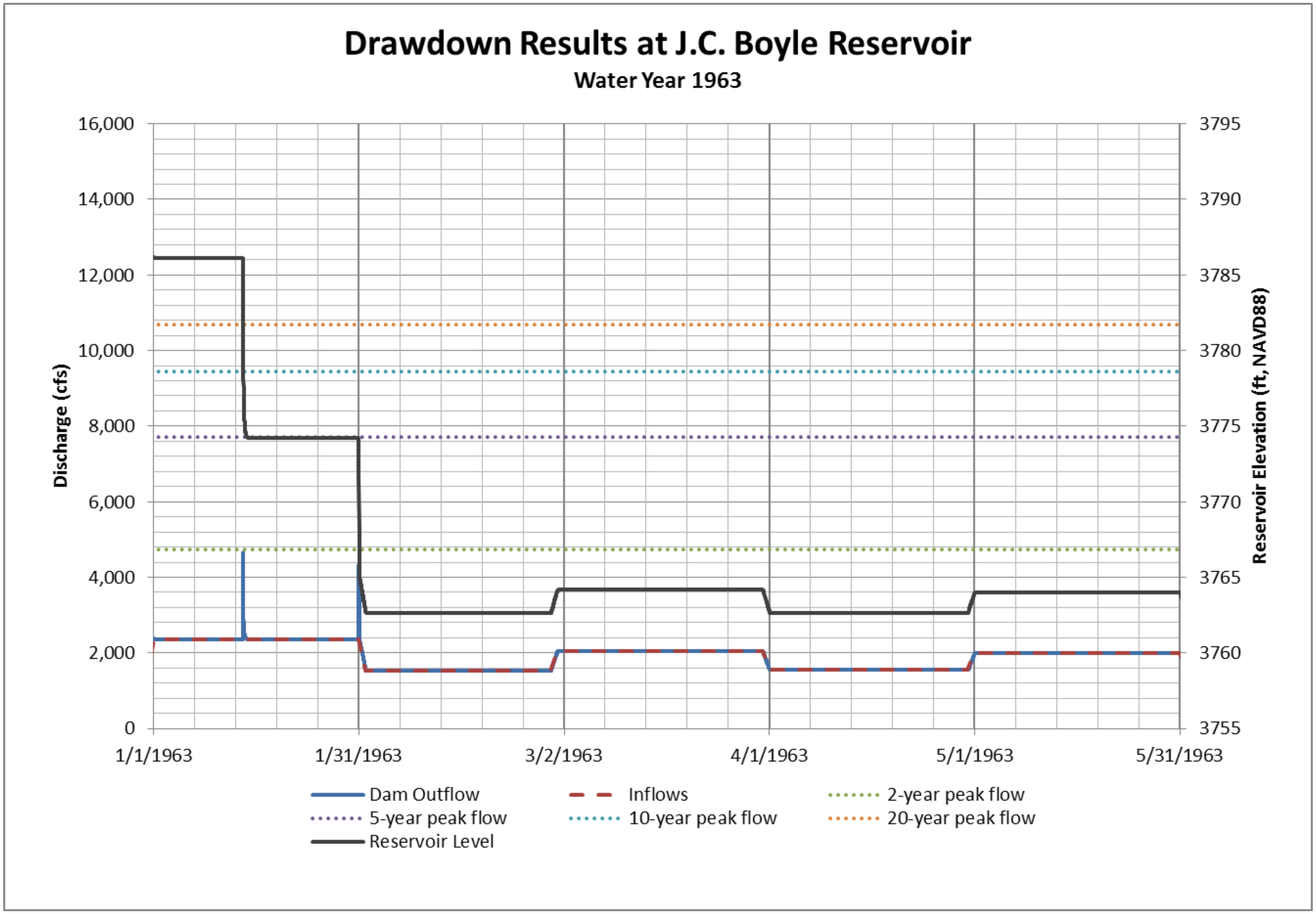

Figure 2-3 J.C. Boyle Reservoir Drawdown, Water Year 1963

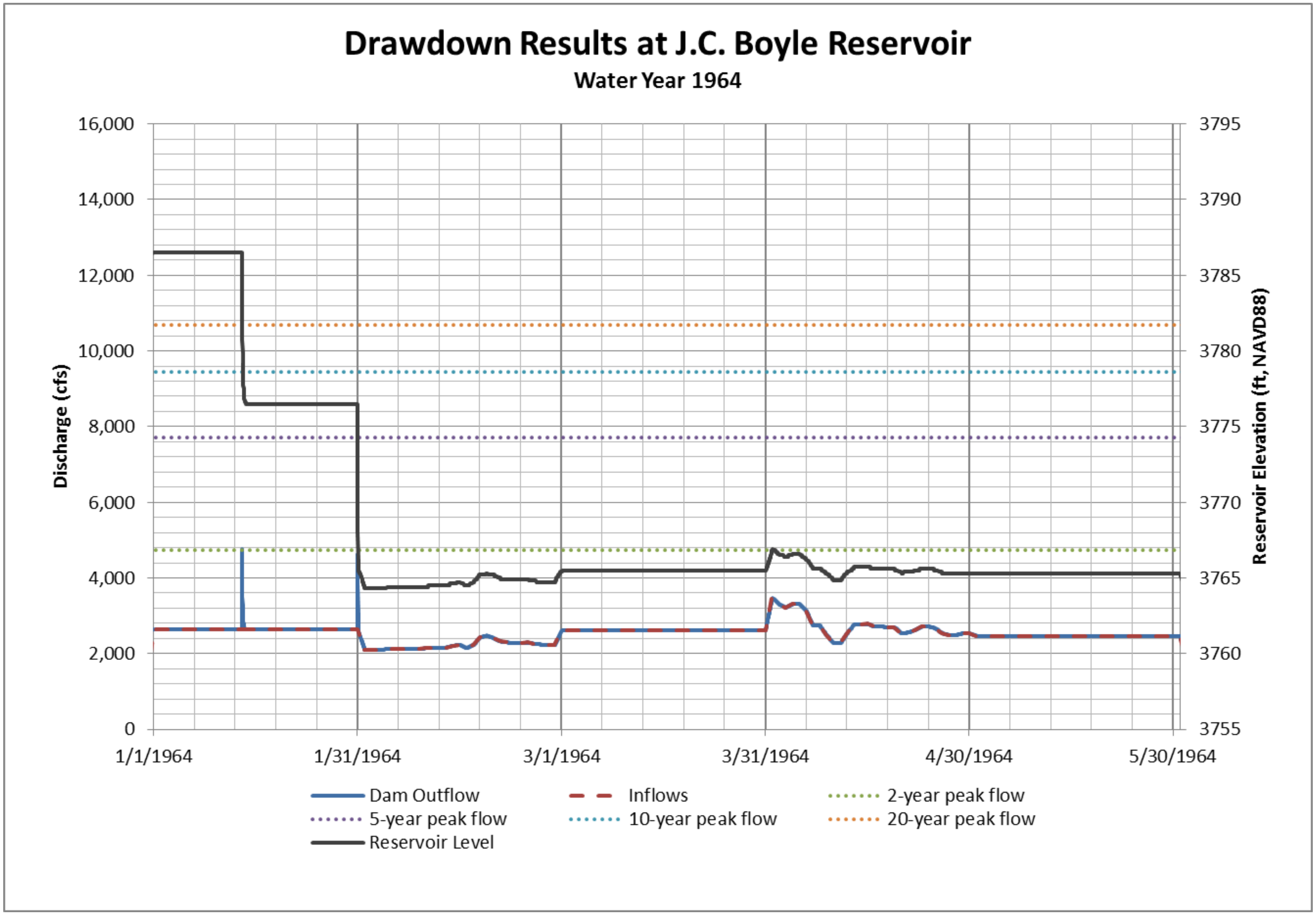

Figure 2-4 J.C. Boyle Reservoir Drawdown, Water Year 1964

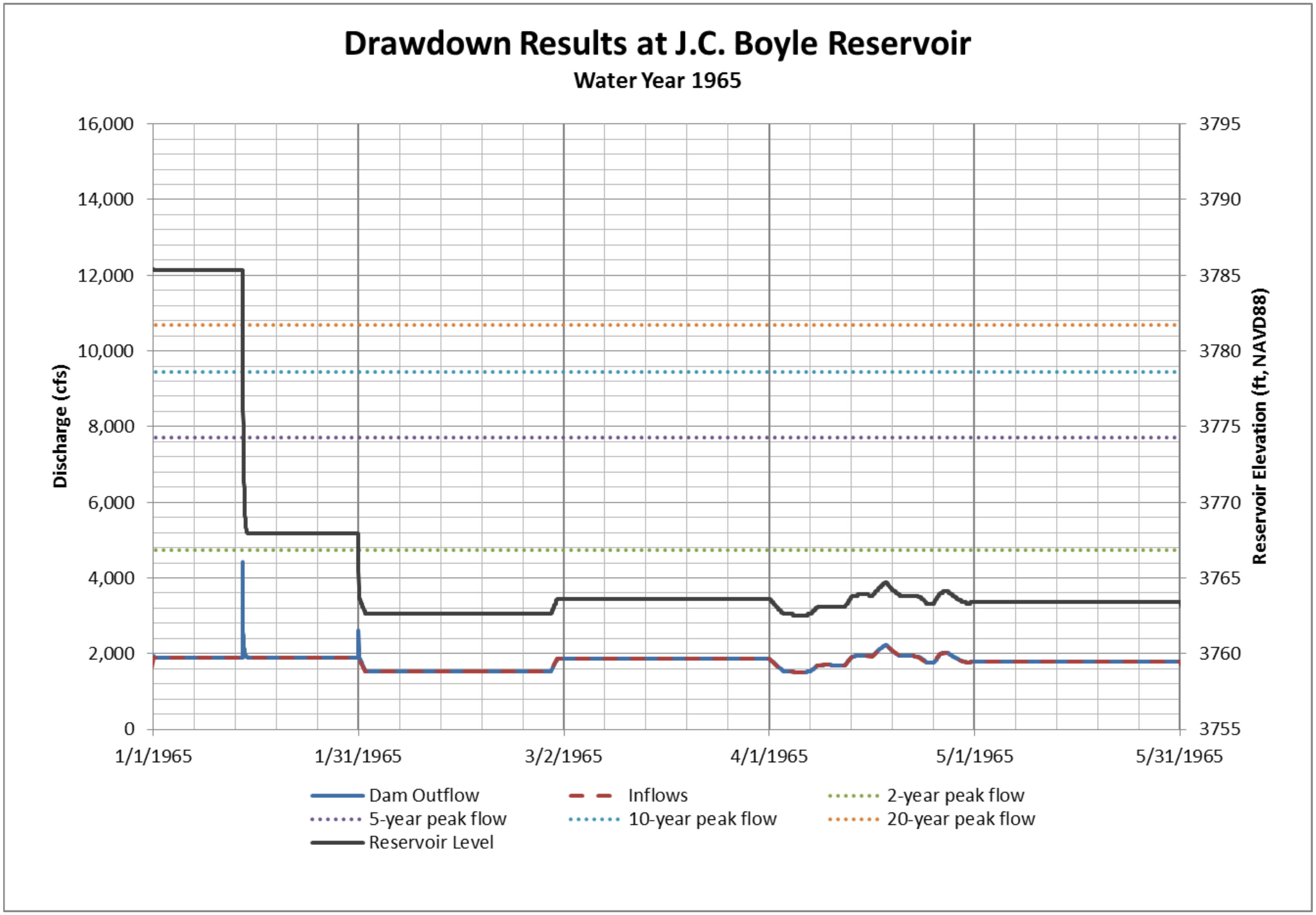

Figure 2-5 J.C. Boyle Reservoir Drawdown, Water Year 1965

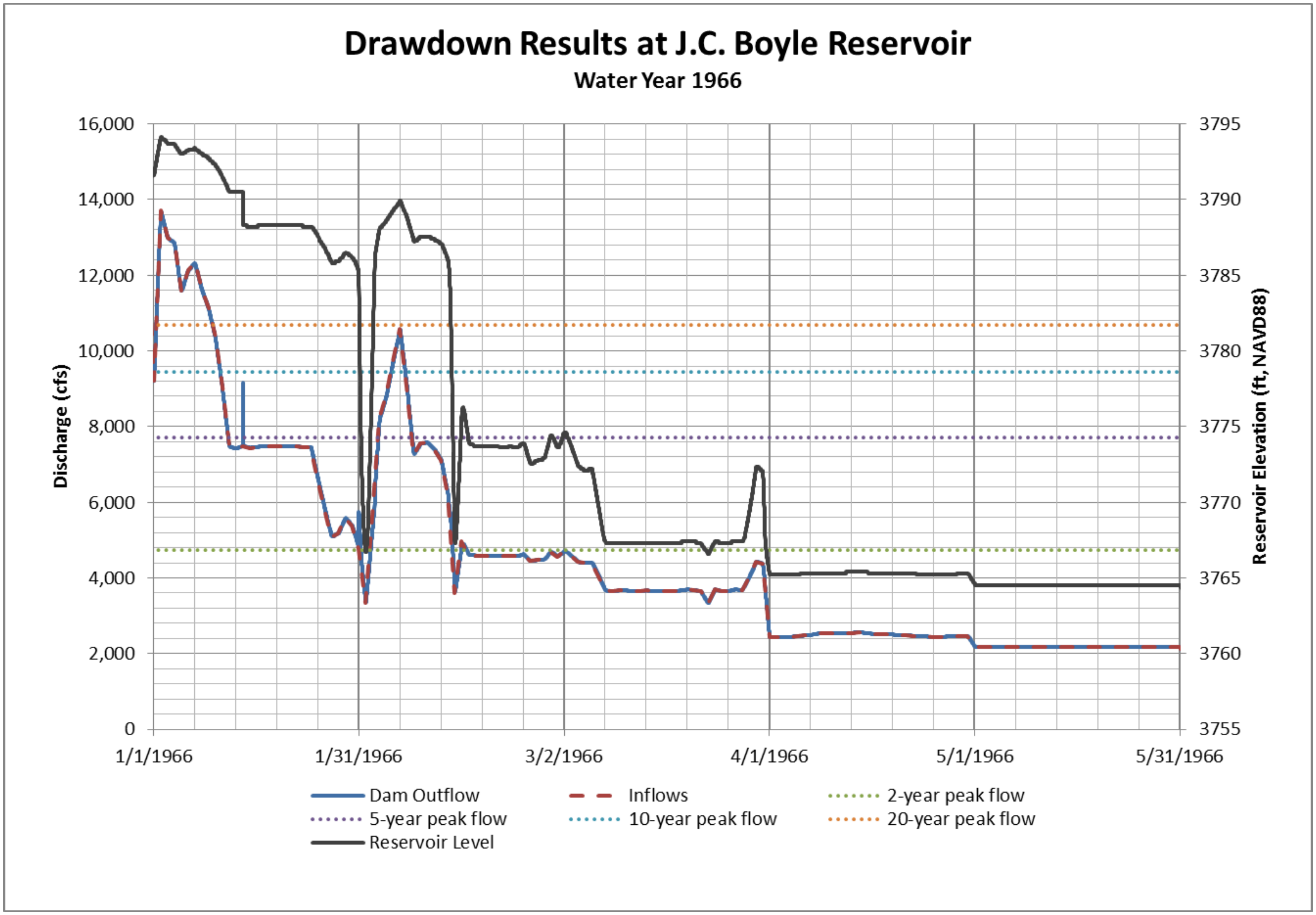

Figure 2-6 J.C. Boyle Reservoir Drawdown, Water Year 1966 (Wettest Year)

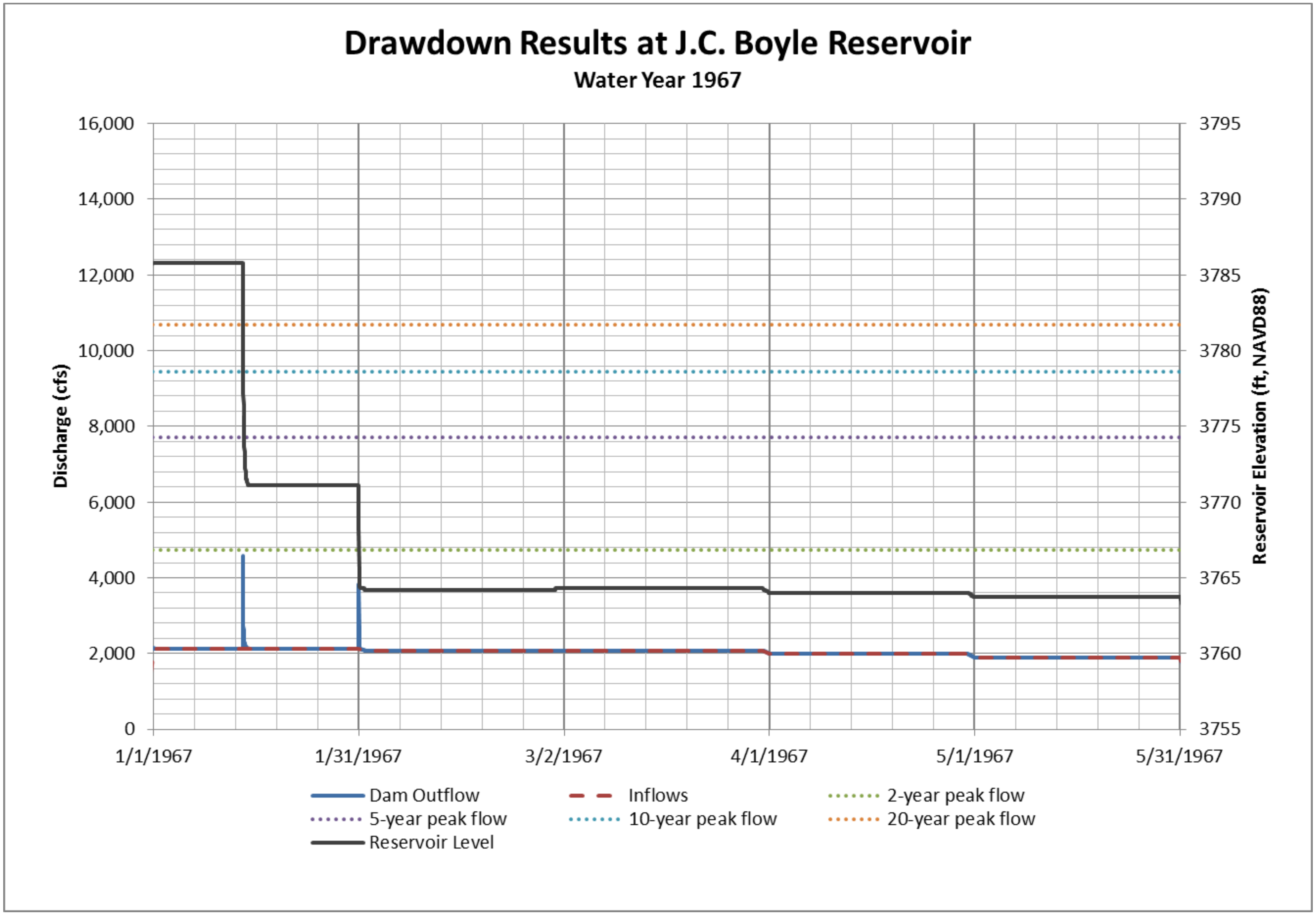

Figure 2-7 J.C. Boyle Reservoir Drawdown, Water Year 1967

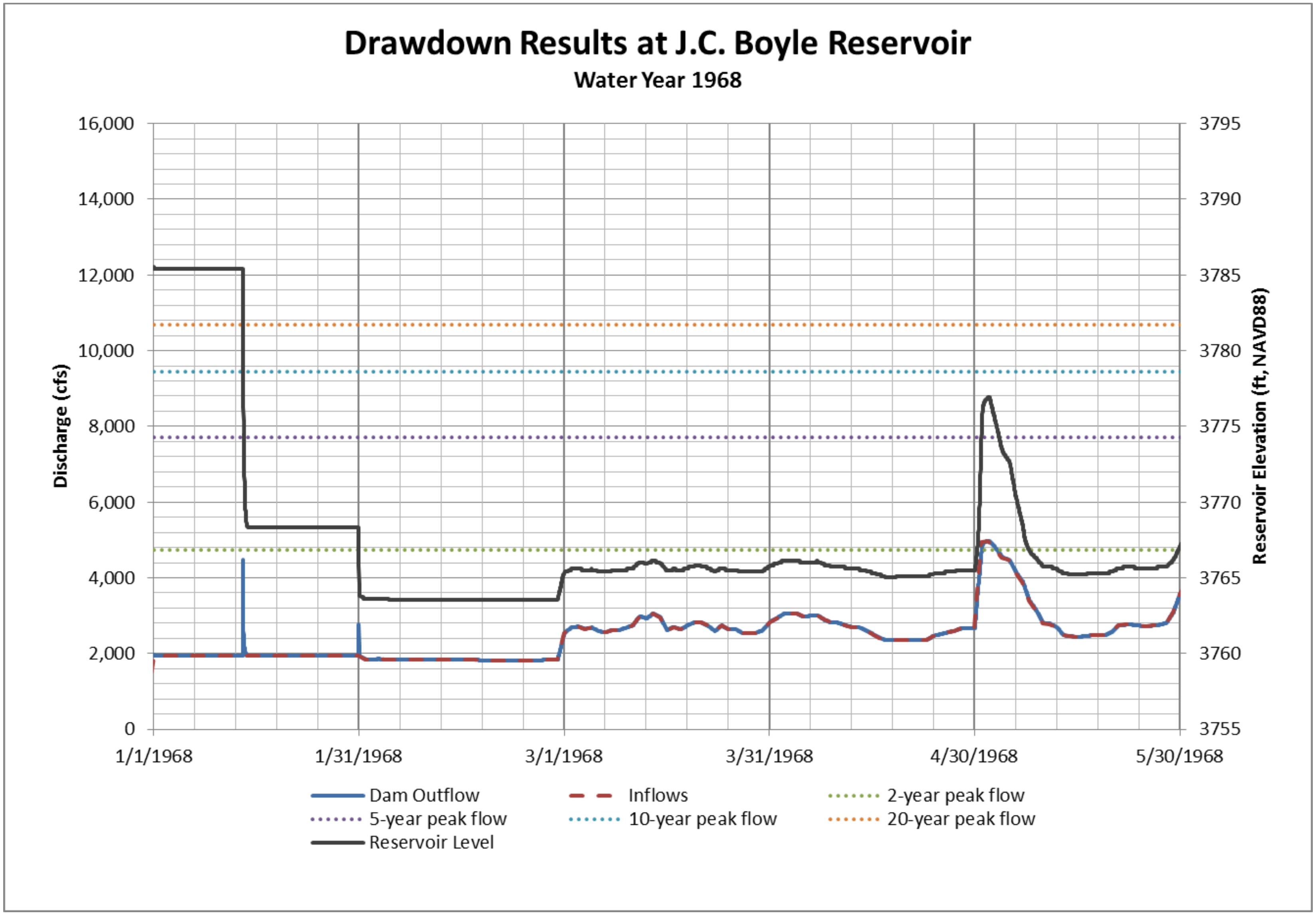

Figure 2-8 J.C. Boyle Reservoir Drawdown, Water Year 1968

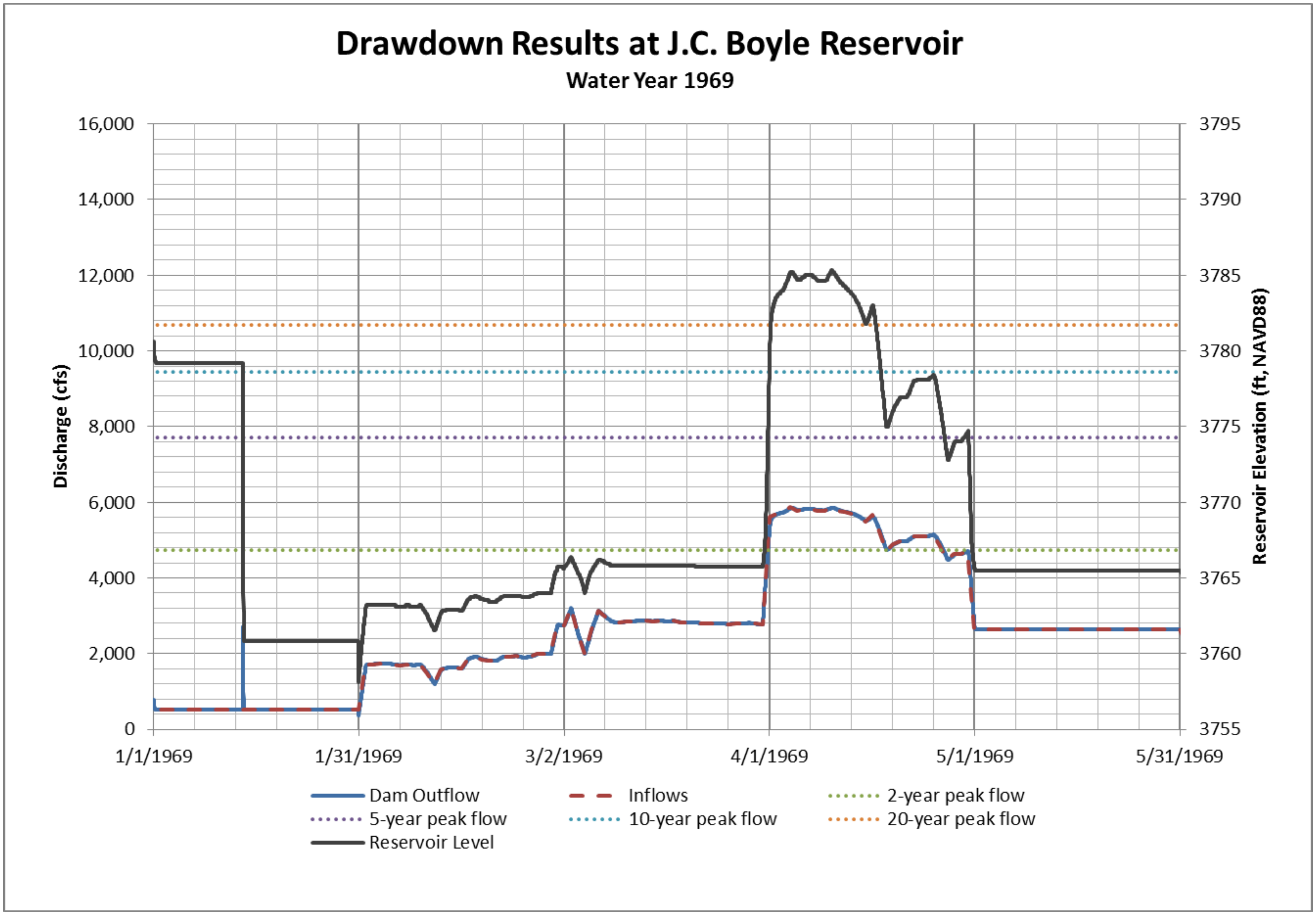

Figure 2-9 J.C. Boyle Reservoir Drawdown, Water Year 1969

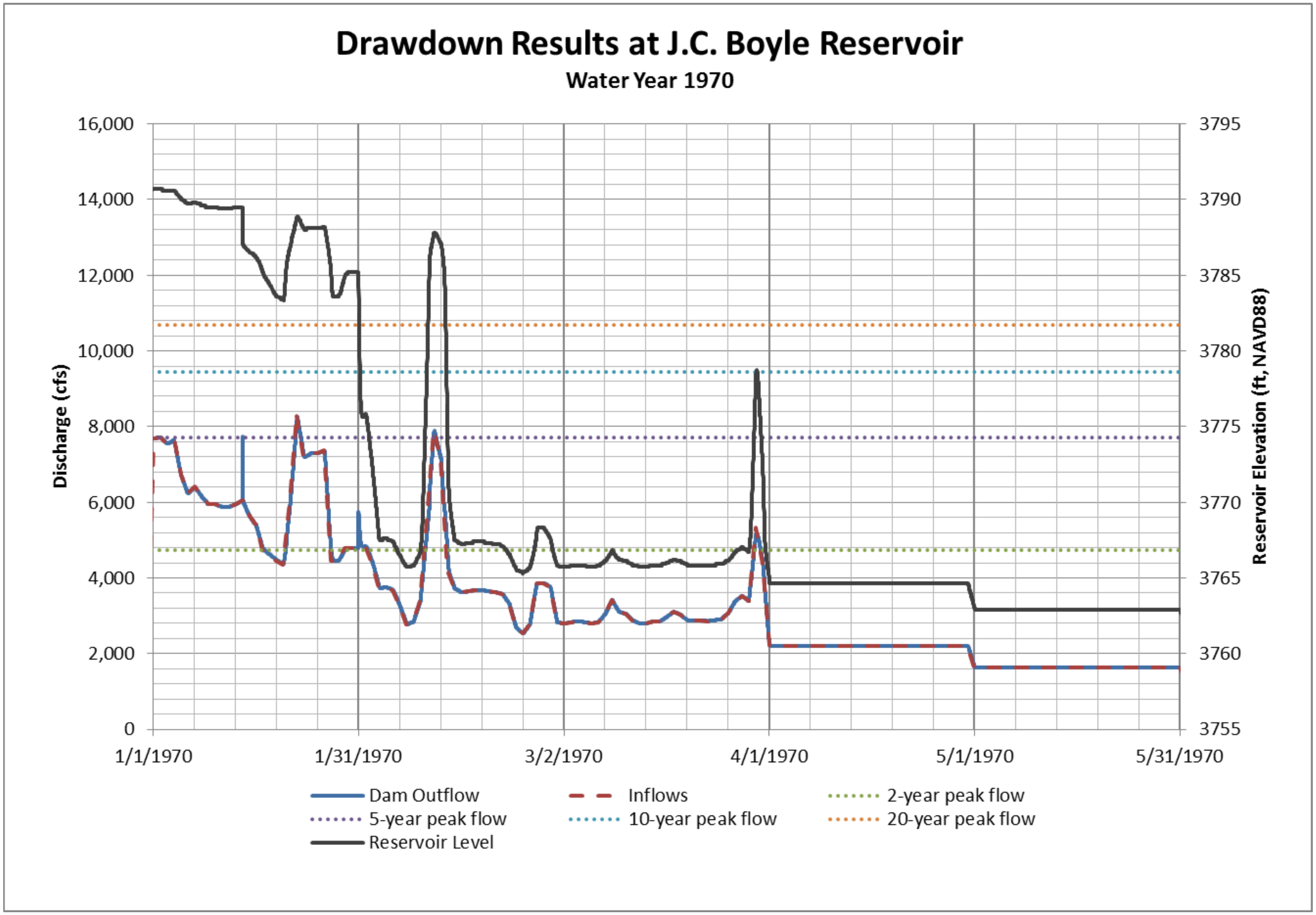

Figure 2-10 J.C. Boyle Reservoir Drawdown, Water Year 1970 (Above Normal Year)

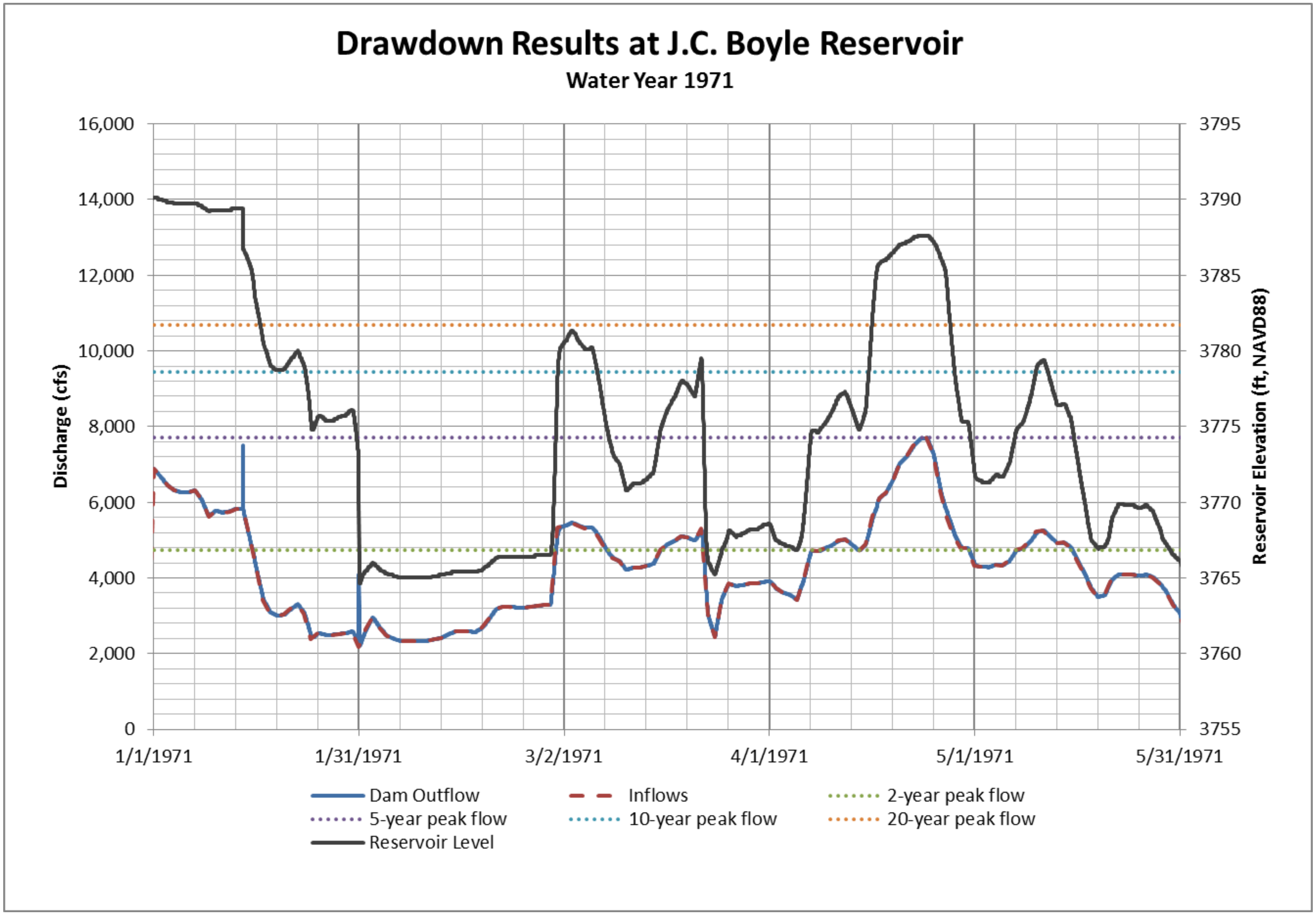

Figure 2-11 J.C. Boyle Reservoir Drawdown, Water Year 1971

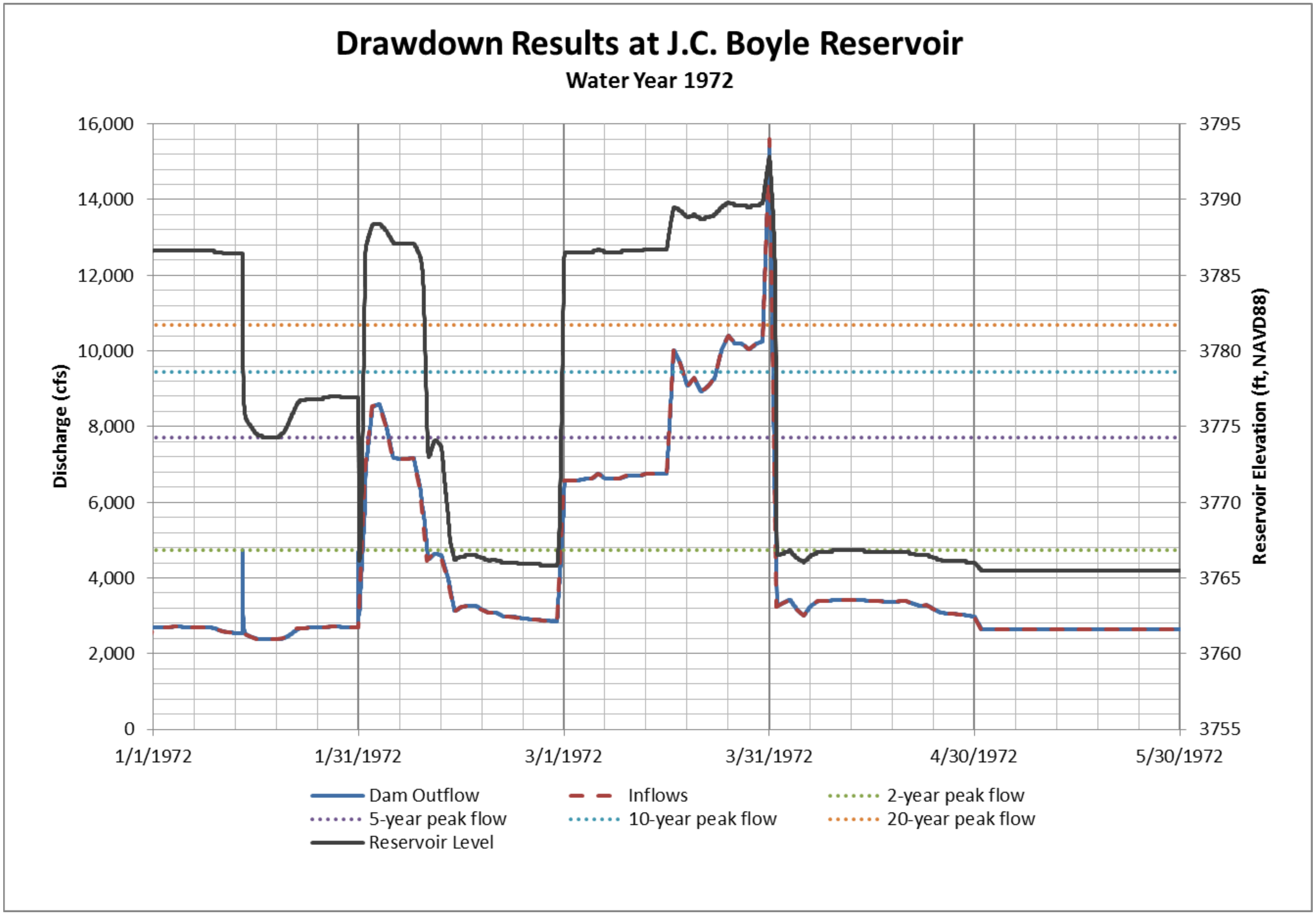

Figure 2-12 J.C. Boyle Reservoir Drawdown, Water Year 1972

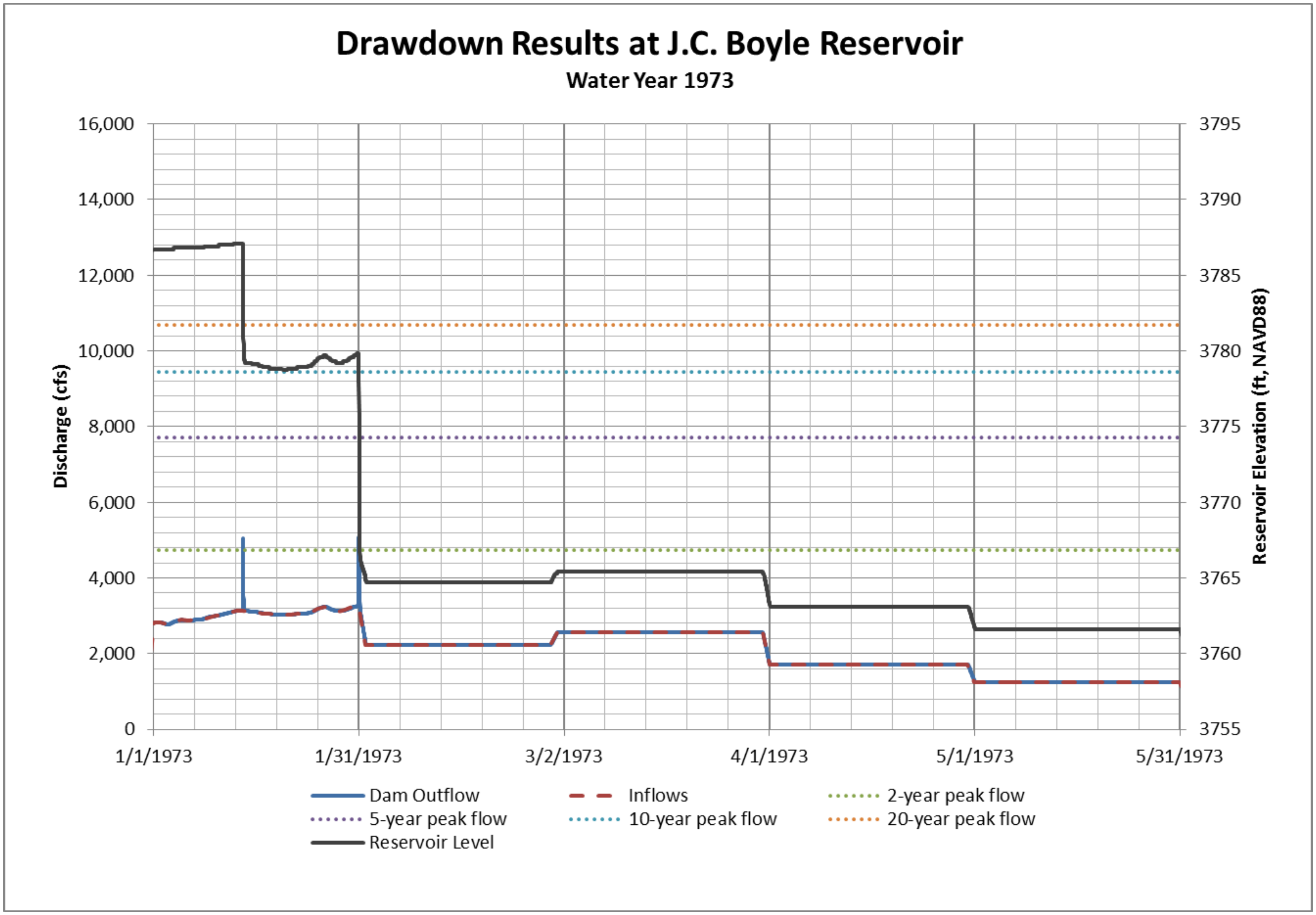

Figure 2-13 J.C. Boyle Reservoir Drawdown, Water Year 1973 (Median Year)

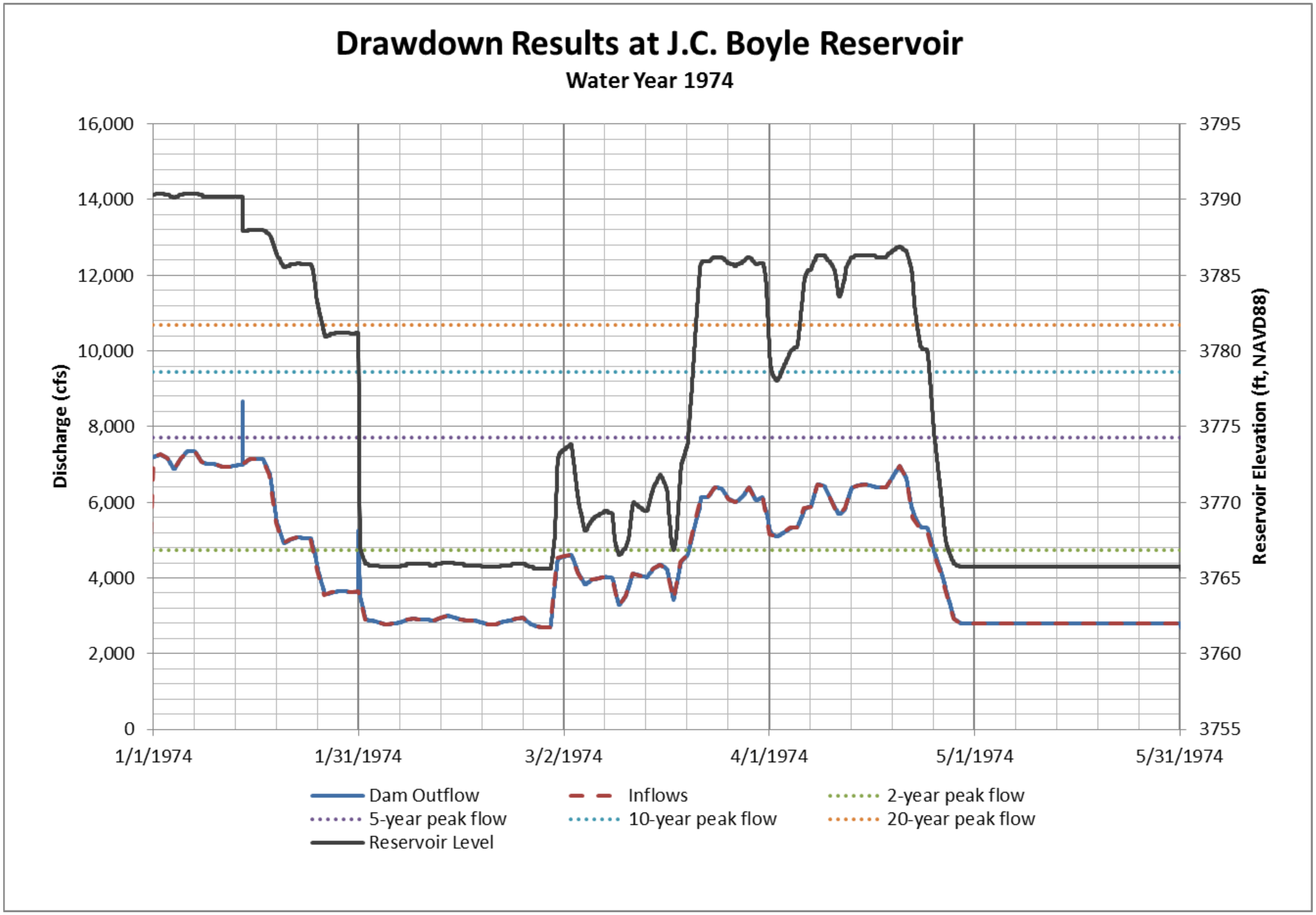

Figure 2-14 J.C. Boyle Reservoir Drawdown, Water Year 1974

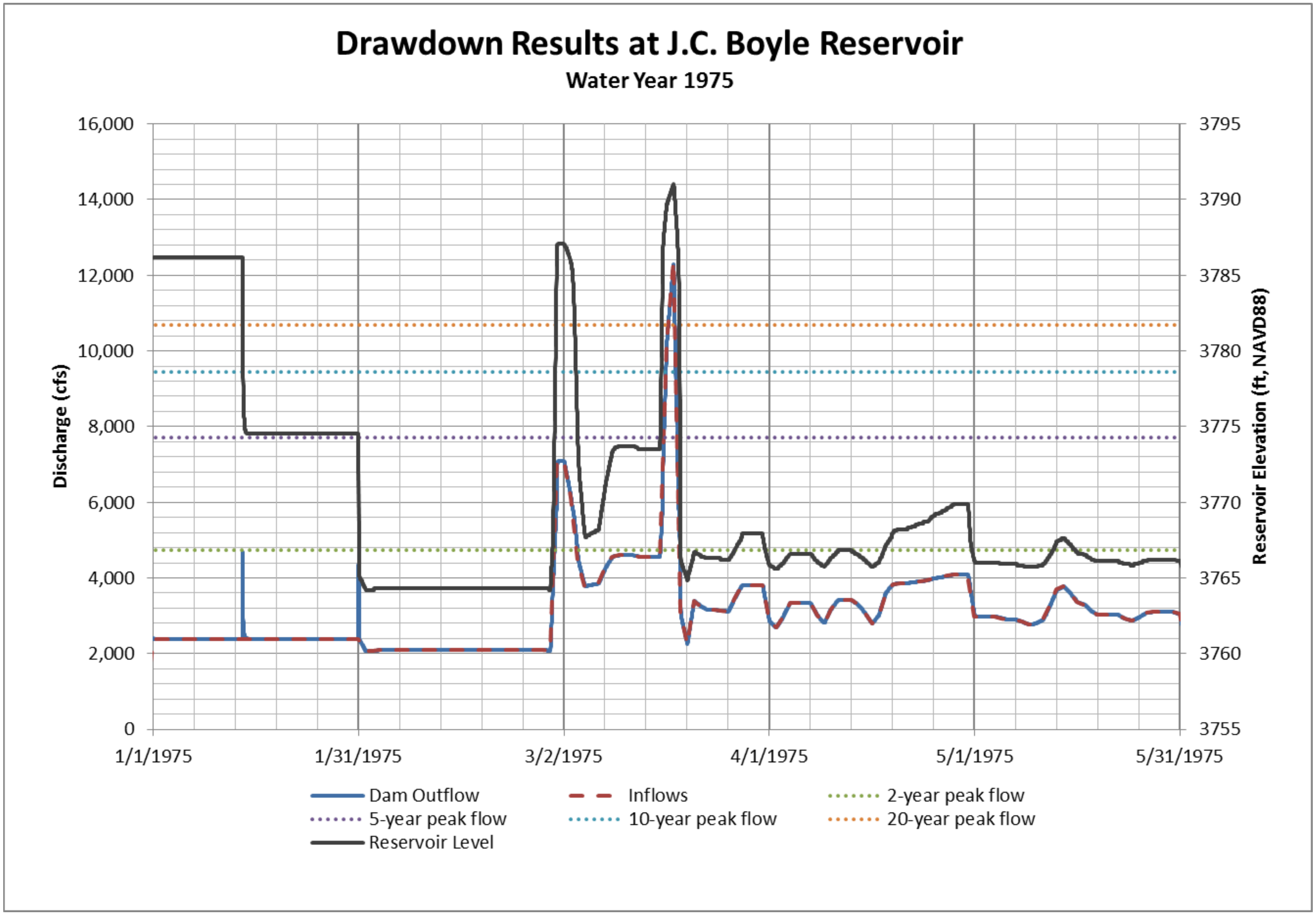

Figure 2-15 J.C. Boyle Reservoir Drawdown, Water Year 1975

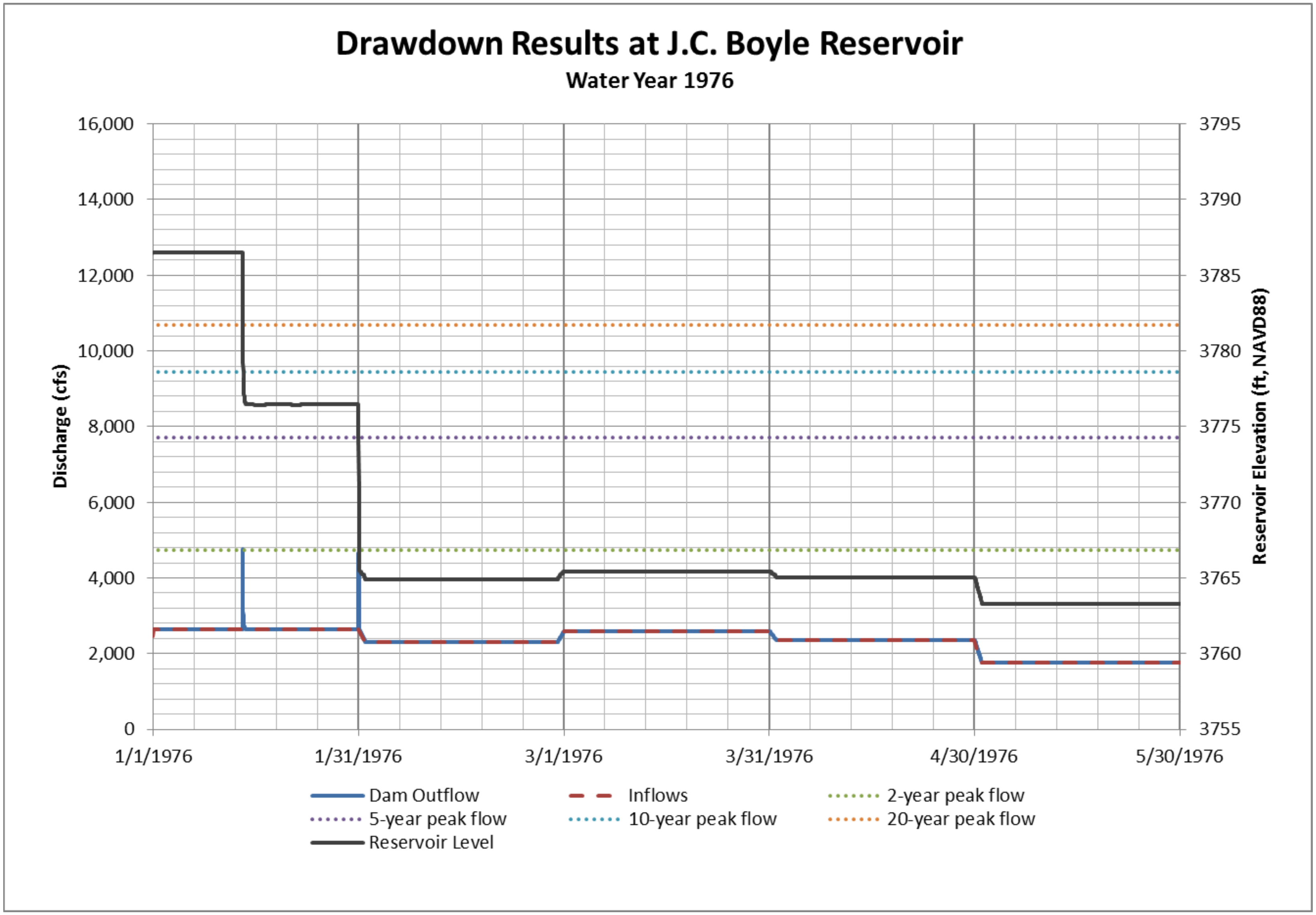

Figure 2-16 J.C. Boyle Reservoir Drawdown, Water Year 1976

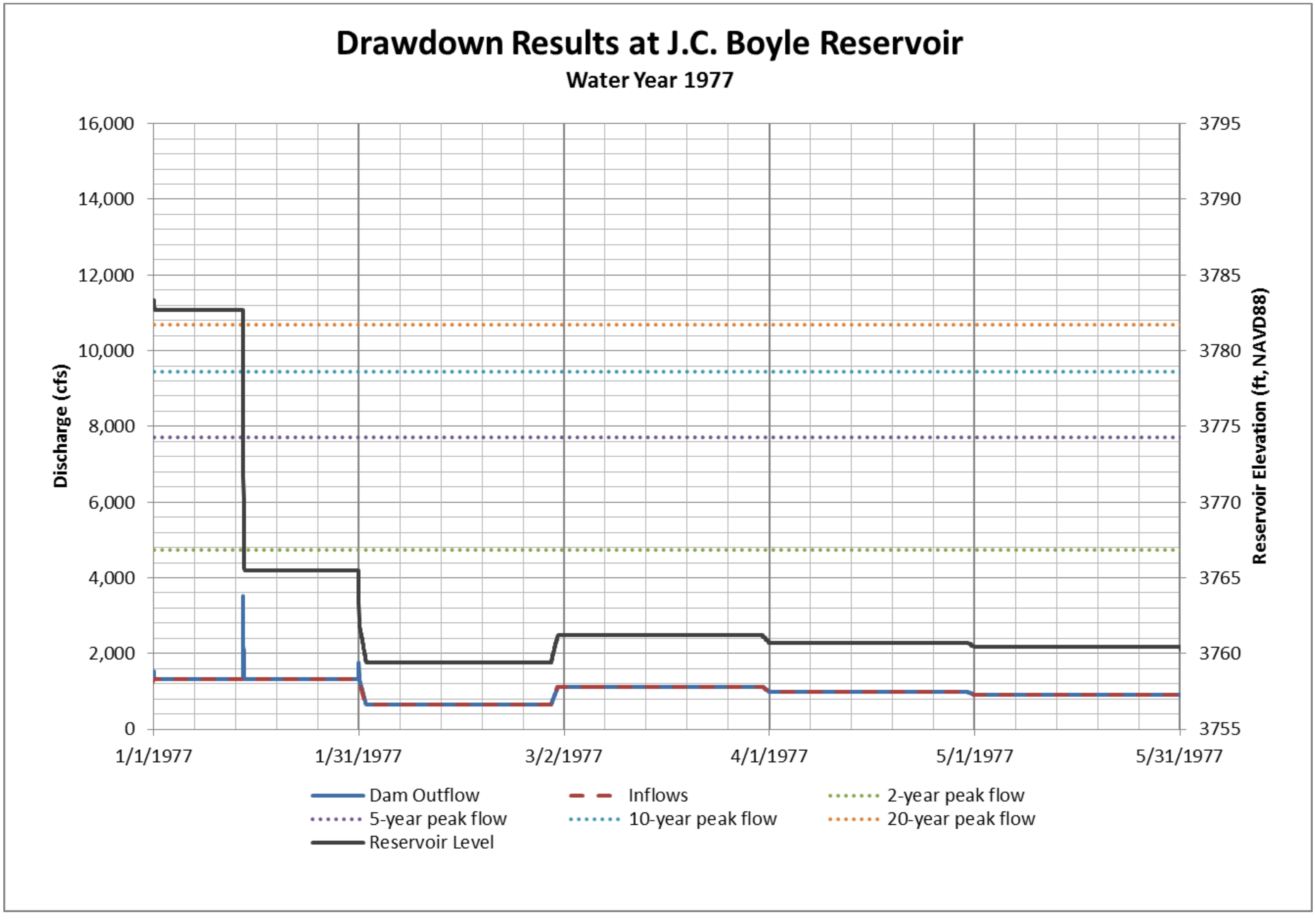

Figure 2-17 J.C. Boyle Reservoir Drawdown, Water Year 1977

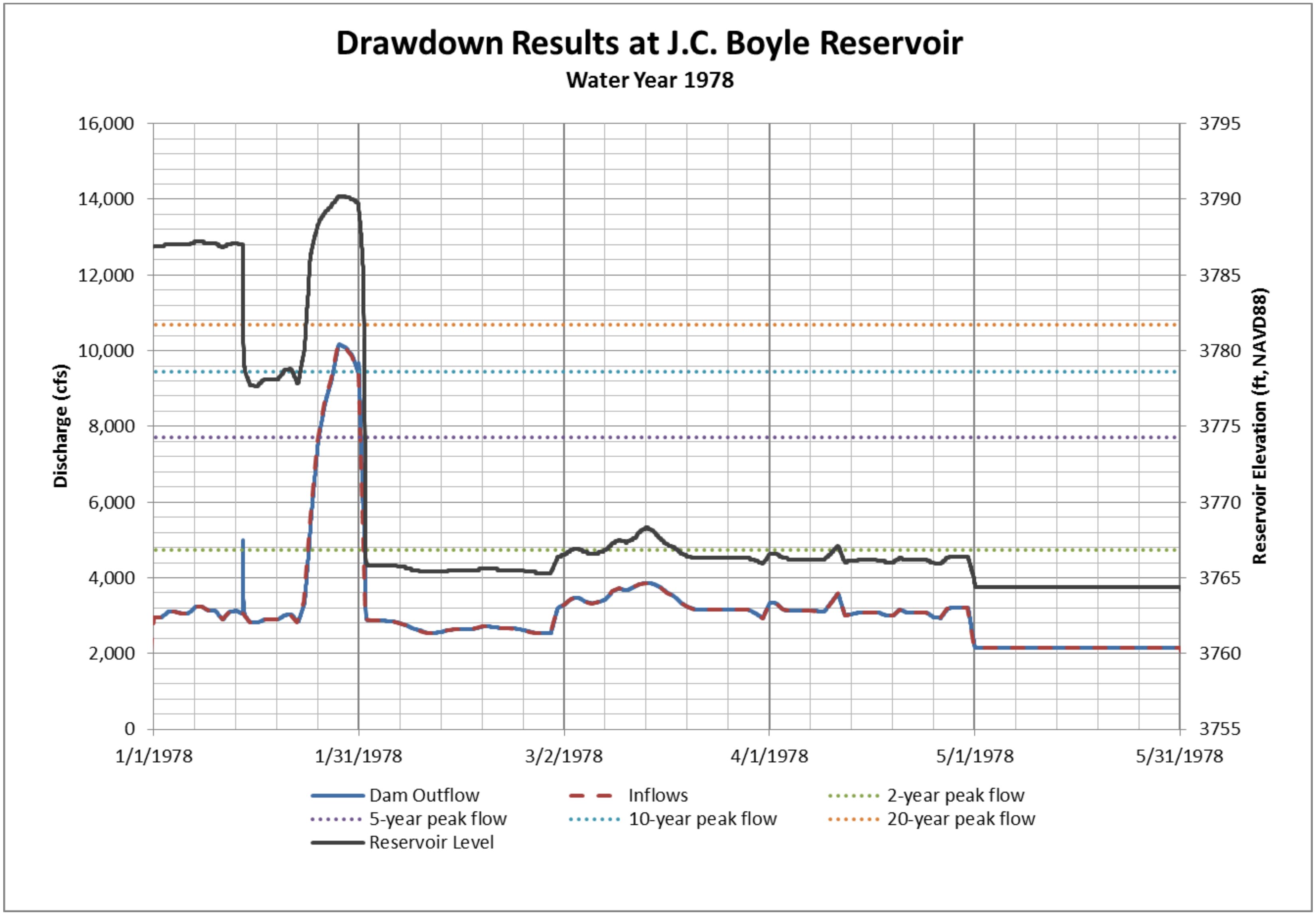

Figure 2-18 J.C. Boyle Reservoir Drawdown, Water Year 1978

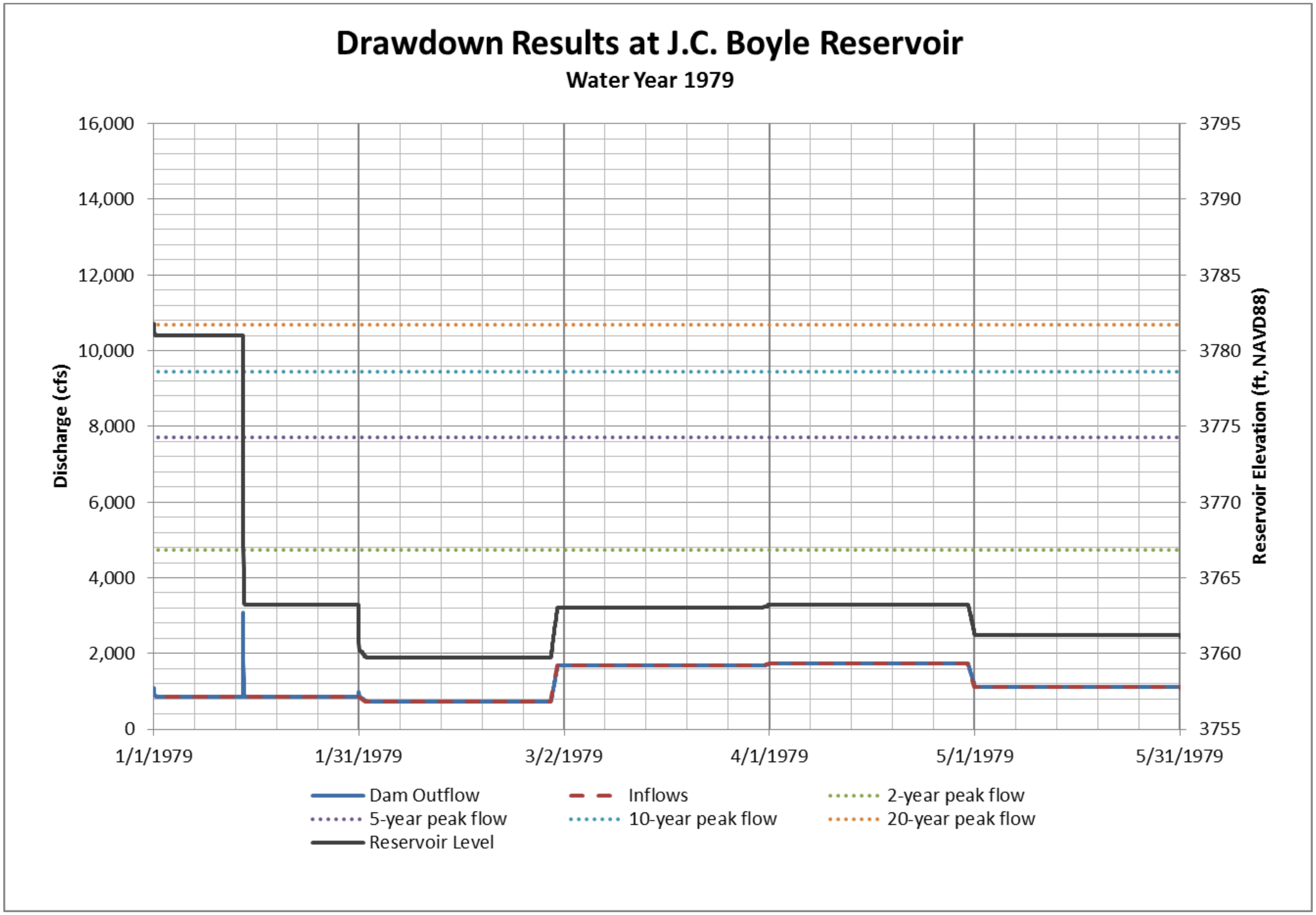

Figure 2-19 J.C. Boyle Reservoir Drawdown, Water Year 1979 (Dry Year)

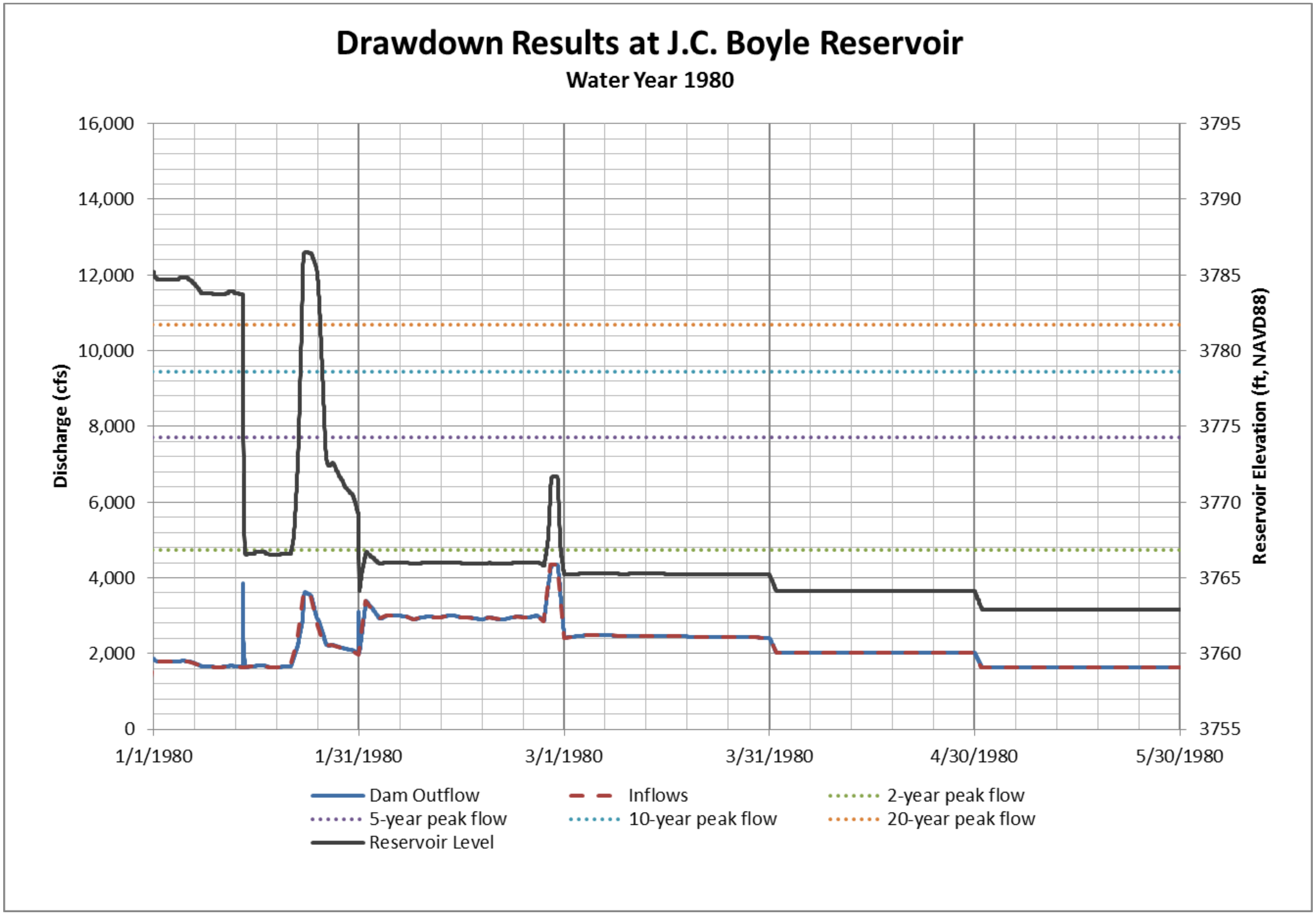

Figure 2-20 J.C. Boyle Reservoir Drawdown, Water Year 1980

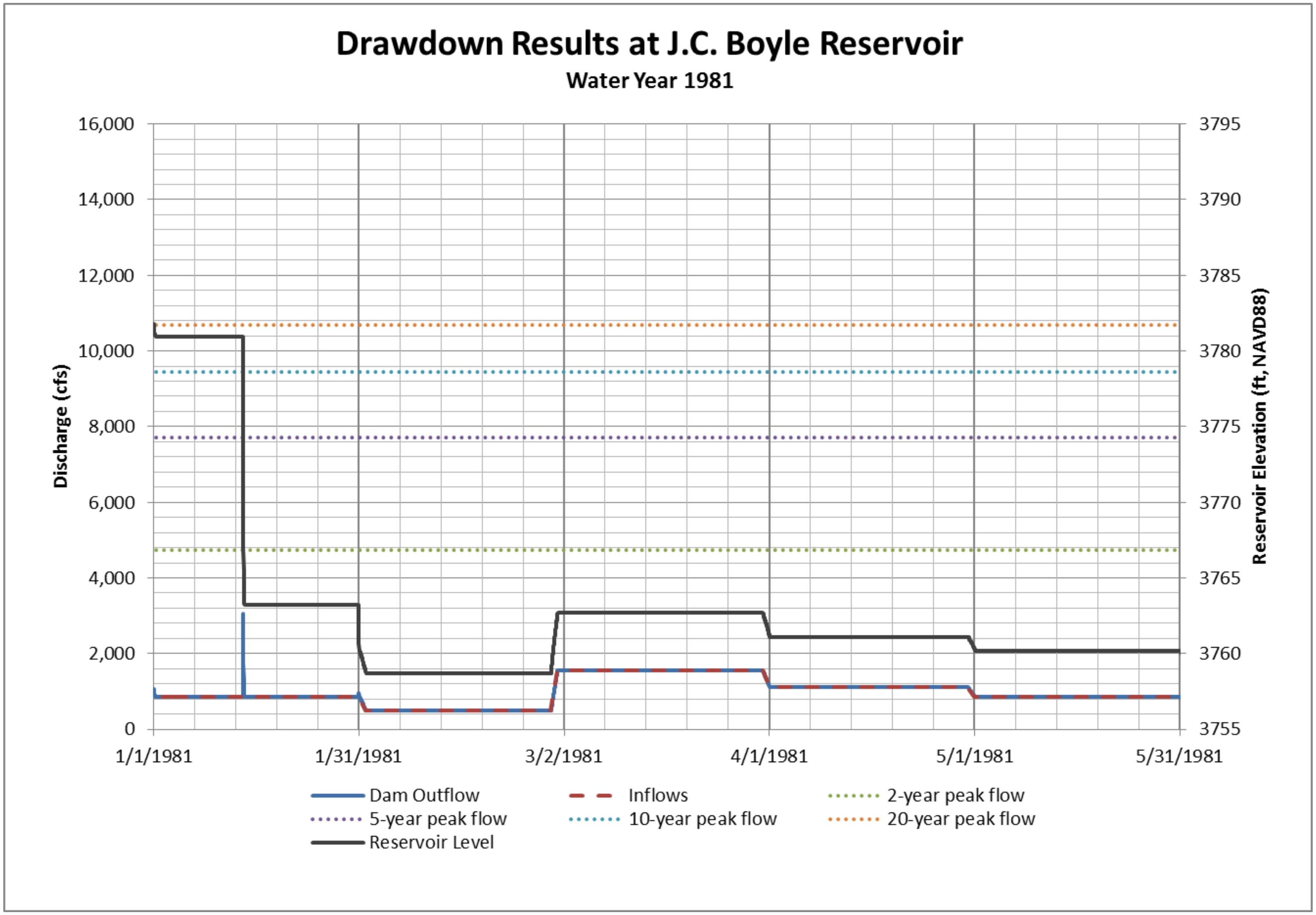

Figure 2-21 J.C. Boyle Reservoir Drawdown, Water Year 1981

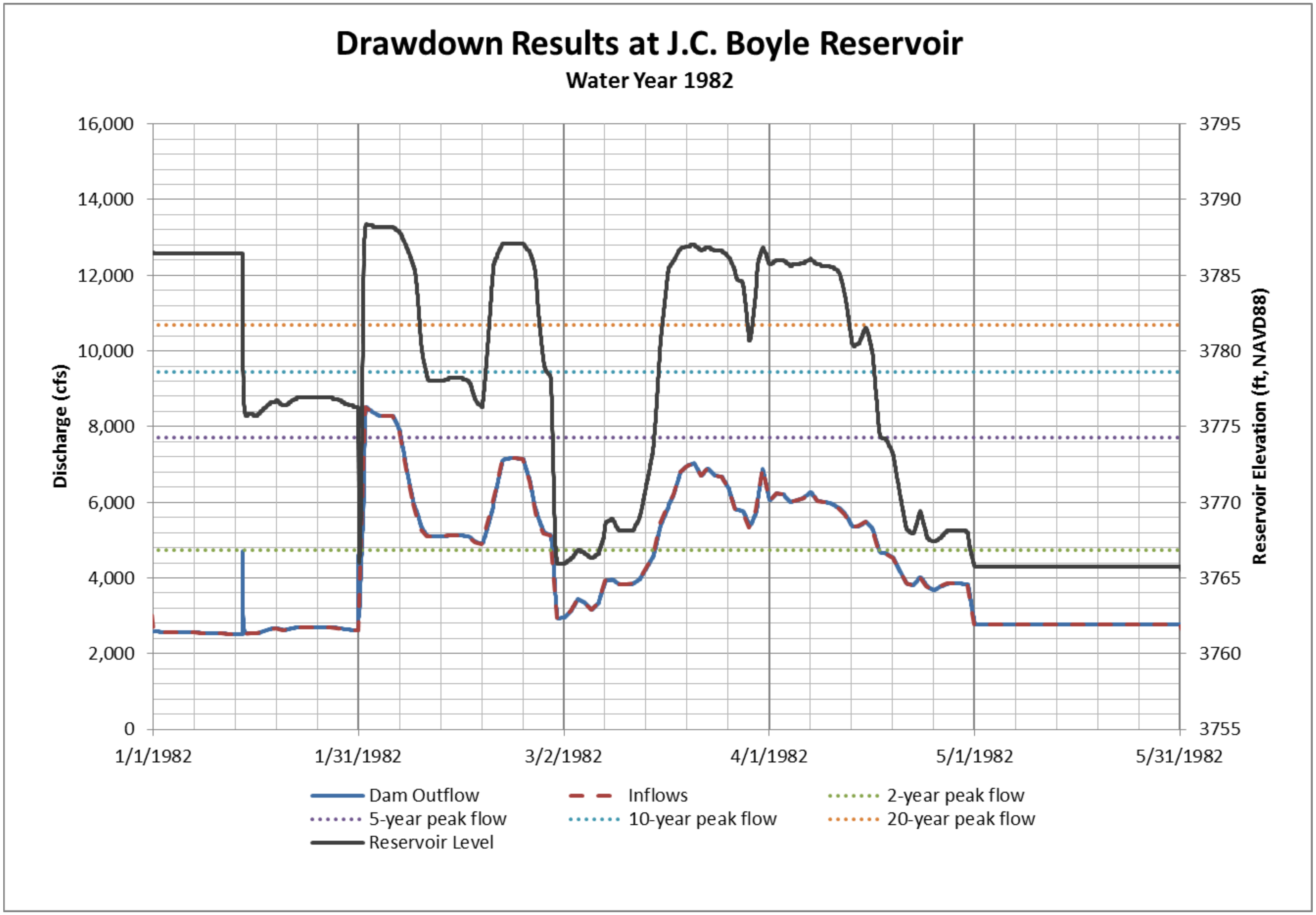

Figure 2-22 J.C. Boyle Reservoir Drawdown, Water Year 1982

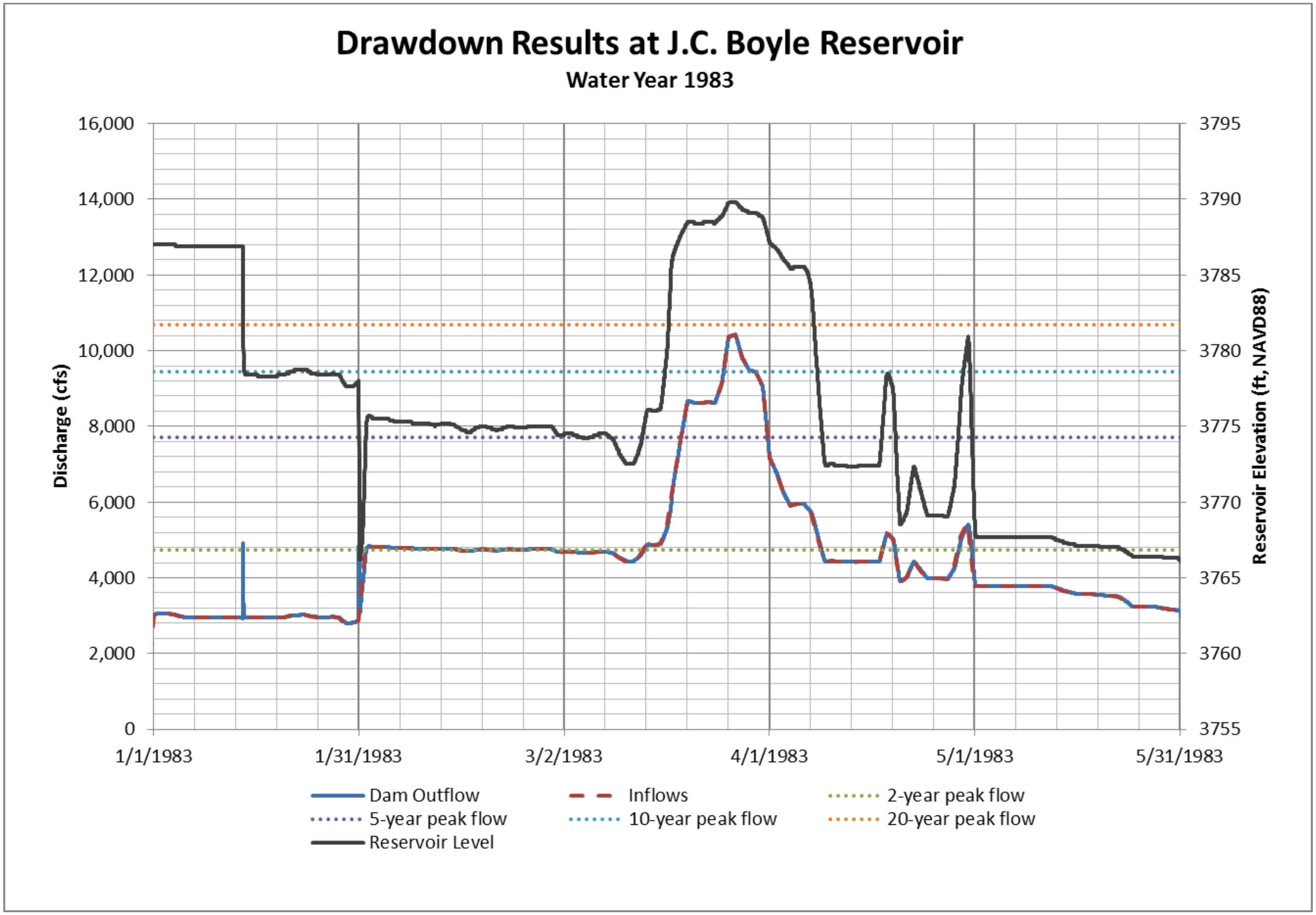

Figure 2-23 J.C. Boyle Reservoir Drawdown, Water Year 1983

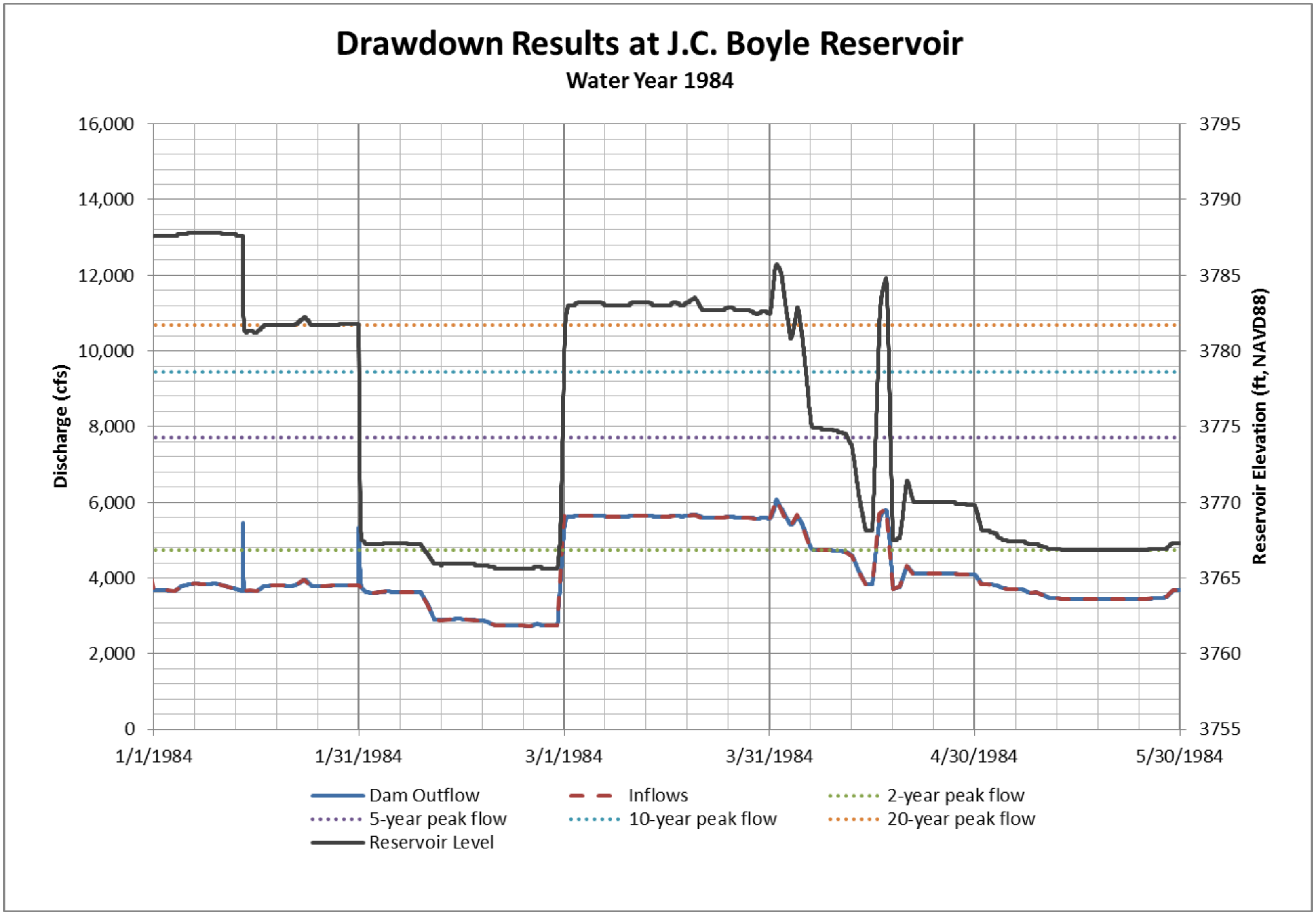

Figure 2-24 J.C. Boyle Reservoir Drawdown, Water Year 1984

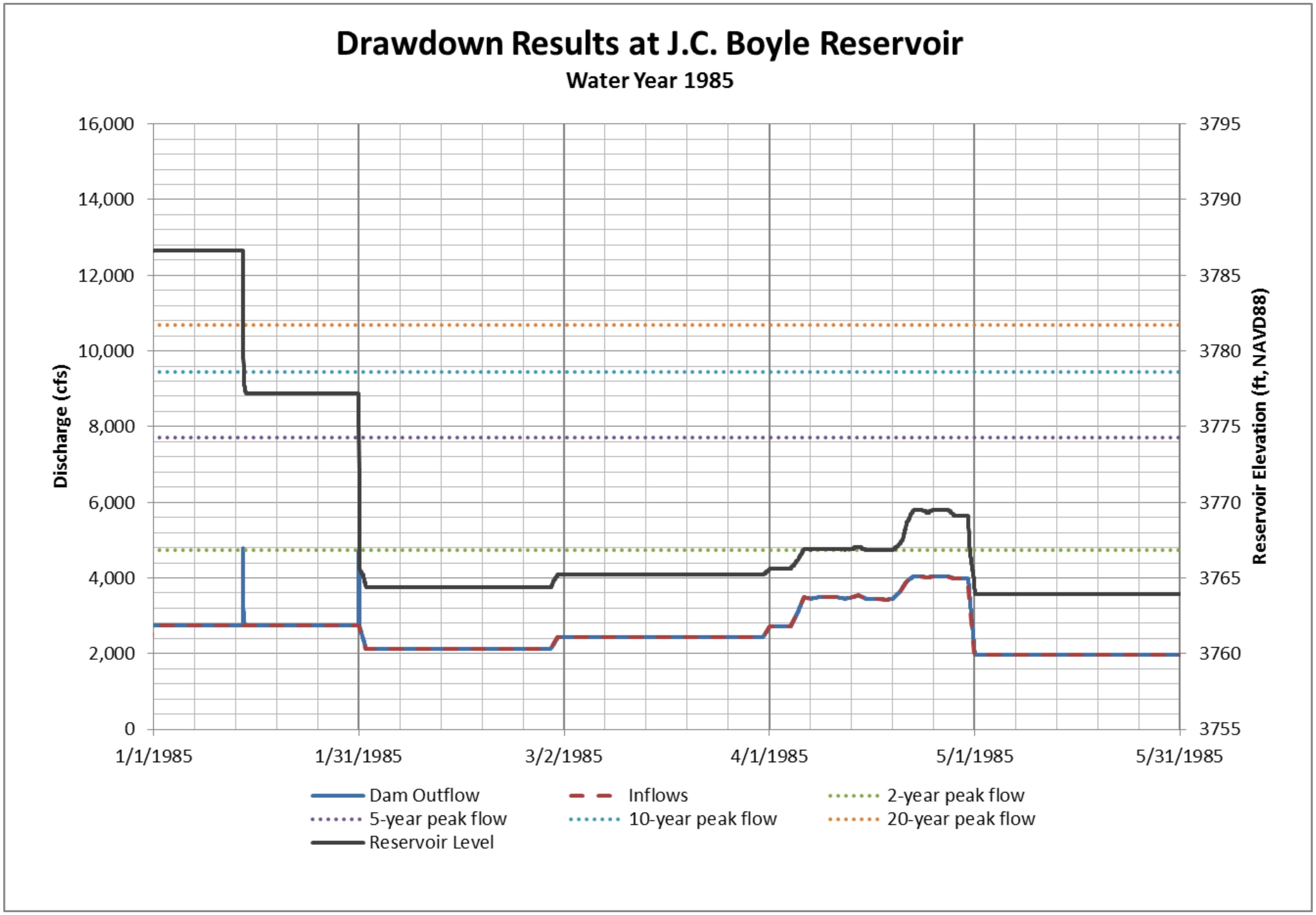

Figure 2-25 J.C. Boyle Reservoir Drawdown, Water Year 1985

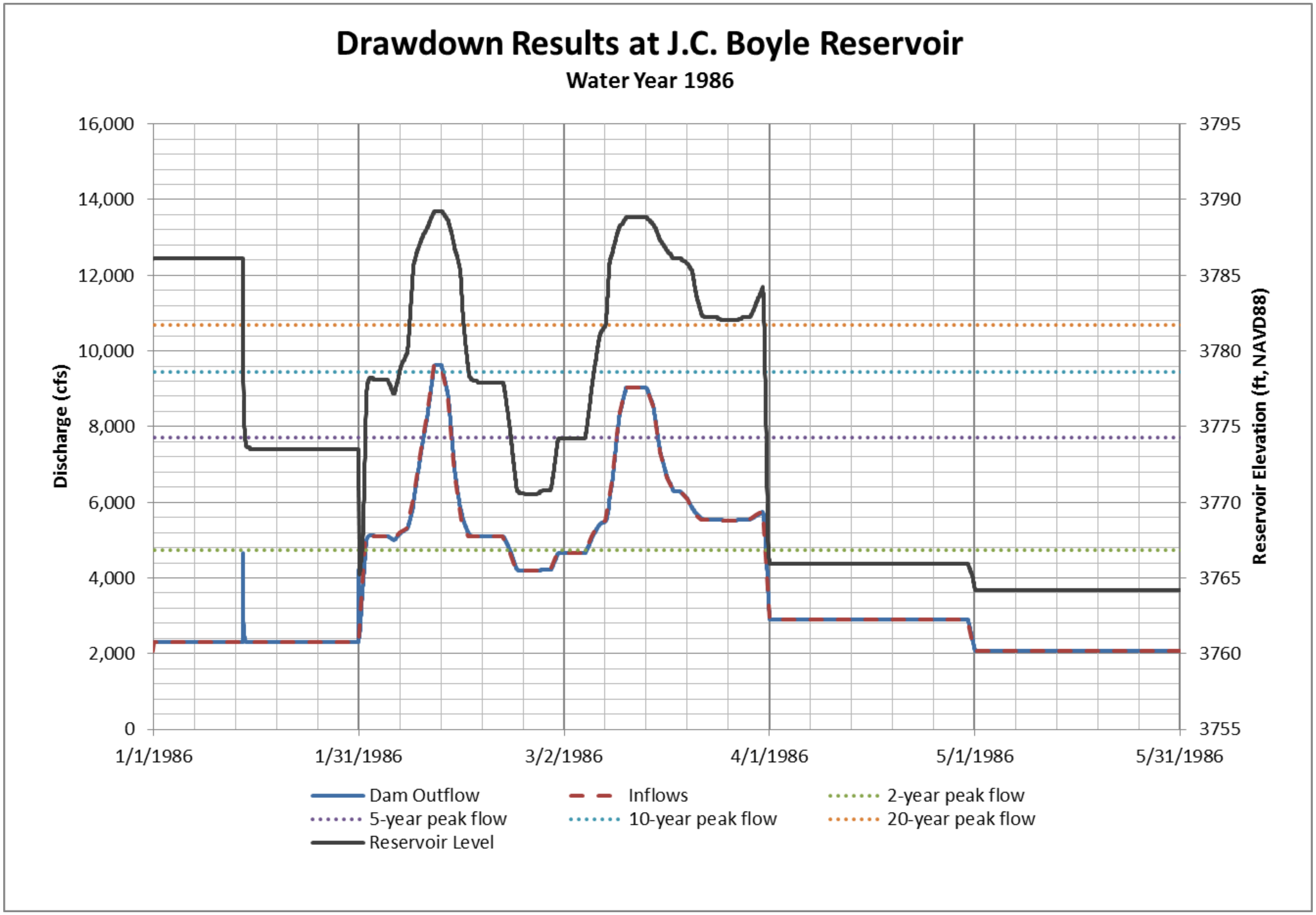

Figure 2-26 J.C. Boyle Reservoir Drawdown, Water Year 1986 (Wet Year)

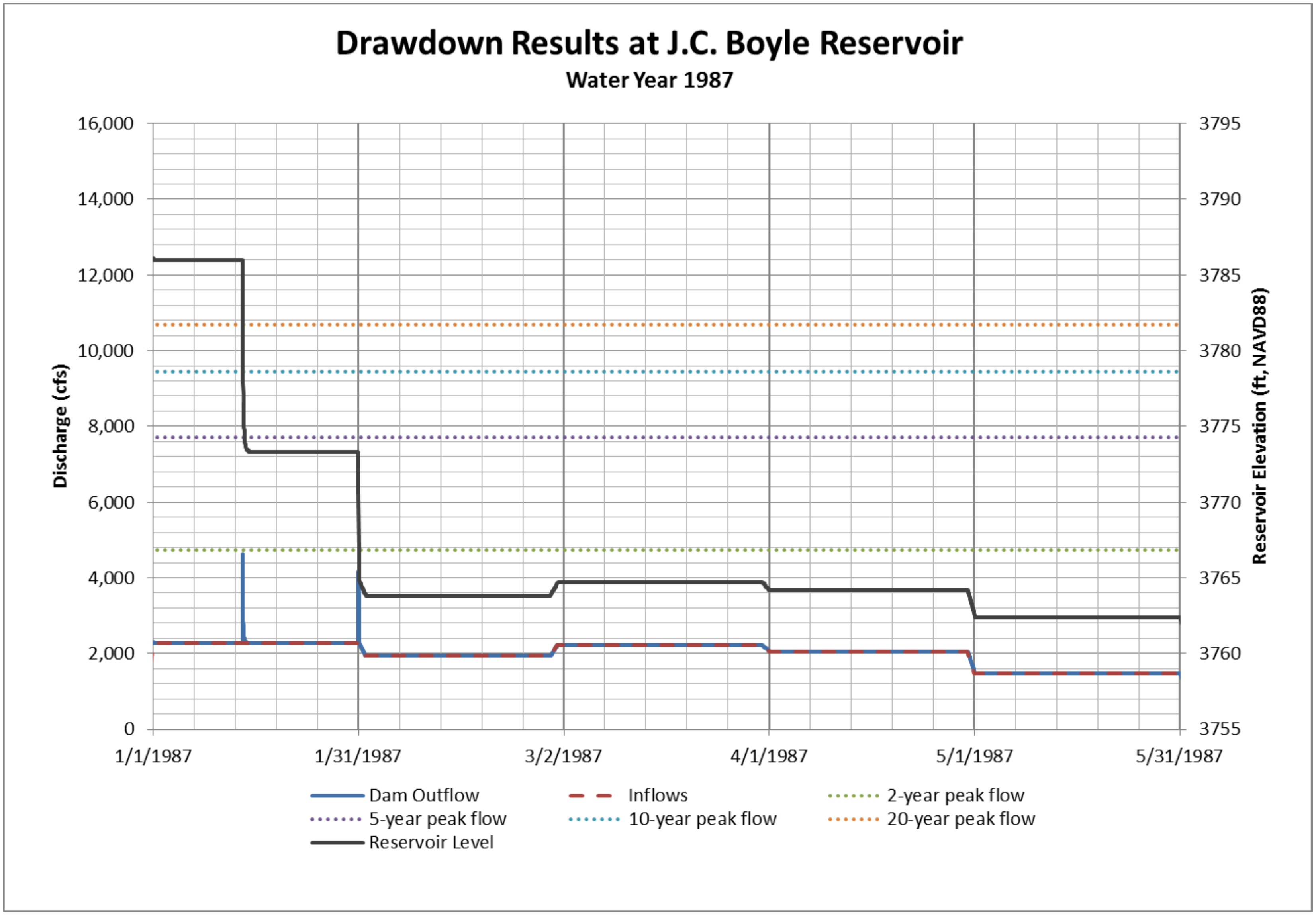

Figure 2-27 J.C. Boyle Reservoir Drawdown, Water Year 1987

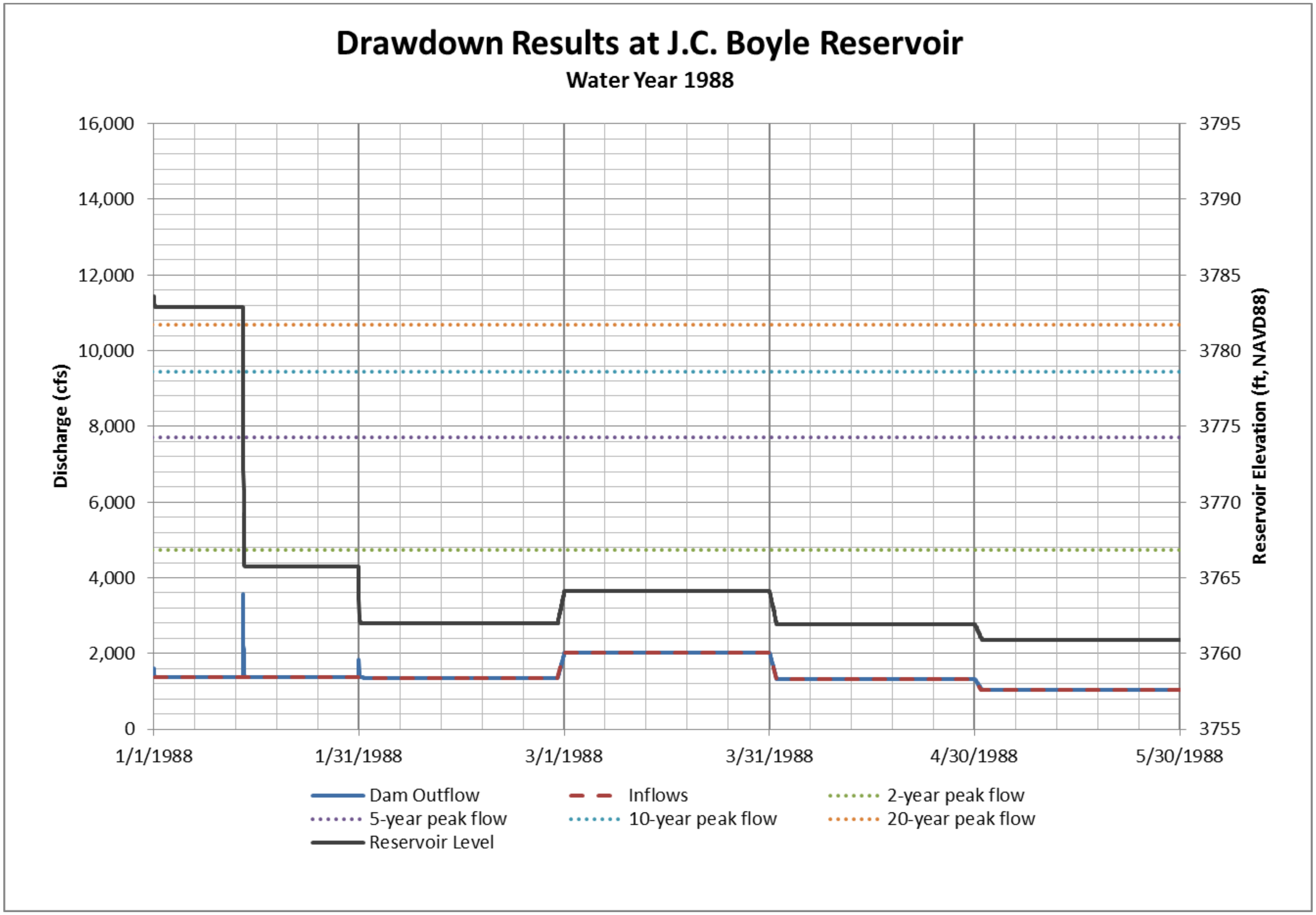

Figure 2-28 J.C. Boyle Reservoir Drawdown, Water Year 1988

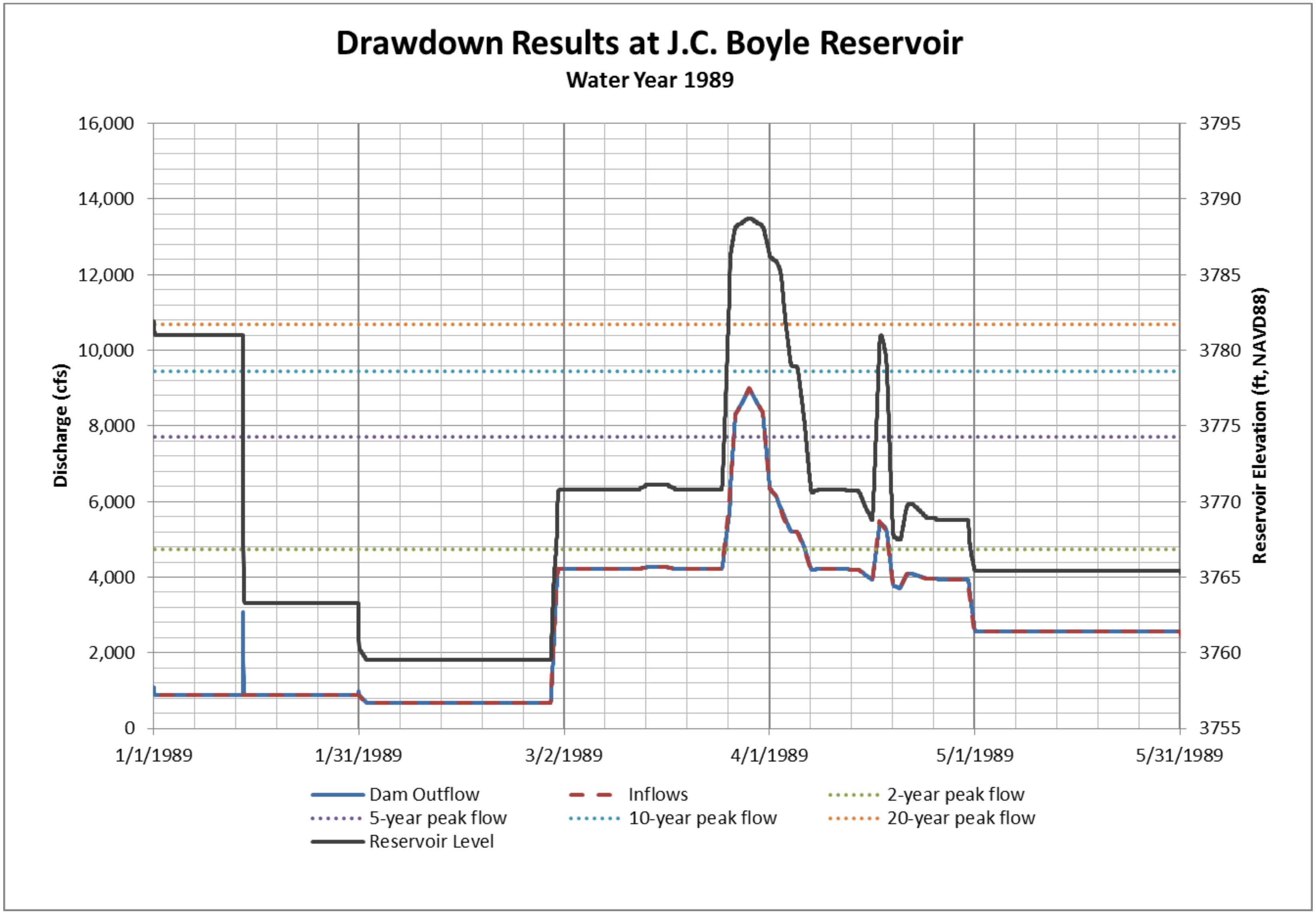

Figure 2-29 J.C. Boyle Reservoir Drawdown, Water Year 1989

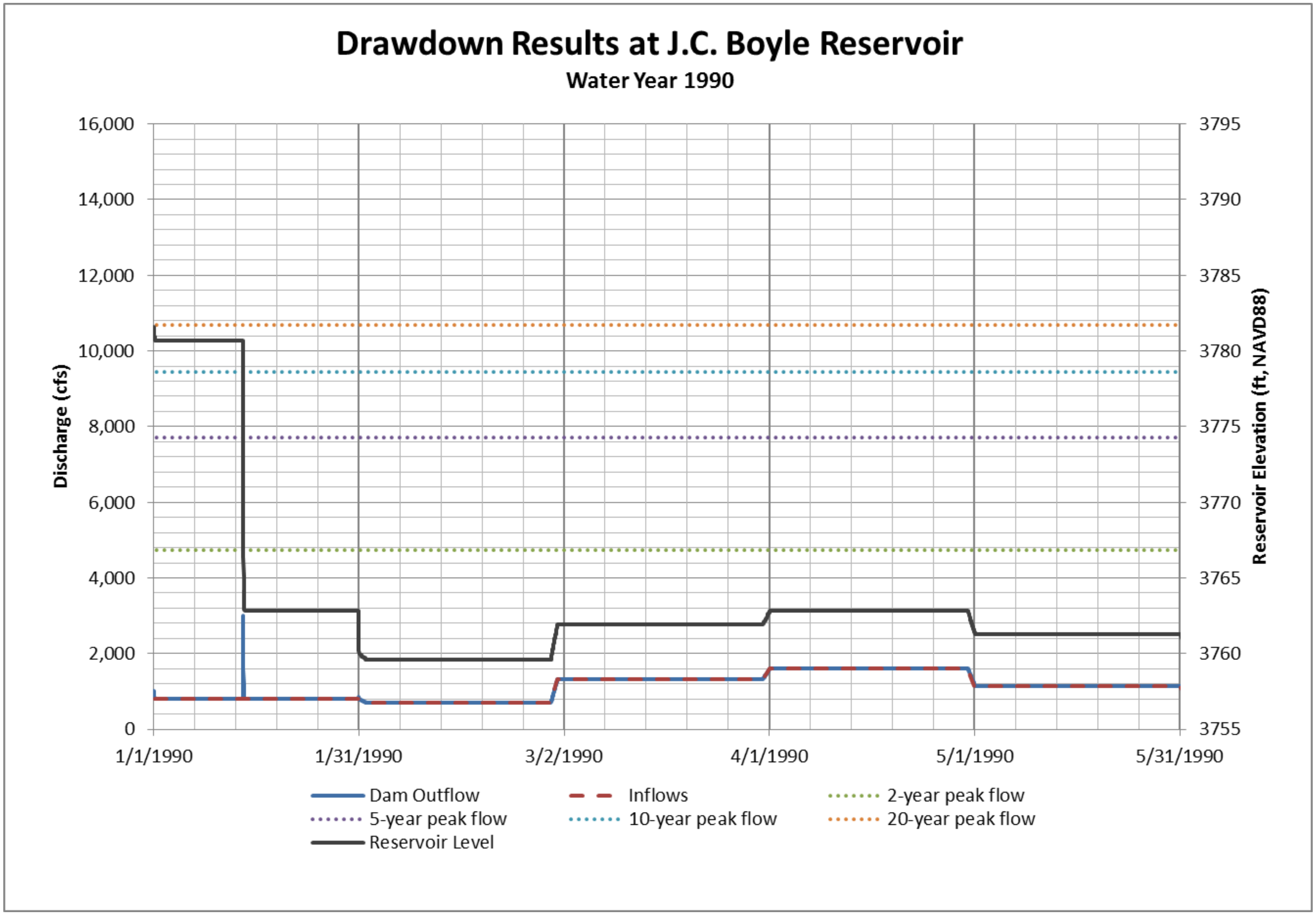

Figure 2-30 J.C. Boyle Reservoir Drawdown, Water Year 1990

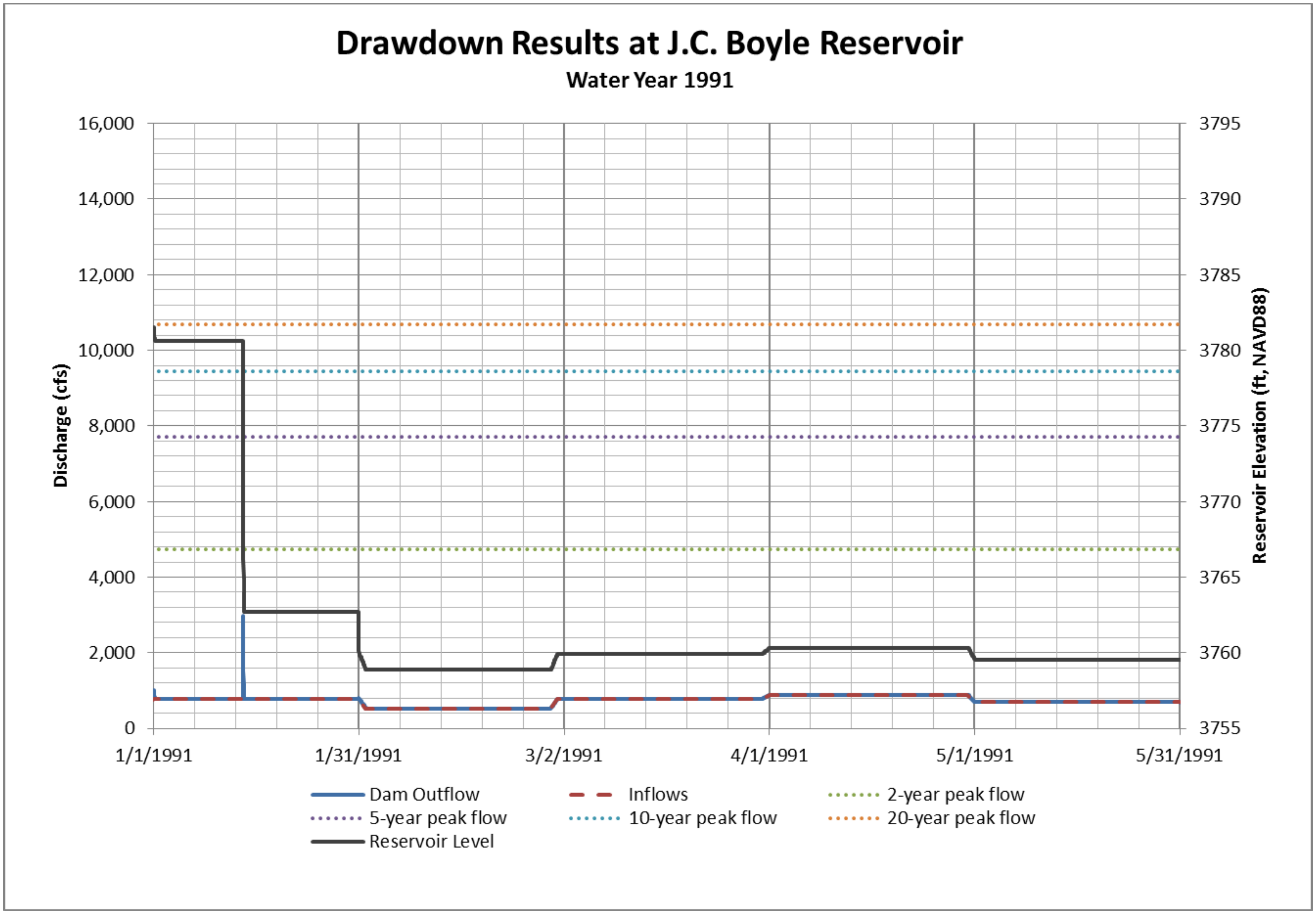

Figure 2-31 J.C. Boyle Reservoir Drawdown, Water Year 1991

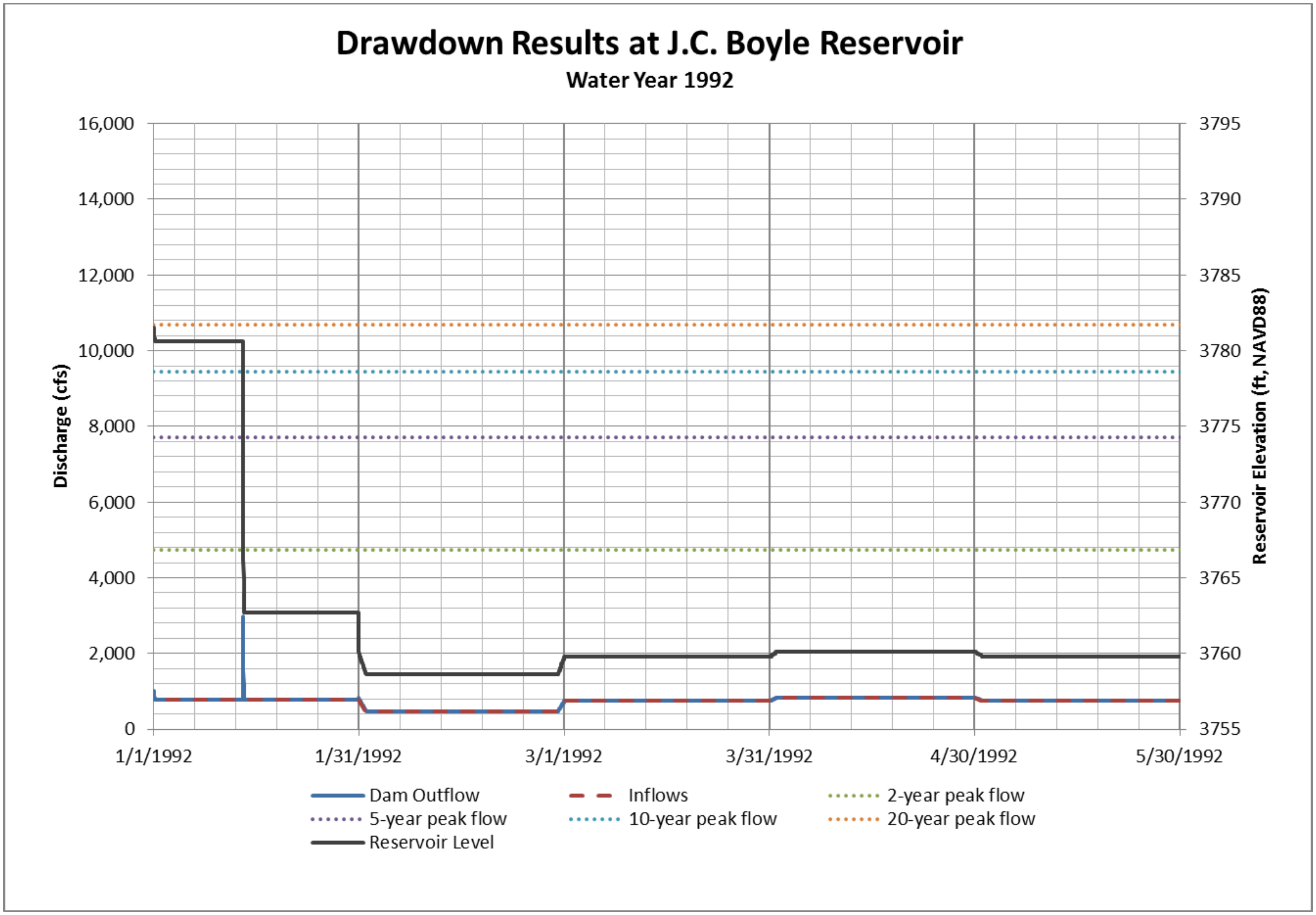

Figure 2-32 J.C. Boyle Reservoir Drawdown, Water Year 1992

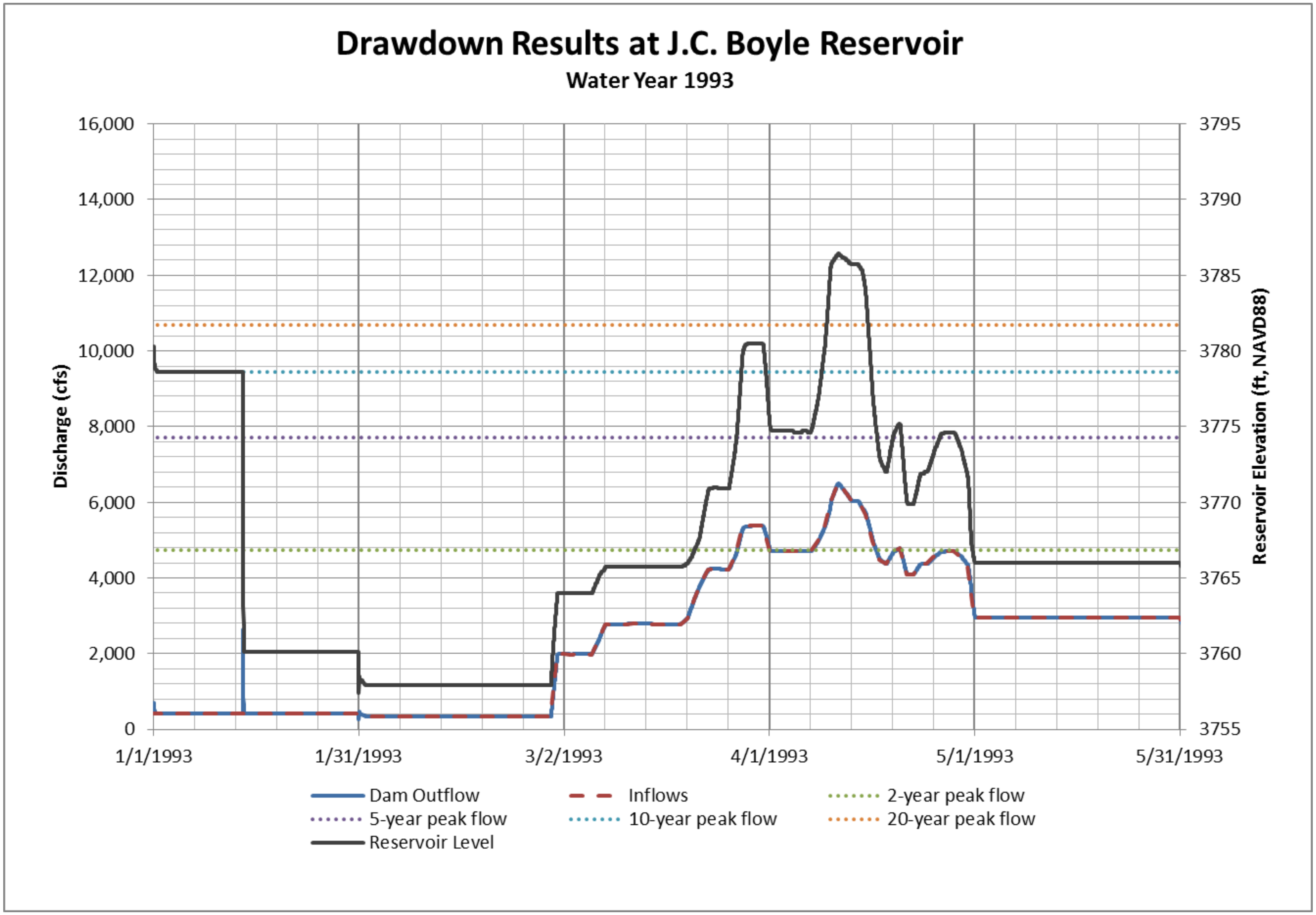

Figure 2-33 J.C. Boyle Reservoir Drawdown, Water Year 1993

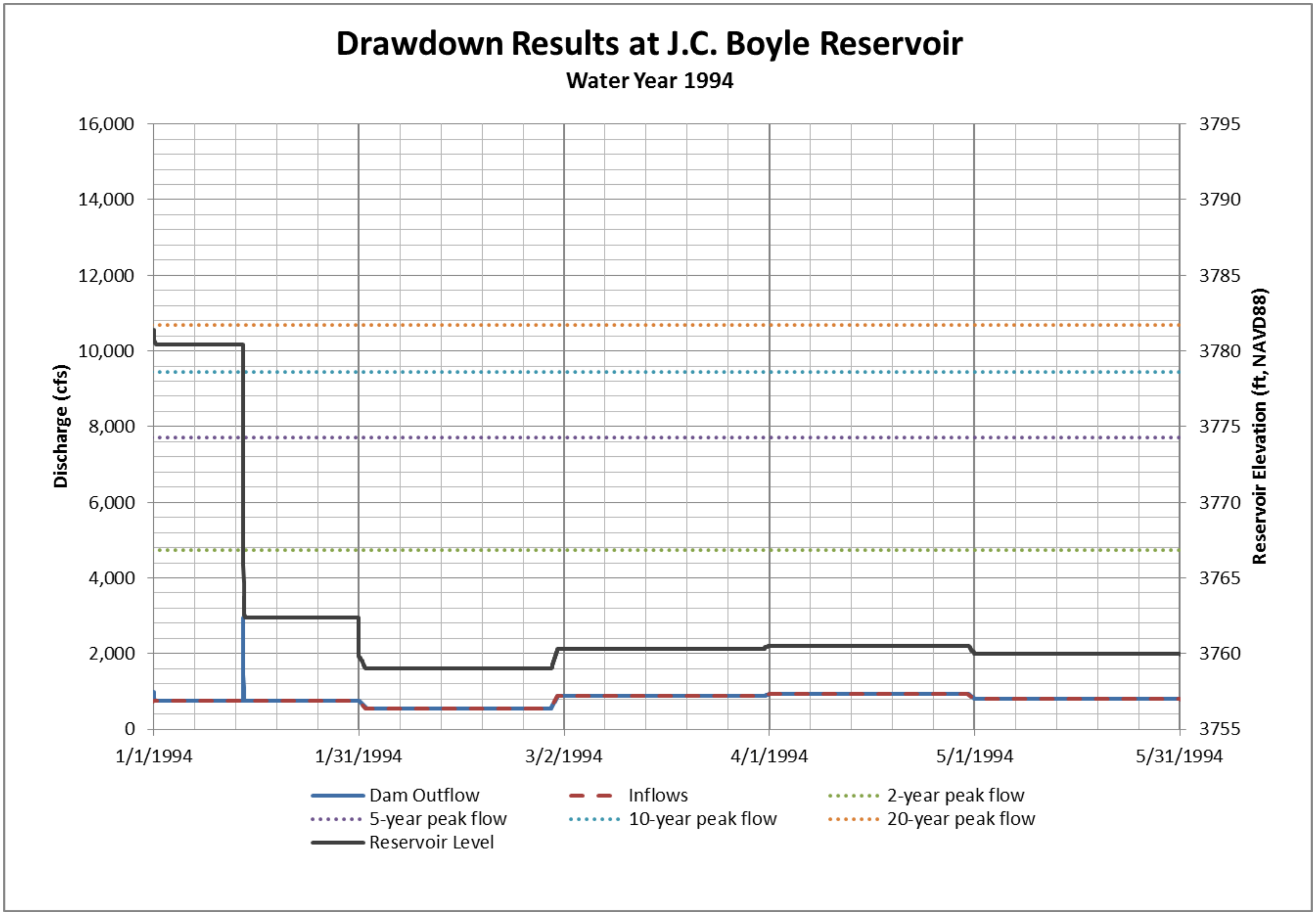

Figure 2-34 J.C. Boyle Reservoir Drawdown, Water Year 1994

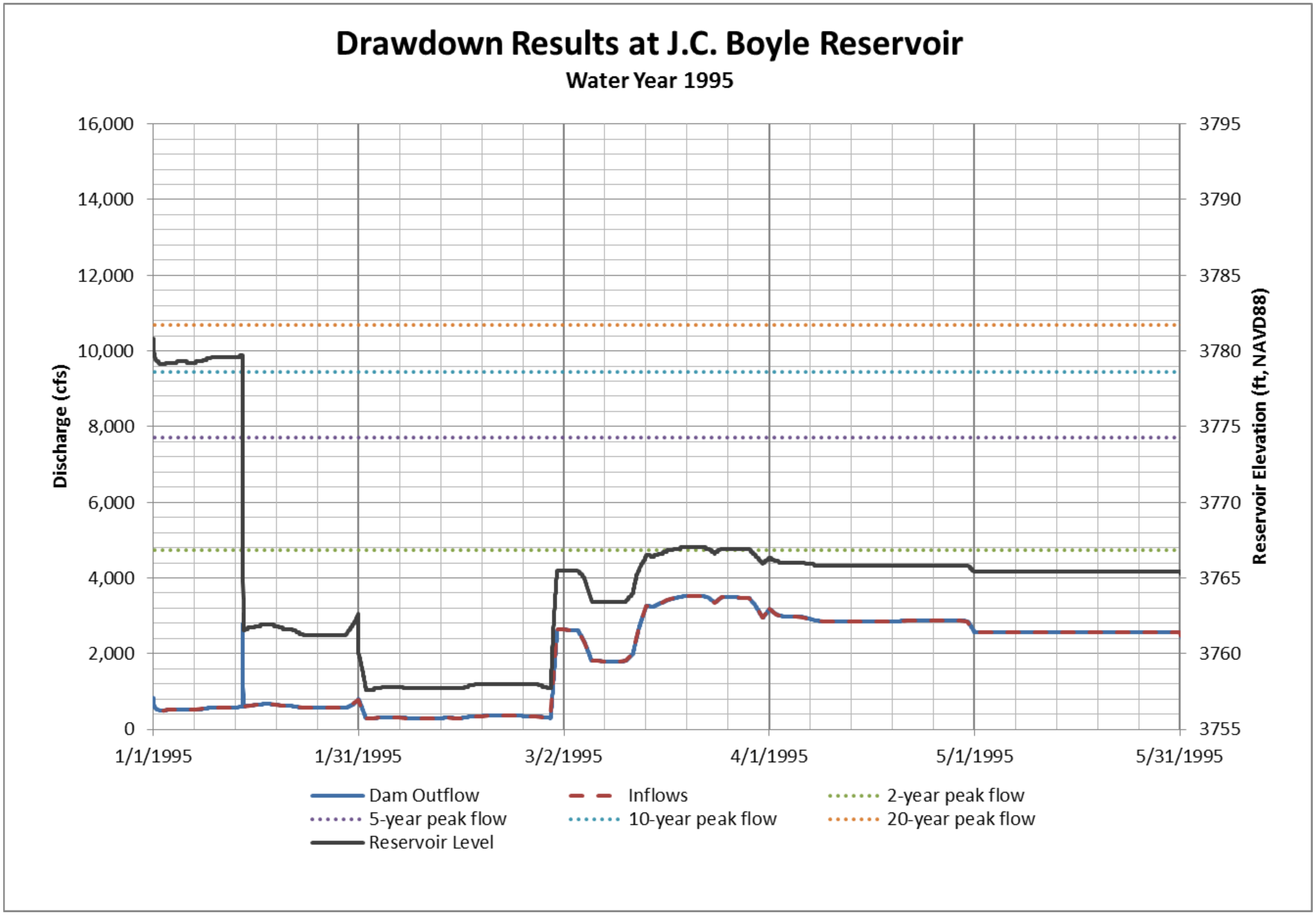

Figure 2-35 J.C. Boyle Reservoir Drawdown, Water Year 1995

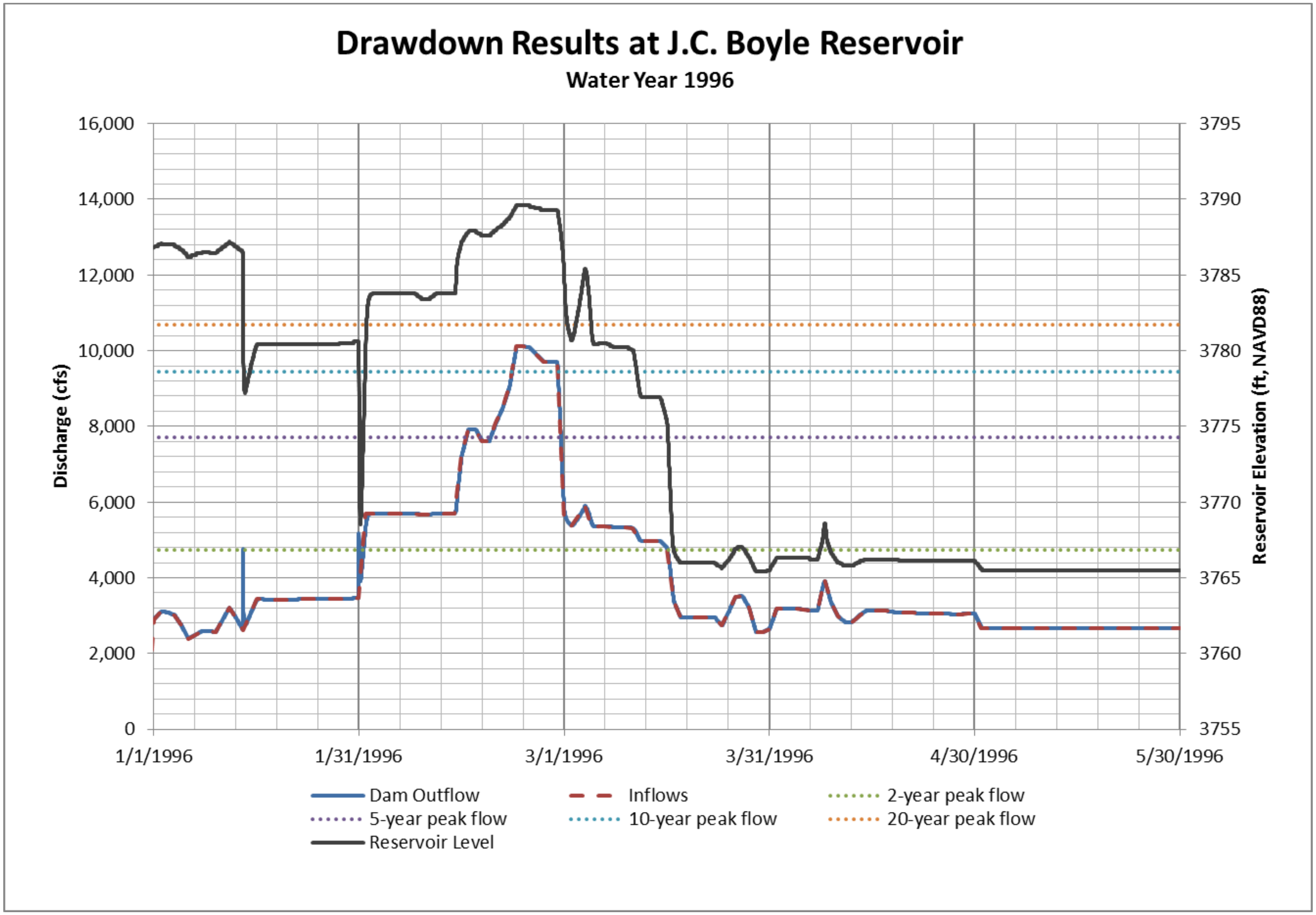

Figure 2-36 J.C. Boyle Reservoir Drawdown, Water Year 1996

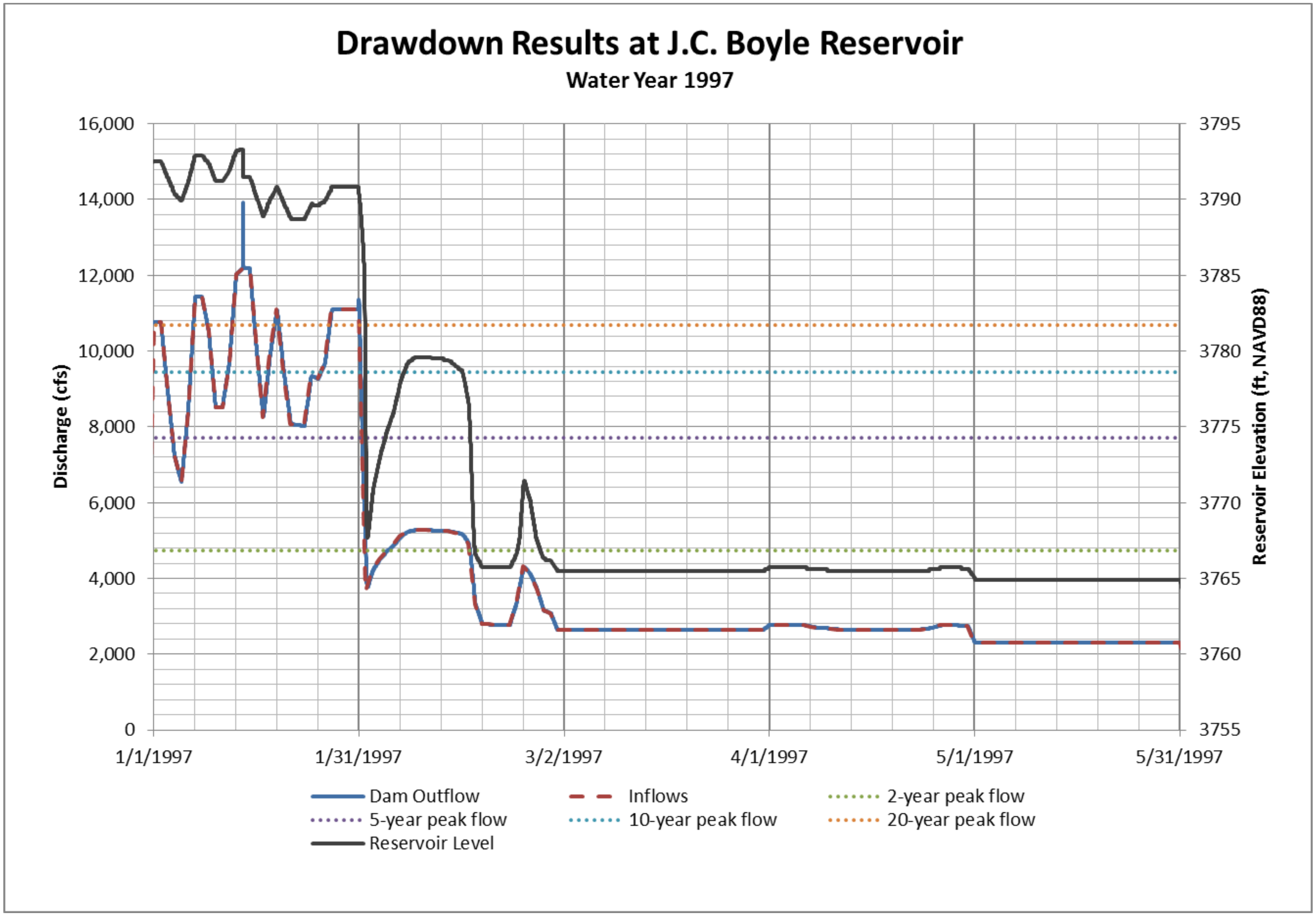

Figure 2-37 J.C. Boyle Reservoir Drawdown, Water Year 1997

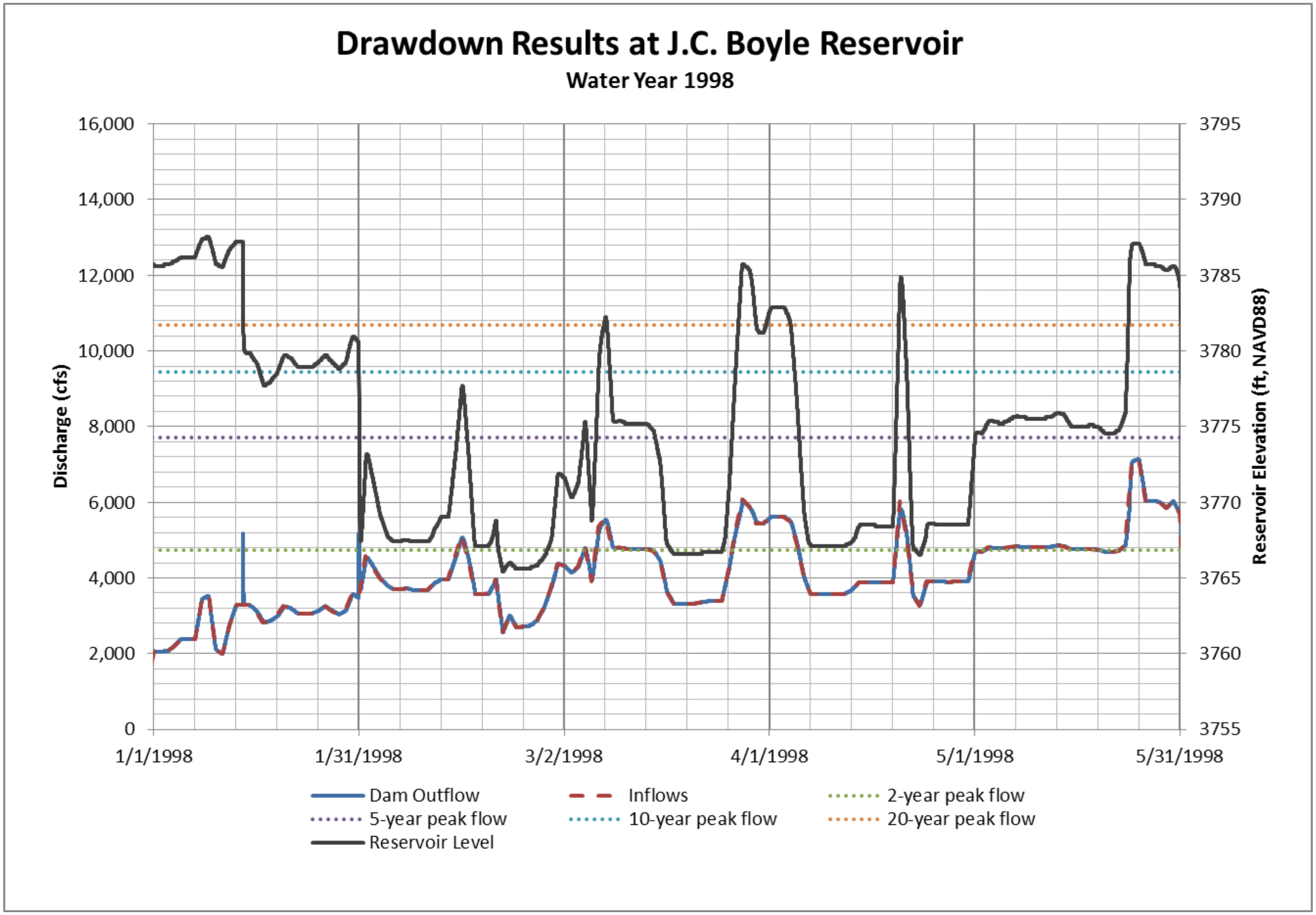

Figure 2-38 J.C. Boyle Reservoir Drawdown, Water Year 1998

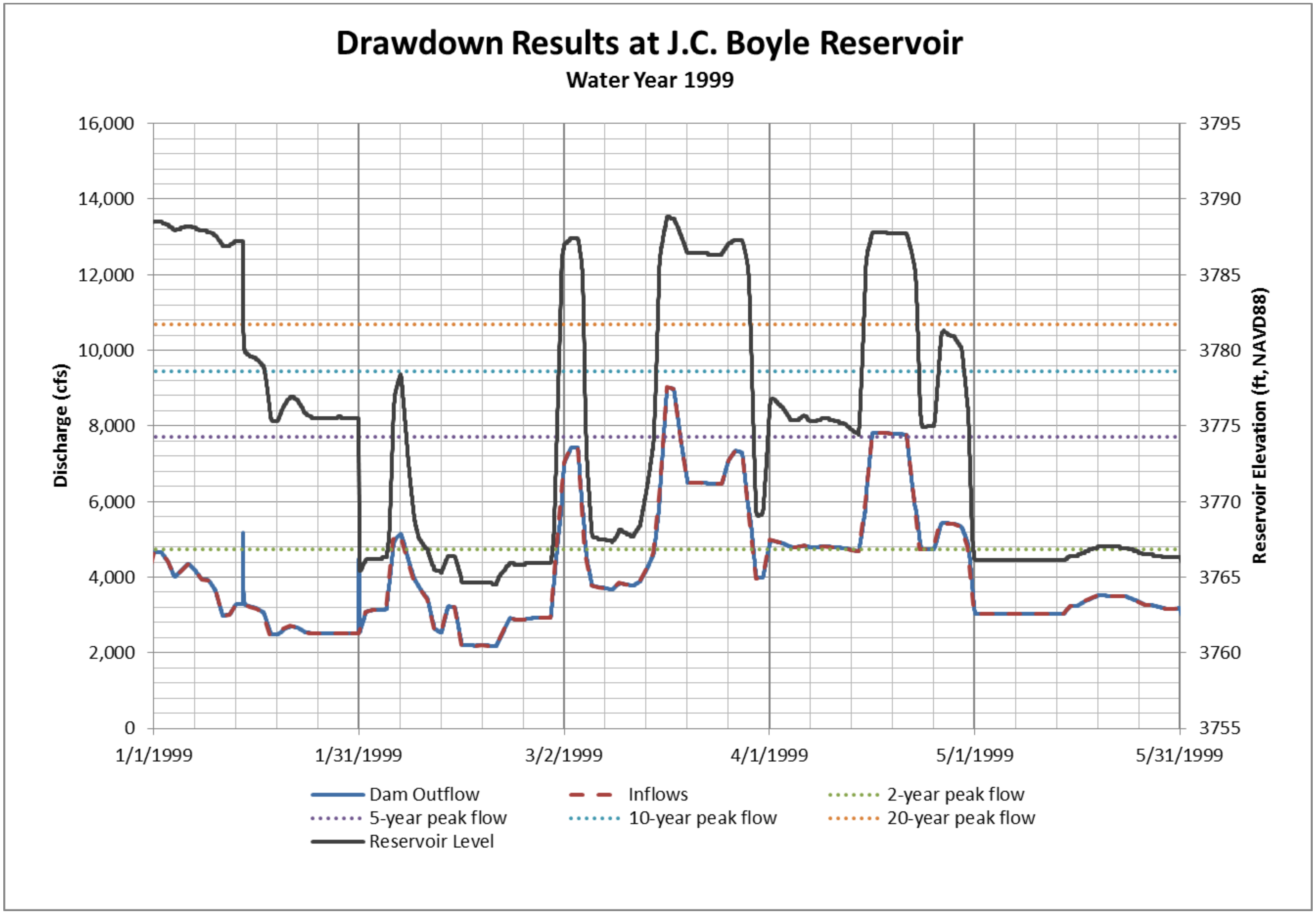

Figure 2-39 J.C. Boyle Reservoir Drawdown, Water Year 1999

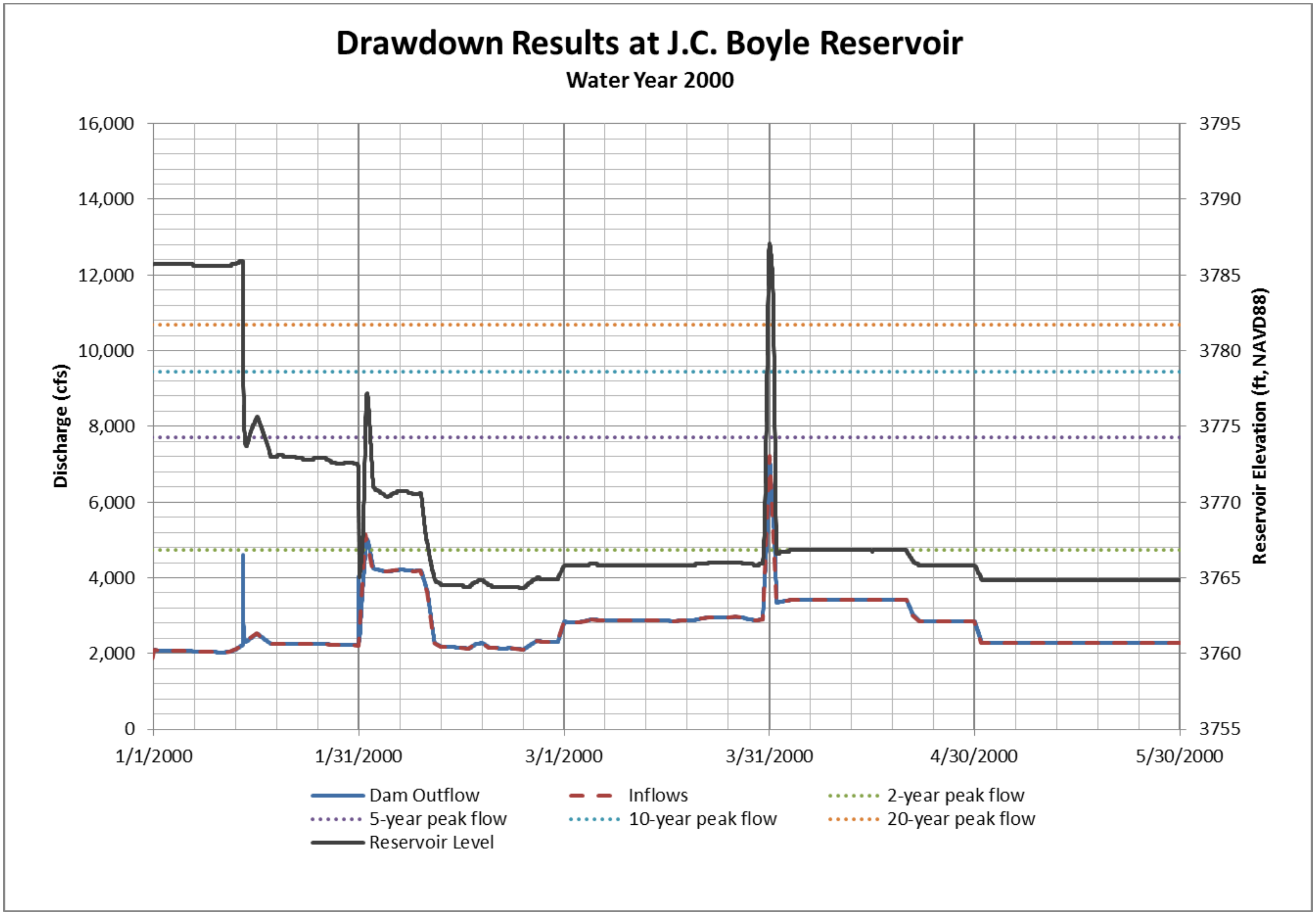

Figure 2-40 J.C. Boyle Reservoir Drawdown, Water Year 2000

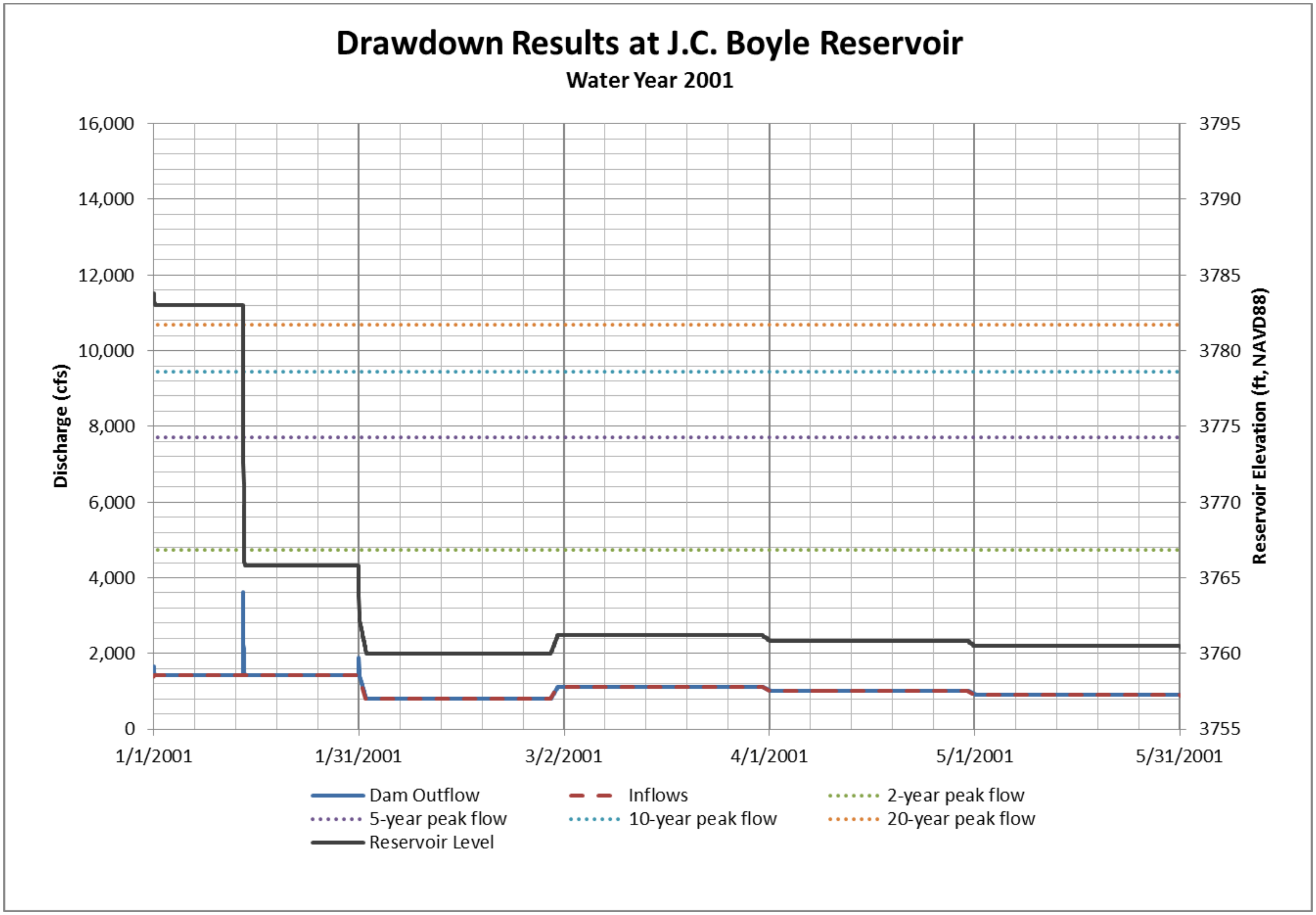

Figure 2-41 J.C. Boyle Reservoir Drawdown, Water Year 2001

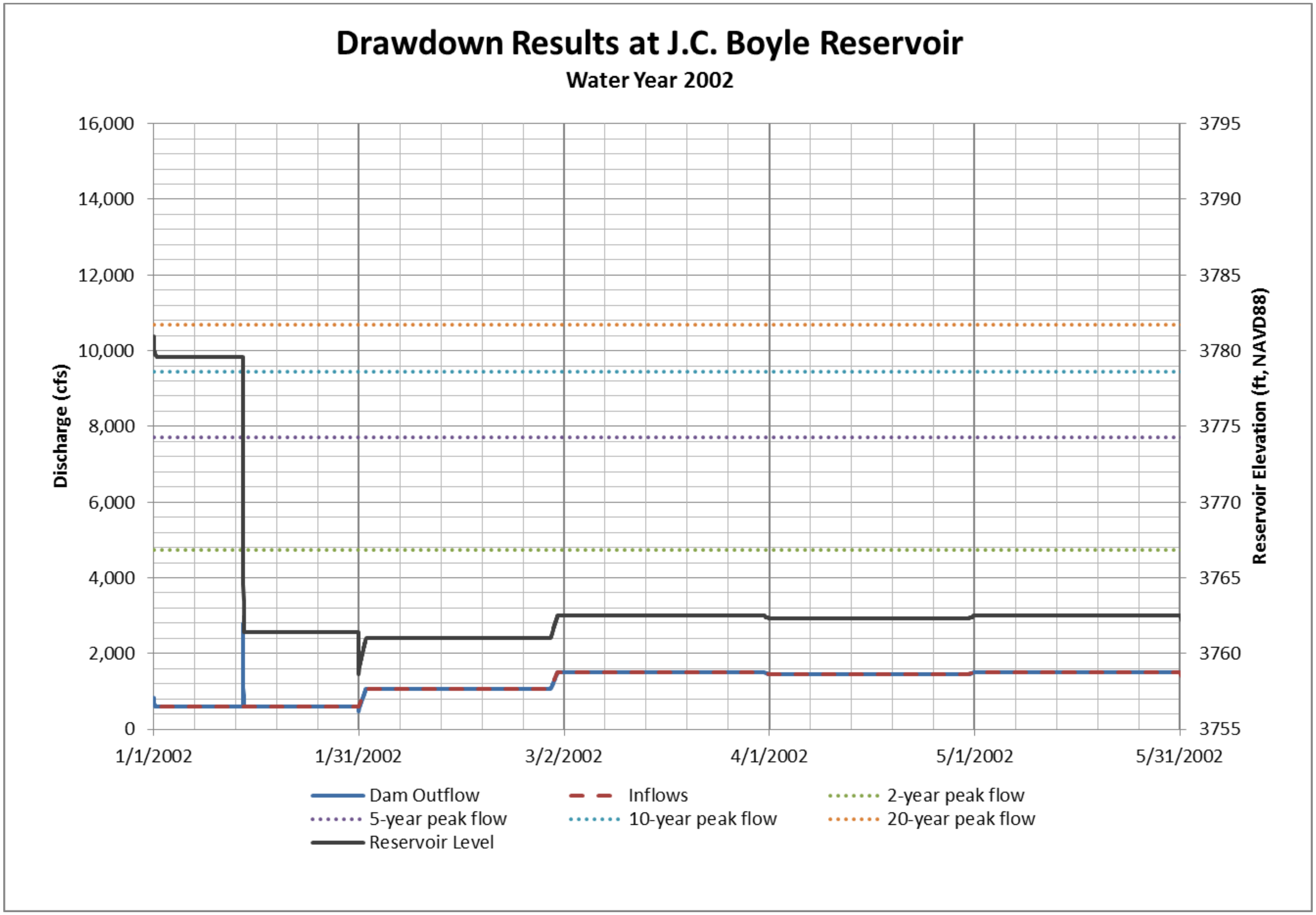

Figure 2-42 J.C. Boyle Reservoir Drawdown, Water Year 2002

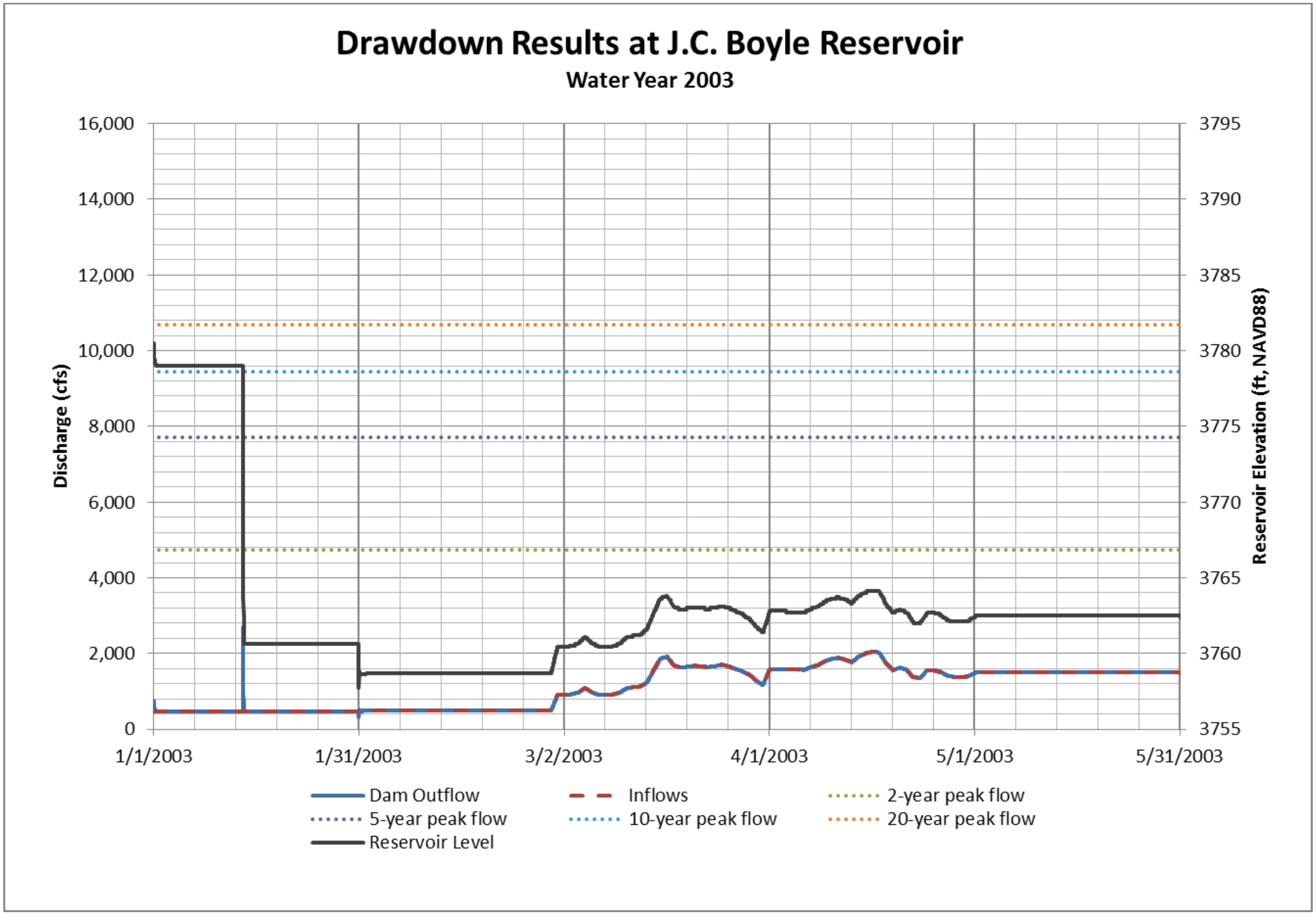

Figure 2-43 J.C. Boyle Reservoir Drawdown, Water Year 2003

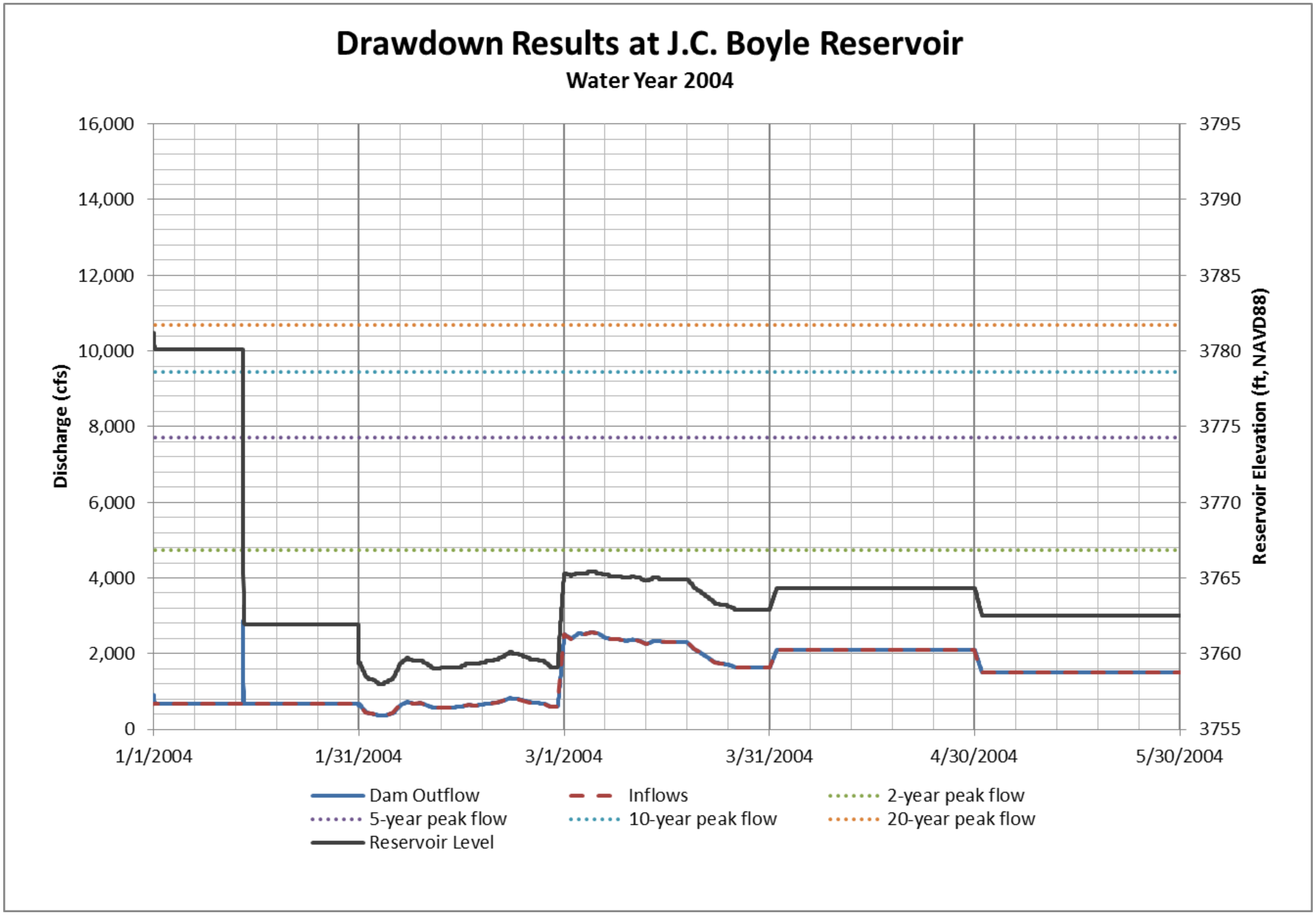

Figure 2-44 J.C. Boyle Reservoir Drawdown, Water Year 2004

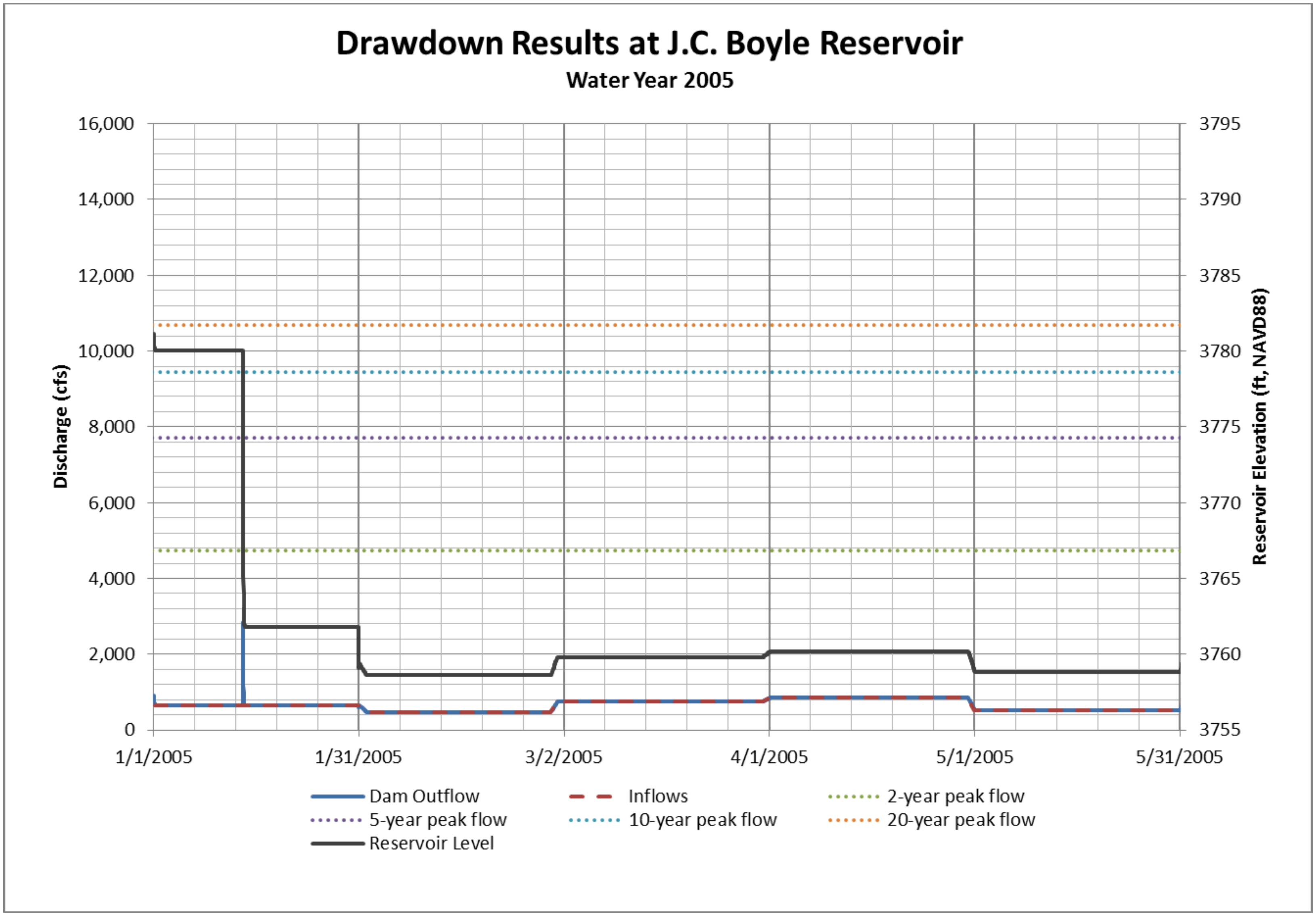

Figure 2-45 J.C. Boyle Reservoir Drawdown, Water Year 2005

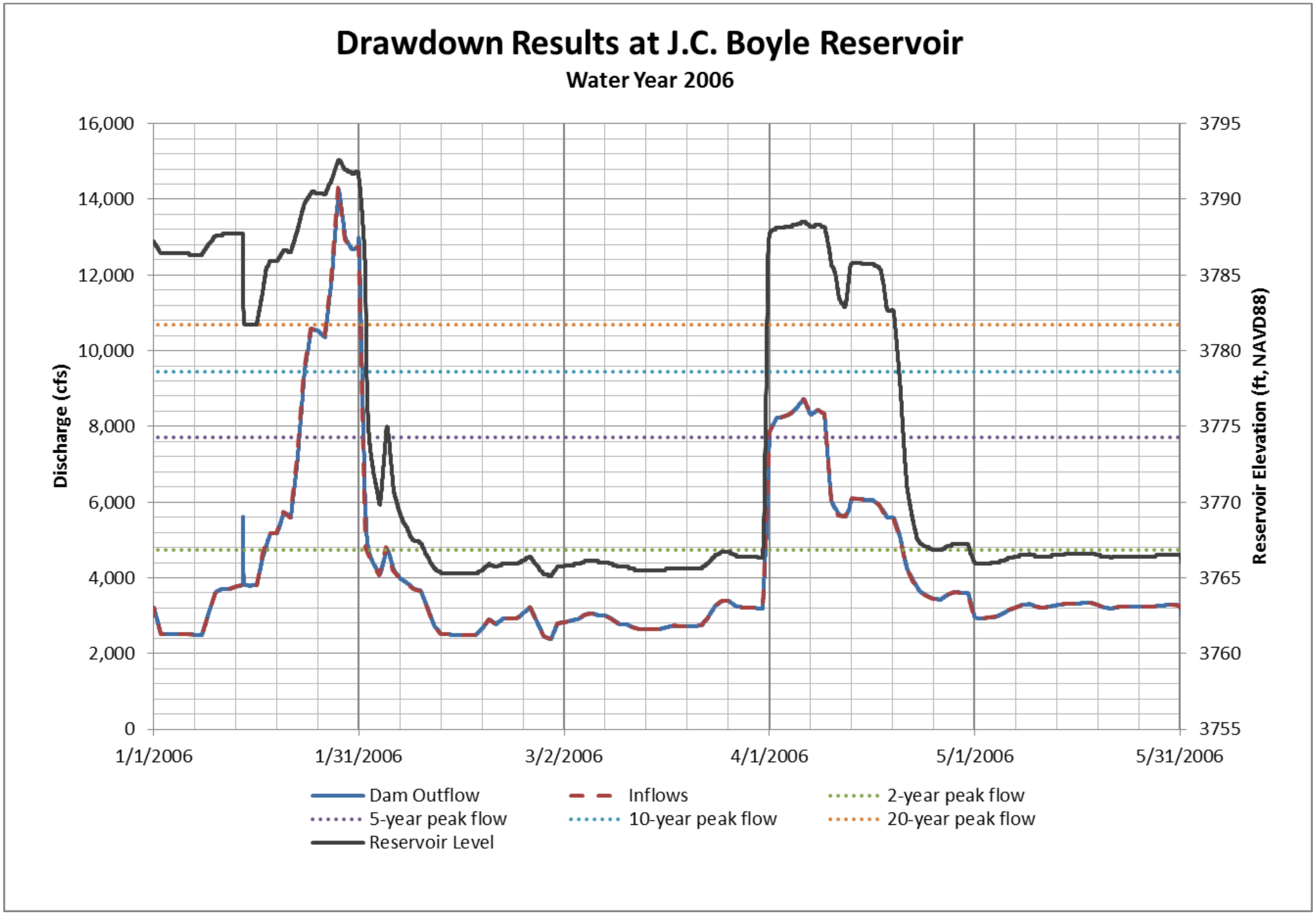

Figure 2-46 J.C. Boyle Reservoir Drawdown, Water Year 2006 (Wet Year)

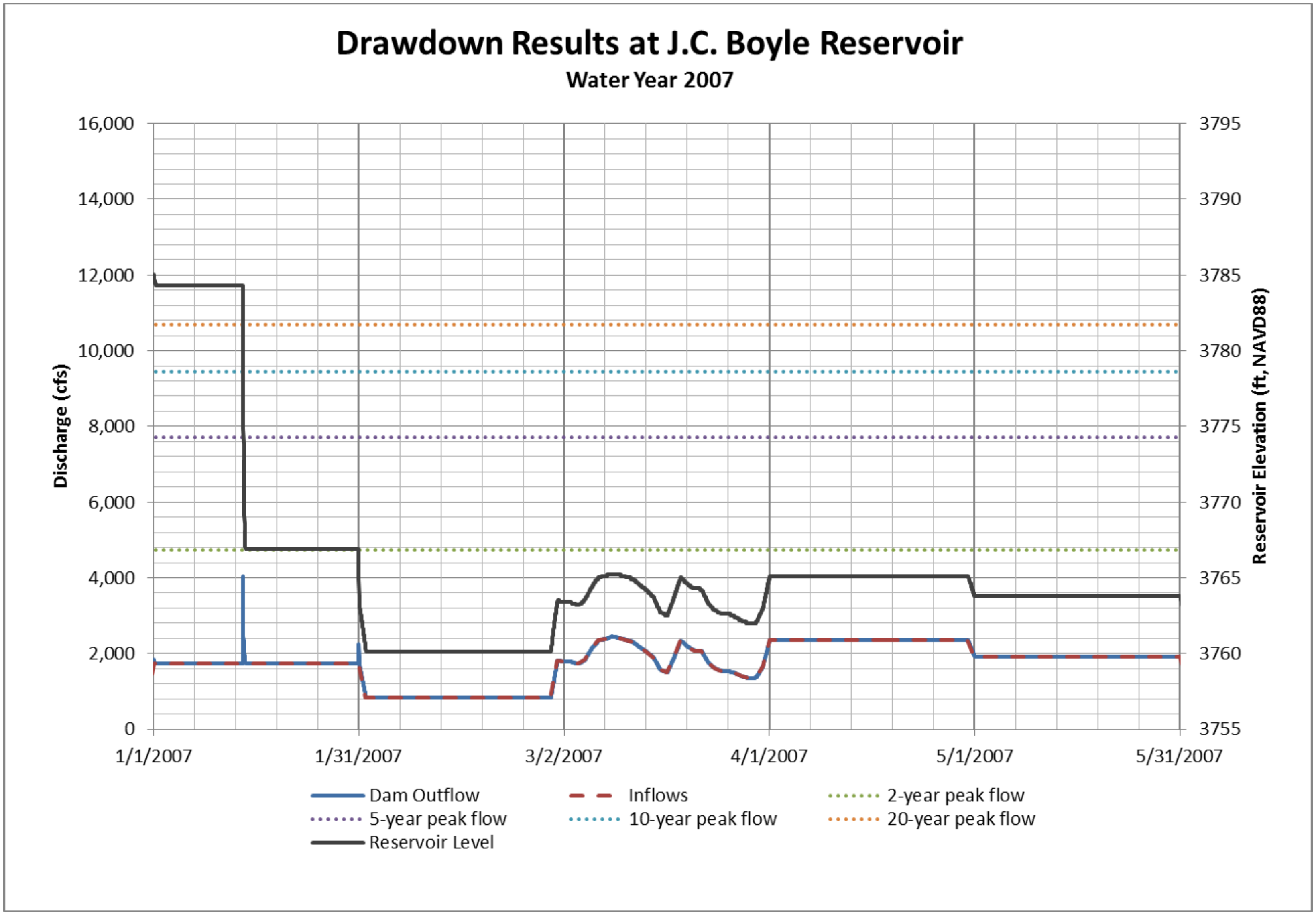

Figure 2-47 J.C. Boyle Reservoir Drawdown, Water Year 2007

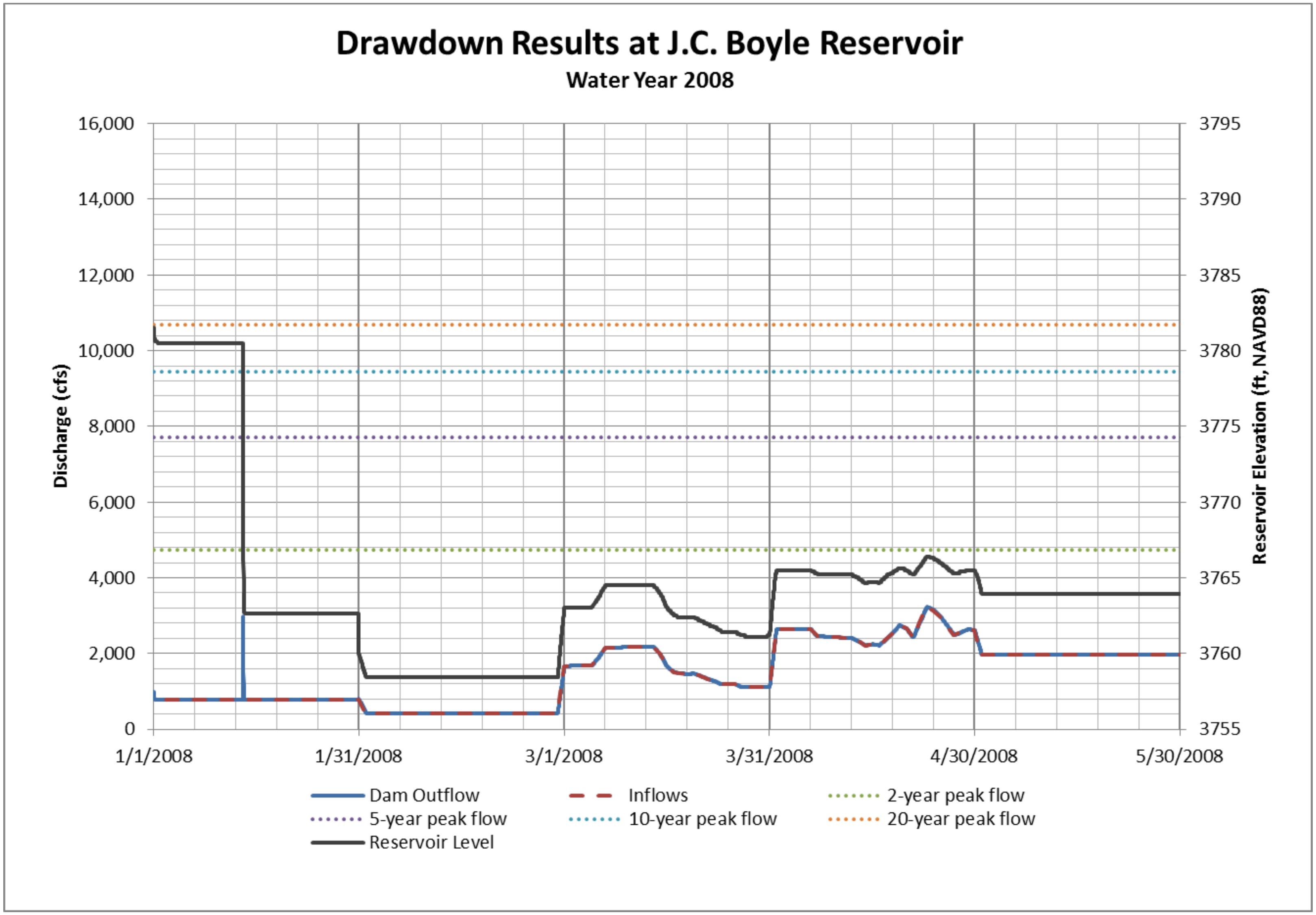

Figure 2-48 J.C. Boyle Reservoir Drawdown, Water Year 2008

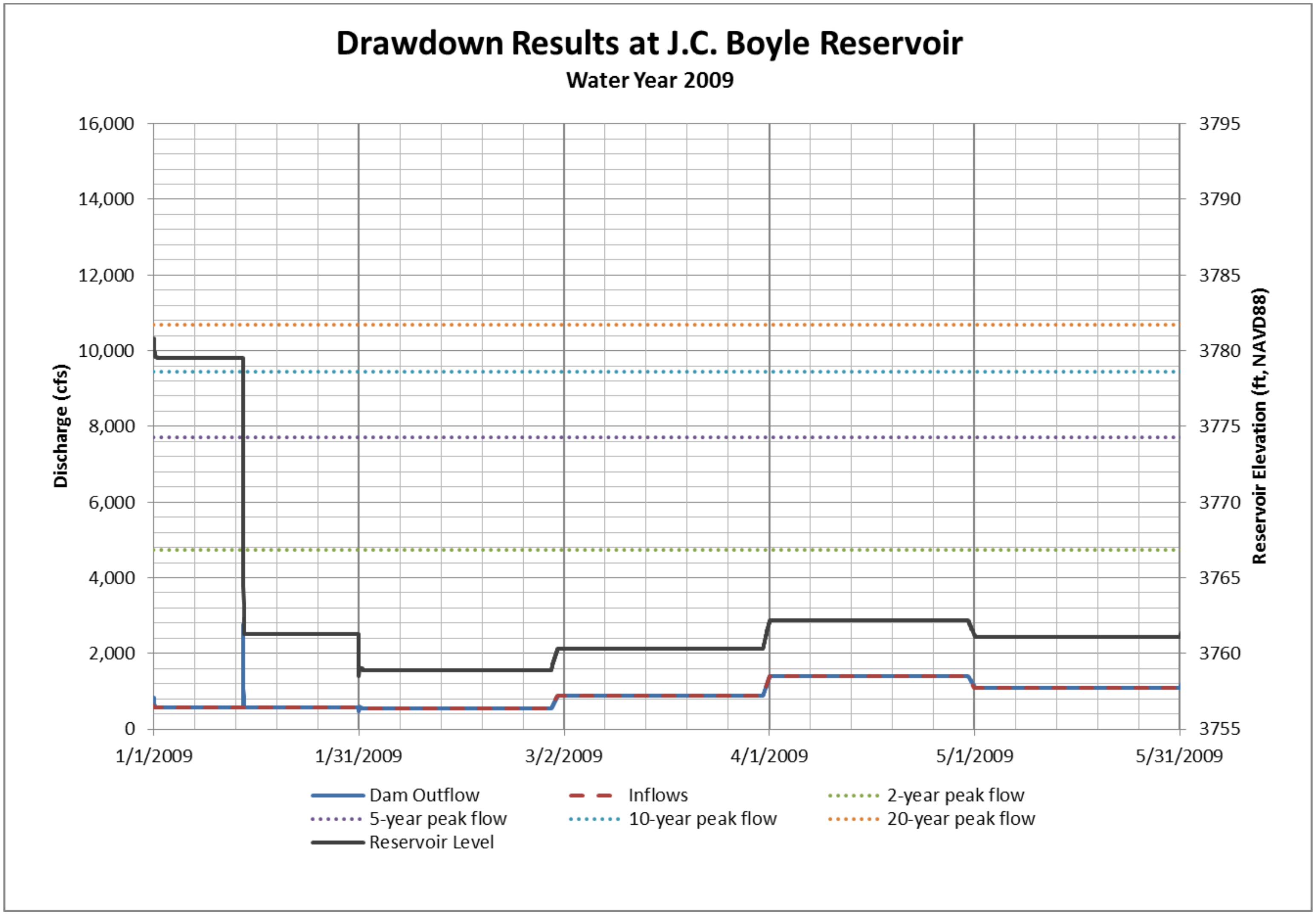

Figure 2-49 J.C. Boyle Reservoir Drawdown, Water Year 2009

Chapter 3: Copco 1 Reservoir

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3. COPCO 1 RESERVOIR

KRRC analyzed two options for reservoir drawdown at Copco No. 1: Option 1 includes dam notching and Option 2 does not include dam notching. KRRC proposes Option 2 as the proposed action, but KRRC also analyzed Option 1 because it was the method originally proposed in the Detailed Plan. In general, Option 1 with notching performs worse than Option 2 in terms of minimizing peak flows and drawdown duration, particularly in wet years. Therefore, KRRC proposes Option 2 for Copco No. 1 drawdown. The following discusses drawdown of Copco Lake separately for the two tunnel modification options described in Definite Plan Section 4.2.2.

3.1 Option 1 (for comparison only) - Diversion Tunnel Modified to Restore Capacity and Dam Notching

The drawdown procedure at Copco Lake for Option 1 is summarized below:

1. For modeling purposes, KRRC assumes that by January 1, 2021 (the start of the simulation), following the two-month initial drawdown period beginning November 1, 2020, the water level would be at the spillway crest.
2. The model assumes the three 6-foot gates on the diversion tunnel to be open at the start of the simulation.
3. Until completion of the last notch, the model assumes that the 6-foot gates will be closed down to limit the maximum rate of drawdown to 5 feet per day. Once the last notch was complete, the model assumes that the 6-foot gates will be left open.
4. In order to fully draw down the reservoir, the model includes notching the concrete dam with a series of 13 notches: an initial 24.5-foot notch, followed by 11 18-foot deep notches (measured from lowered dam crest to notch elevation; sequentially lowering the notches in 6-foot increments), then a final notch of 22 feet down to the channel bed elevation. The model lowers the dam crest in 6-foot lifts as the notching progressed. The bottom width of all notches was 8 feet. The elevation of the first notch was at 2572.5 feet. The elevation of the final notch was at elevation 2484.5 (regardless of water year) with the lowered dam crest at elevation 2518.5.
5. To simplify the model, KRRC assumed that the Contractor will lower the dam crest at the same time as the completion of the notch. Construction of the notch did not begin until the water level dropped to the level of where the dam crest will be once the lowering was complete (18 feet above the notch elevation). KRRC assumed that the lowered crest will need to be above the water level for construction to continue. KRRC assumed the minimum time needed before starting the next notch is 5 days. This would allow for completion of 13 notches by March 1, assuming no construction delays.
6. Maximum additional discharge downstream of the dam due to drawdown activities is about 7,700 cfs with about 2,800 cfs through the notch (assuming an 18-foot-deep notch with a bottom width of 8 feet adjacent to the 2 previous notches 12 feet and 6 feet deep) and the rest through the diversion

tunnel. The additional flow due to drawdown decreases as the reservoir level drops in the notch. For reference, the 10-year, 20-year, 50-year, and 100-year flow events downstream of Copco No. 1 are about 11,300 cfs, 13,500 cfs, 16,560 cfs, and 18,950 cfs, respectively.

3.2 Option 2 (proposed action) – Diversion Tunnel Modified to Increase Capacity

The drawdown procedure at Copco Lake for Option 2 is summarized in the numbered list below:

1. For modeling purposes, KRRC assume that by January 1, 2021 (the start of the simulation), following the two-month initial drawdown period beginning November 1, 2020, the water level would be at the spillway crest.
2. The model assumes that the large gate on the 14- by 16-foot diversion tunnel will not be opened until January 15 to allow for drawdown of Iron Gate reservoir prior to making additional releases from Copco Lake. The only releases from Copco Lake between January 1 and January 15 will be over the spillway.
3. On January 15, 2021, the model assumes the gate on the diversion tunnel opens.
4. The model assumes that the diversion tunnel gate will be closed down to limit the maximum rate of drawdown to 5 feet per day. Once the reservoir level reached the top of the diversion tunnel, the model assumes that the drawdown rate is no longer limited.
5. Maximum additional discharge downstream of the dam due to drawdown activities is about 6,000 cfs when the gate is opened on January 15. During other times, the increase is generally 1,000 to 2,000 cfs. The total discharge capacity of the new gate structure with the reservoir at the spillway crest elevation of 2597.0 feet is nearly 12,000 cfs. As water levels increase above the spillway crest, KRRC assumes closure of the gate to limit the total discharge to 13,000 cfs to avoid high water levels that could impact power production at Copco No. 2 powerhouse.
6. For reference, the 10-year, 20-year, 50-year, and 100-year flow events downstream of Copco No. 1 are 11,300 cfs, 13,500 cfs, 16,560 cfs, and 18,950 cfs, respectively.

3.3 Results

Figures 3-2 through 3-50 show the drawdown results for Copco No. 1 for both drawdown options.

In general, Option 1 with notching performs worse than Option 2 in terms of minimizing peak flows and drawdown duration, particularly in wet years. Therefore, KRRC proposes Option 2 for Copco No. 1 drawdown, and the remainder of the results discussion will focus on Option 2.

As discussed above, construction of a notch did not begin until the water surface elevation was at the elevation of the next notch crest (18 feet above the current notch invert). The Contractor could start the next notch at a higher elevation (for example, 1 foot below the notch crest being constructed). However, if a higher water surface elevation was used the notch crest could not be lowered 6 feet unless the water surface elevation dropped. Figure 3-1 shows the length of time that high water levels delay the first and last notch. There is a 30 percent chance that the last notch would be delayed at least one week and a 10 percent chance that it would be delayed 7 weeks or more. The delay is usually caused by storms that occur after most of the notches have been constructed and result in an overtopping of the notch crest.

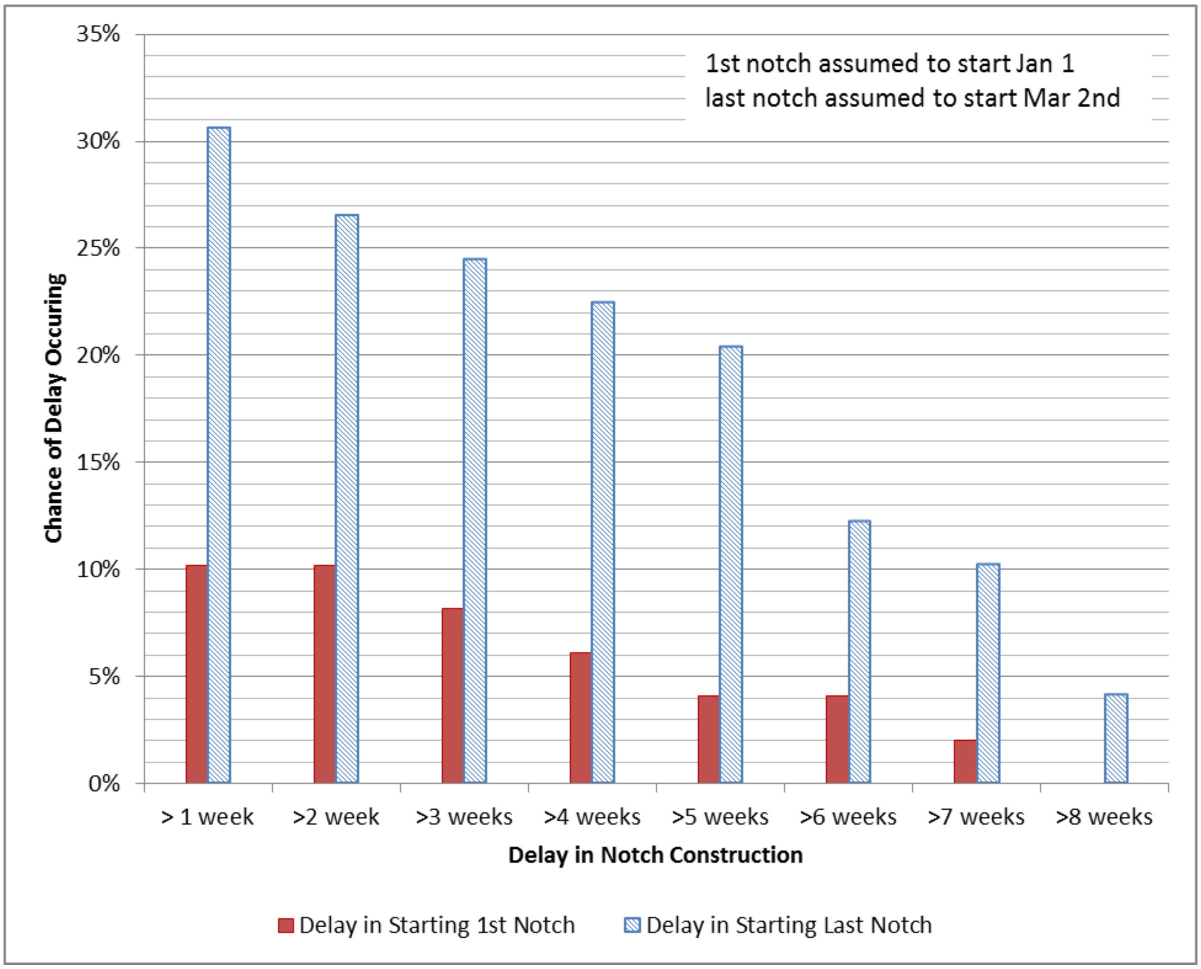

Figure 3-1 Graph Showing the Chance of a Delay in the Construction of the First and Last Notches in Copco No. 1 Dam

During representative dry years (e.g., 1973 and 1979), the reservoir was easily drawn down by the end of February, and does not refill after that point.

For Option 2 during the wetter years (e.g., 1966, 2006, 1986, and 1970), the reservoir was completely drawn down by the end of February, but in some cases partially refilled later in the year when storms occurred. The majority of the accumulated sediment would mobilize during the initial drawdown, and subsequent reservoir filling and drawdown is expected to cause only moderate increases in high suspended sediment (relative to background) (USBR 2012c).

Also during the wetter years, flows are higher than what would be expected via the spillway alone (i.e., without drawdown), but the increases are limited to those periods when flows are below the 10-year flood elevation.

KRRC does not anticipate that sediment concentrations resulting from the proposed drawdown procedure and associated hydraulics would differ from those previously estimated (USBR 2012c).

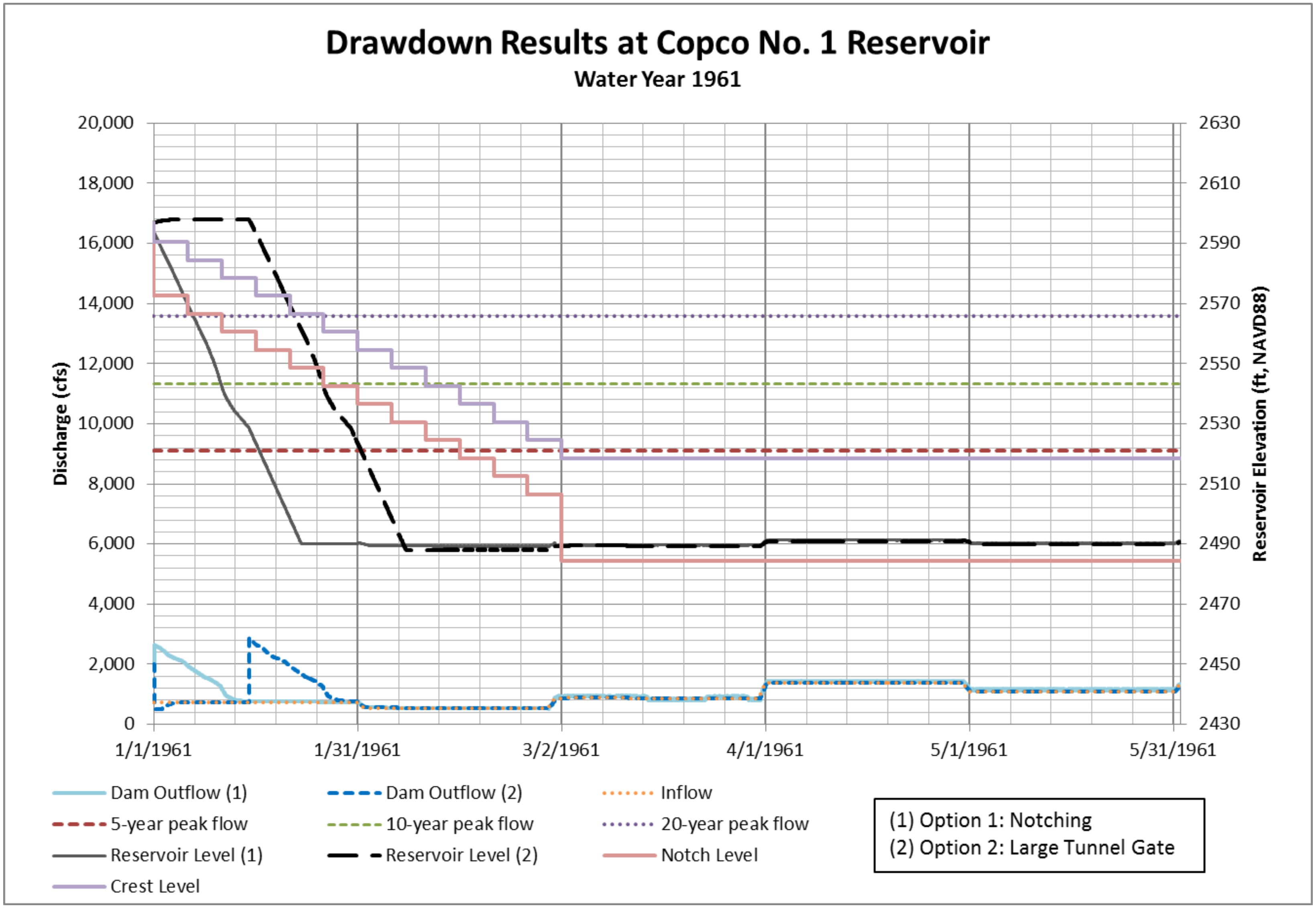

Figure 3-2 Copco No. 1 Reservoir Drawdown, Water Year 1961

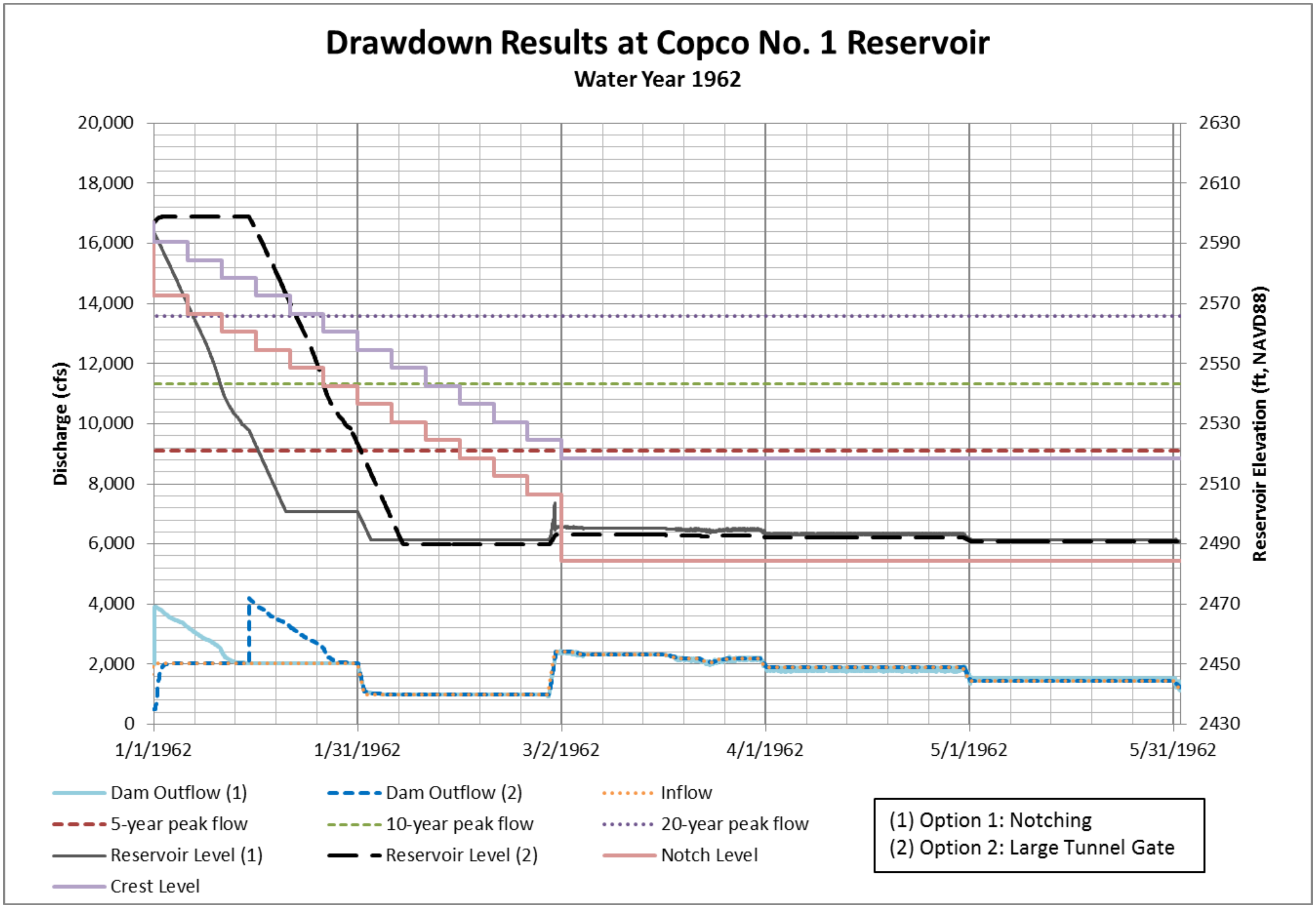

Figure 3-3 **Copco No. 1 Reservoir Drawdown, Water Year 1962**

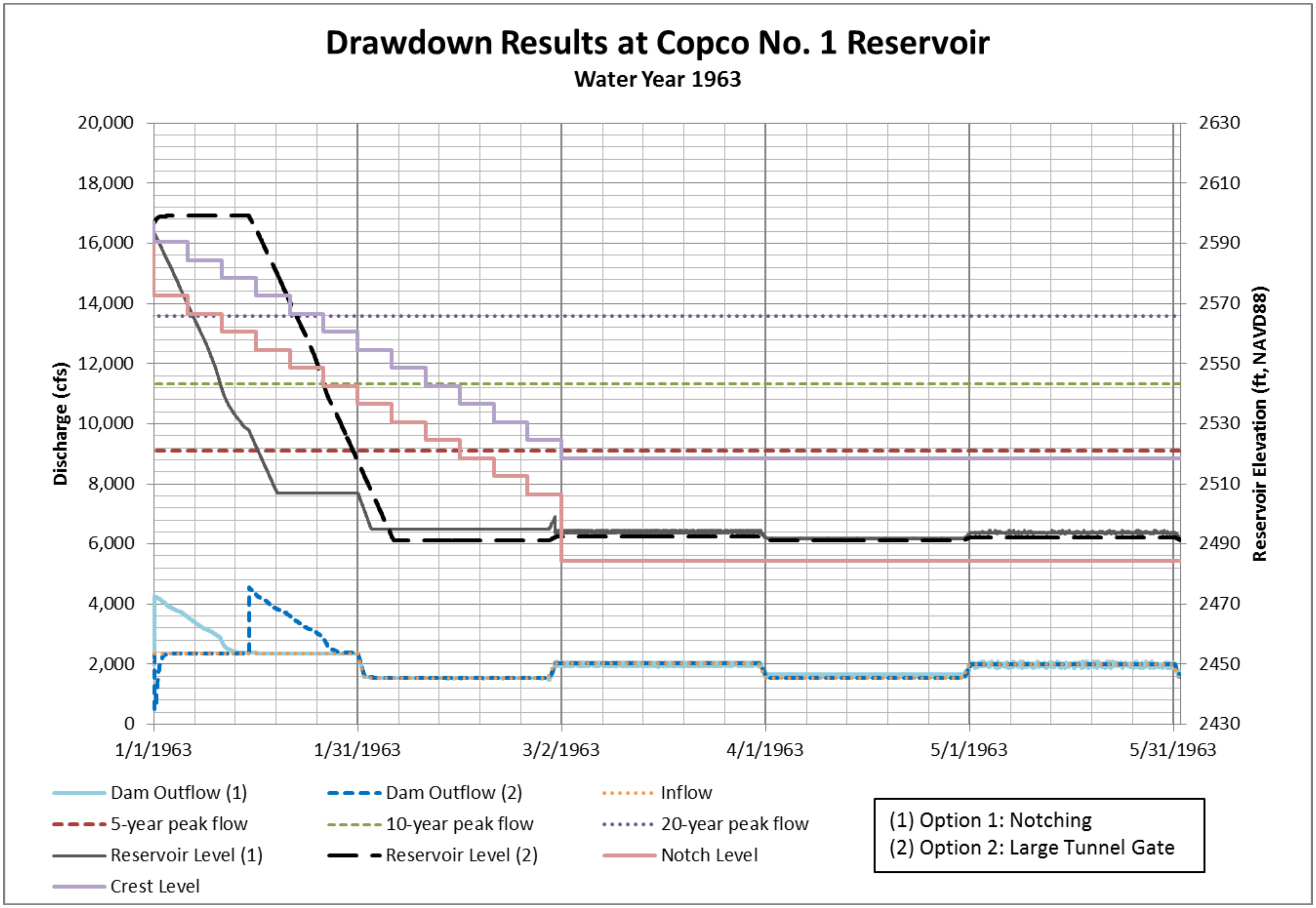

Figure 3-4 Copco No. 1 Reservoir Drawdown, Water Year 1963

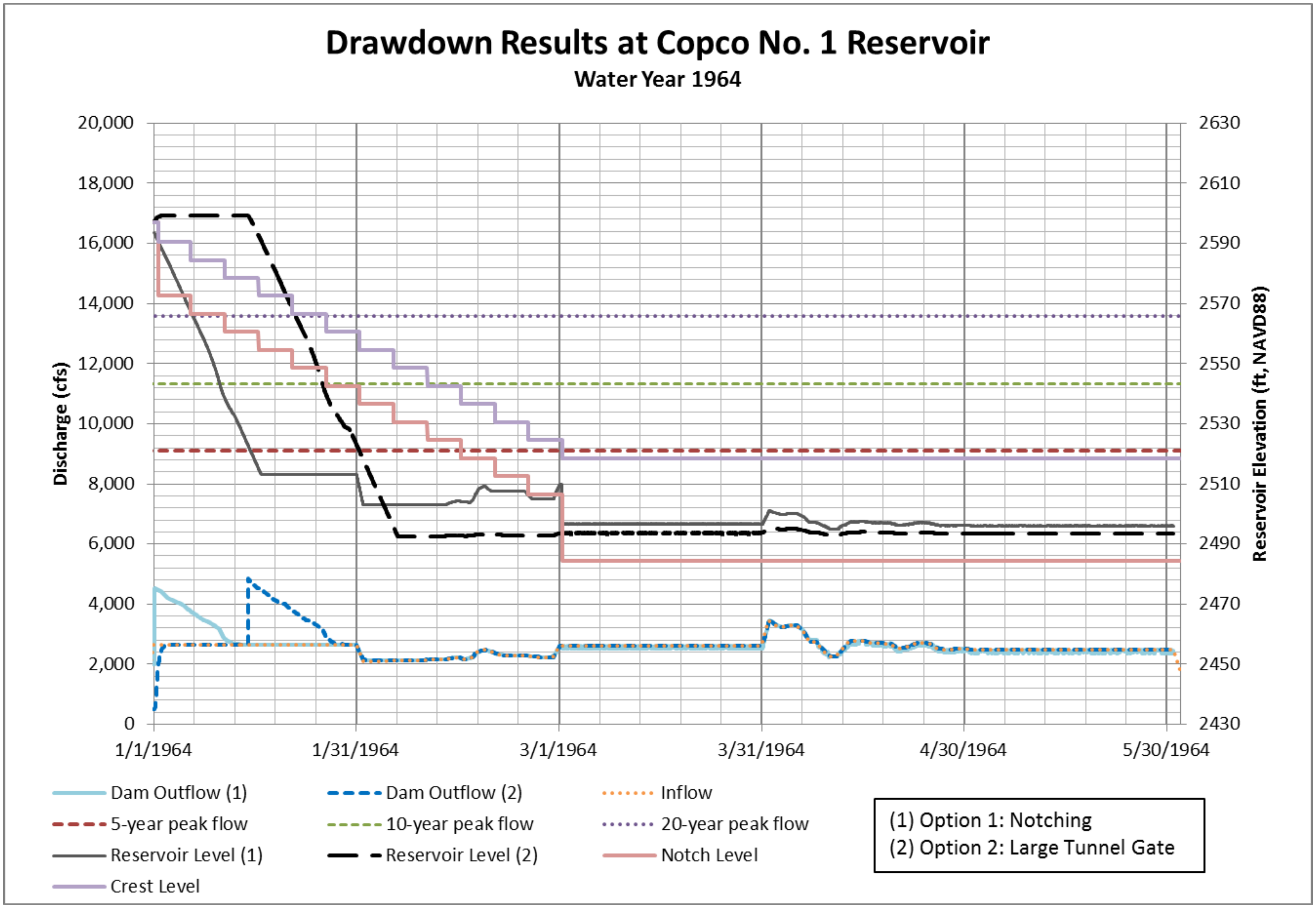

Figure 3-5 **Copco No. 1 Reservoir Drawdown, Water Year 1964**

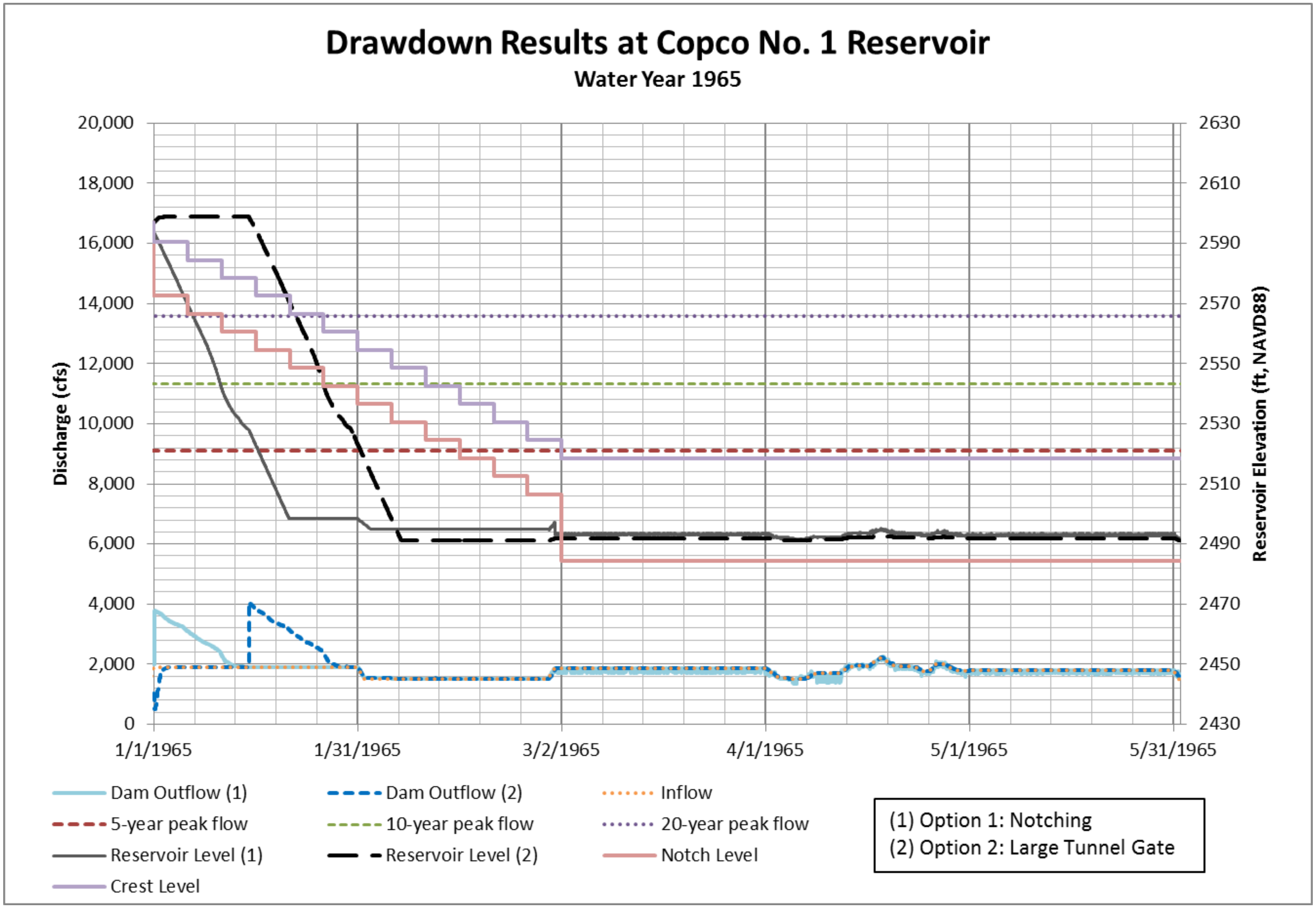

Figure 3-6 Copco No. 1 Reservoir Drawdown, Water Year 1965

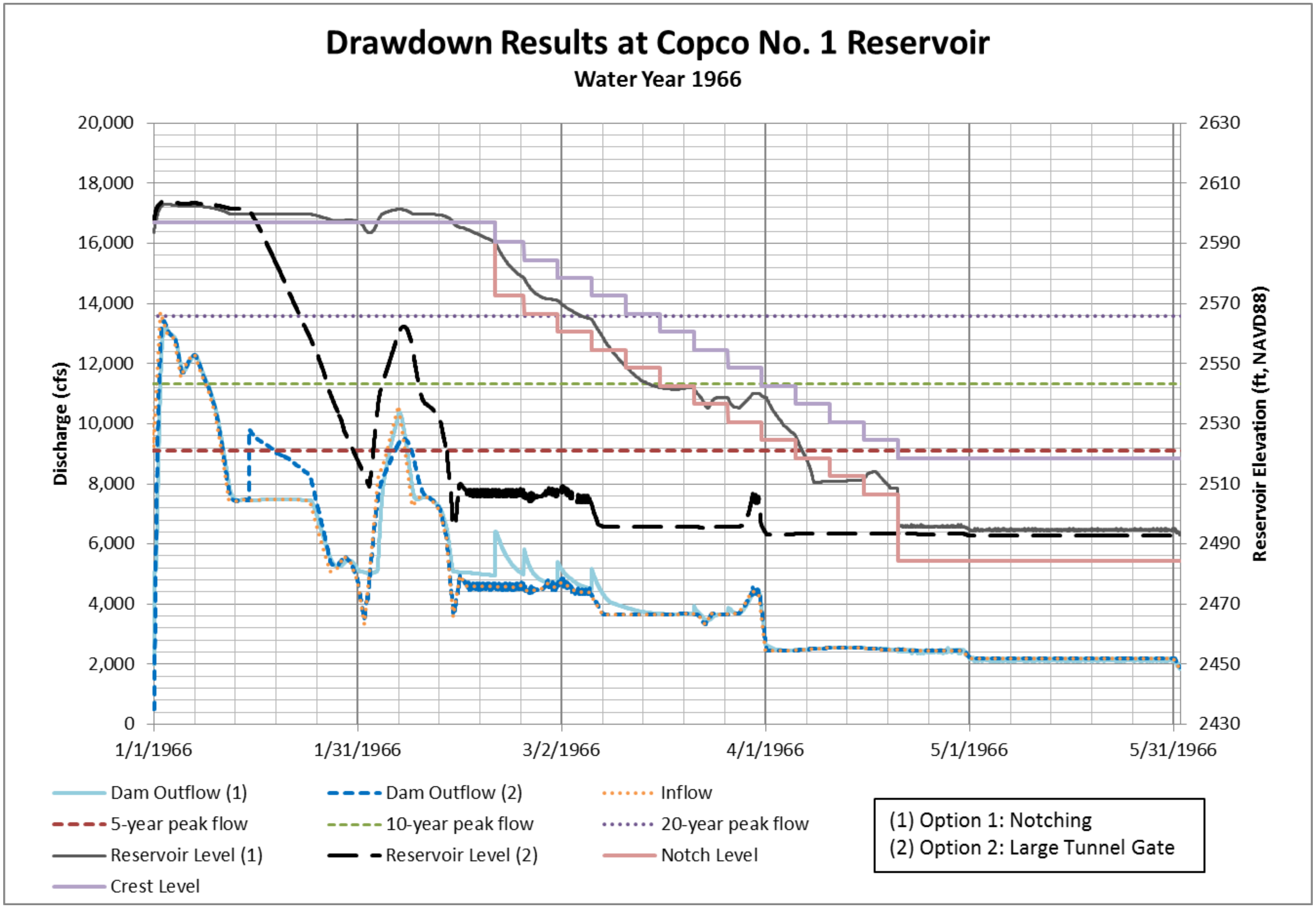

Figure 3-7 Copco No. 1 Reservoir Drawdown, Water Year 1966

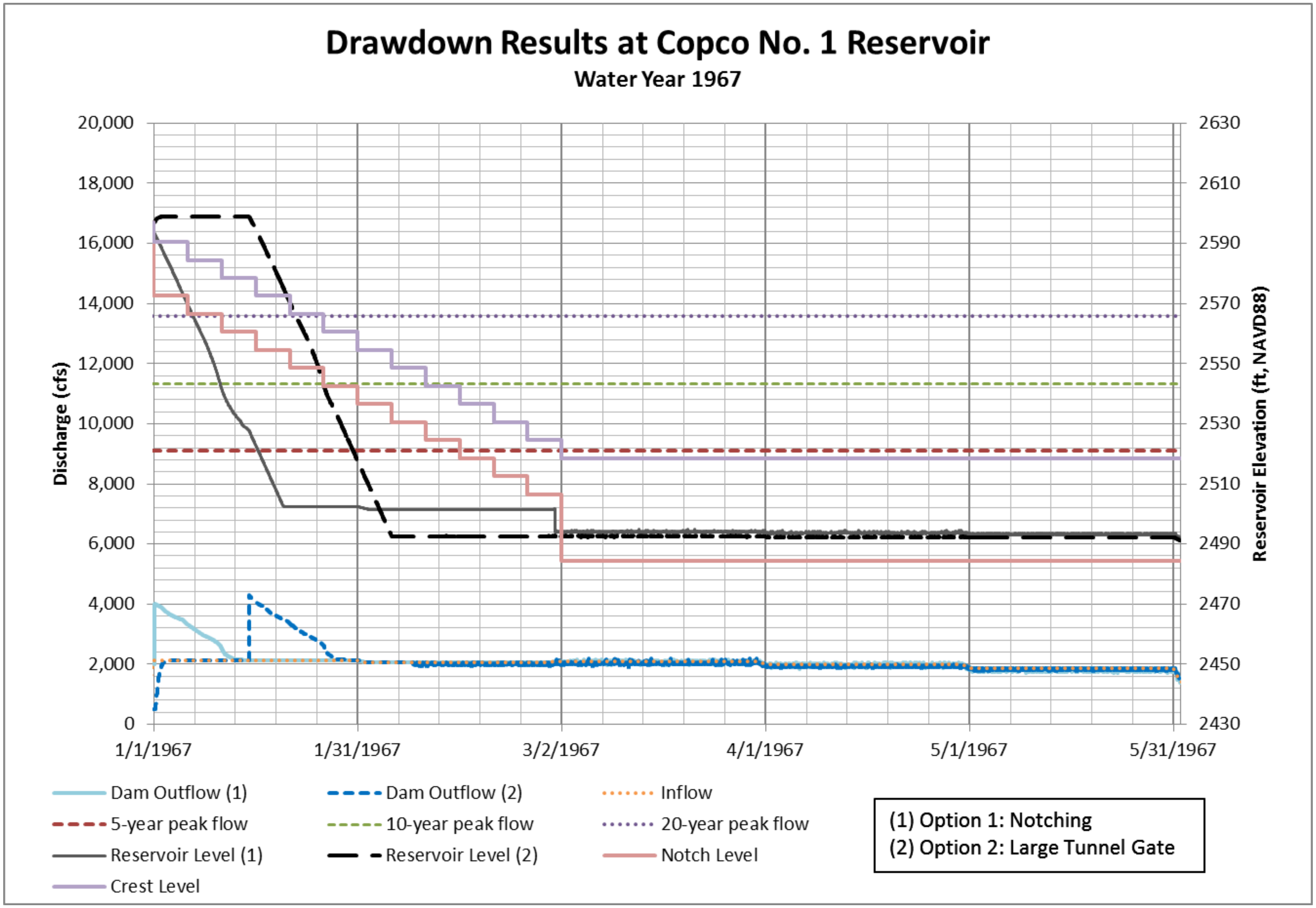

Figure 3-8 Copco No. 1 Reservoir Drawdown, Water Year 1967

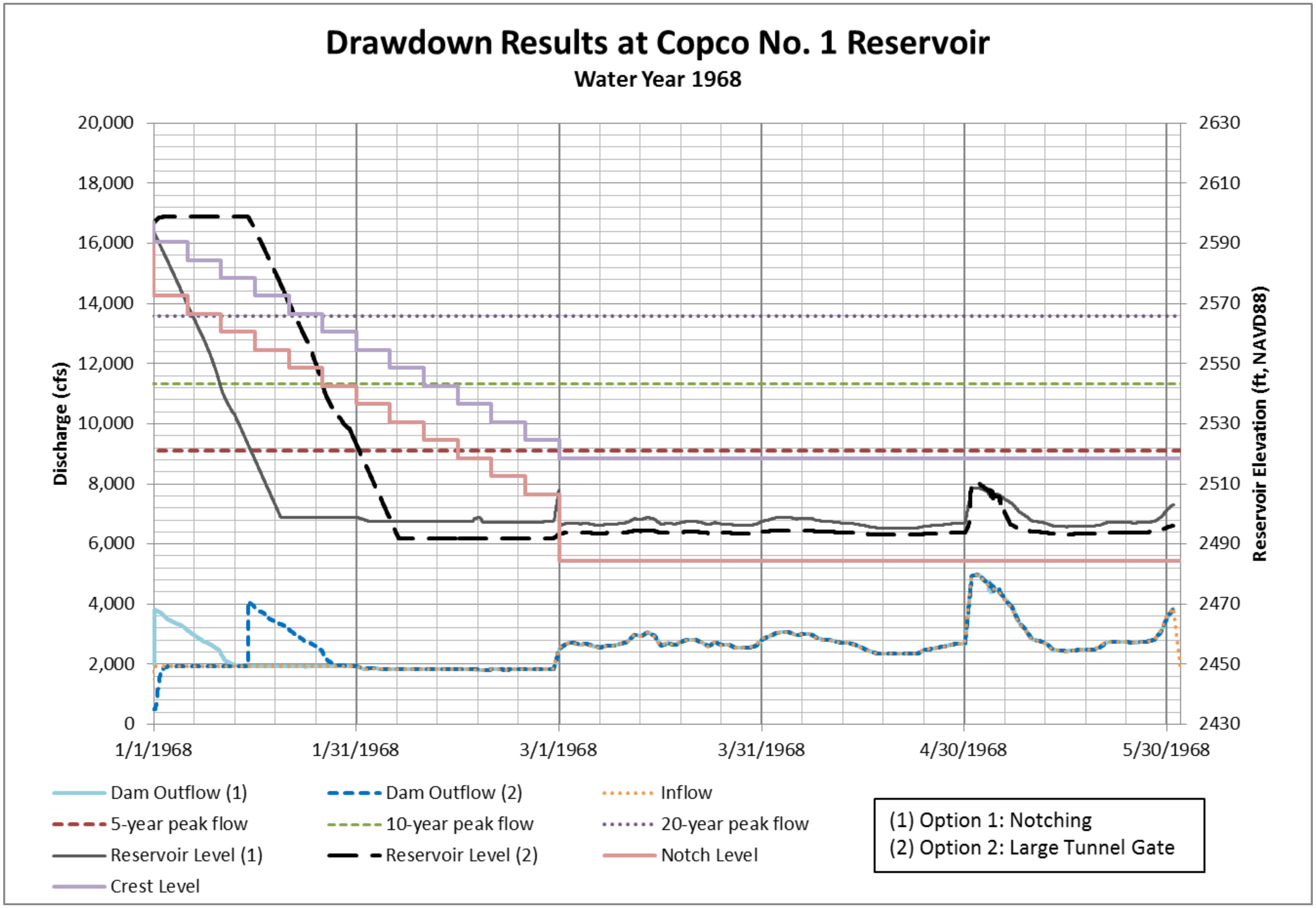

Figure 3-9 Copco No. 1 Reservoir Drawdown, Water Year 1968

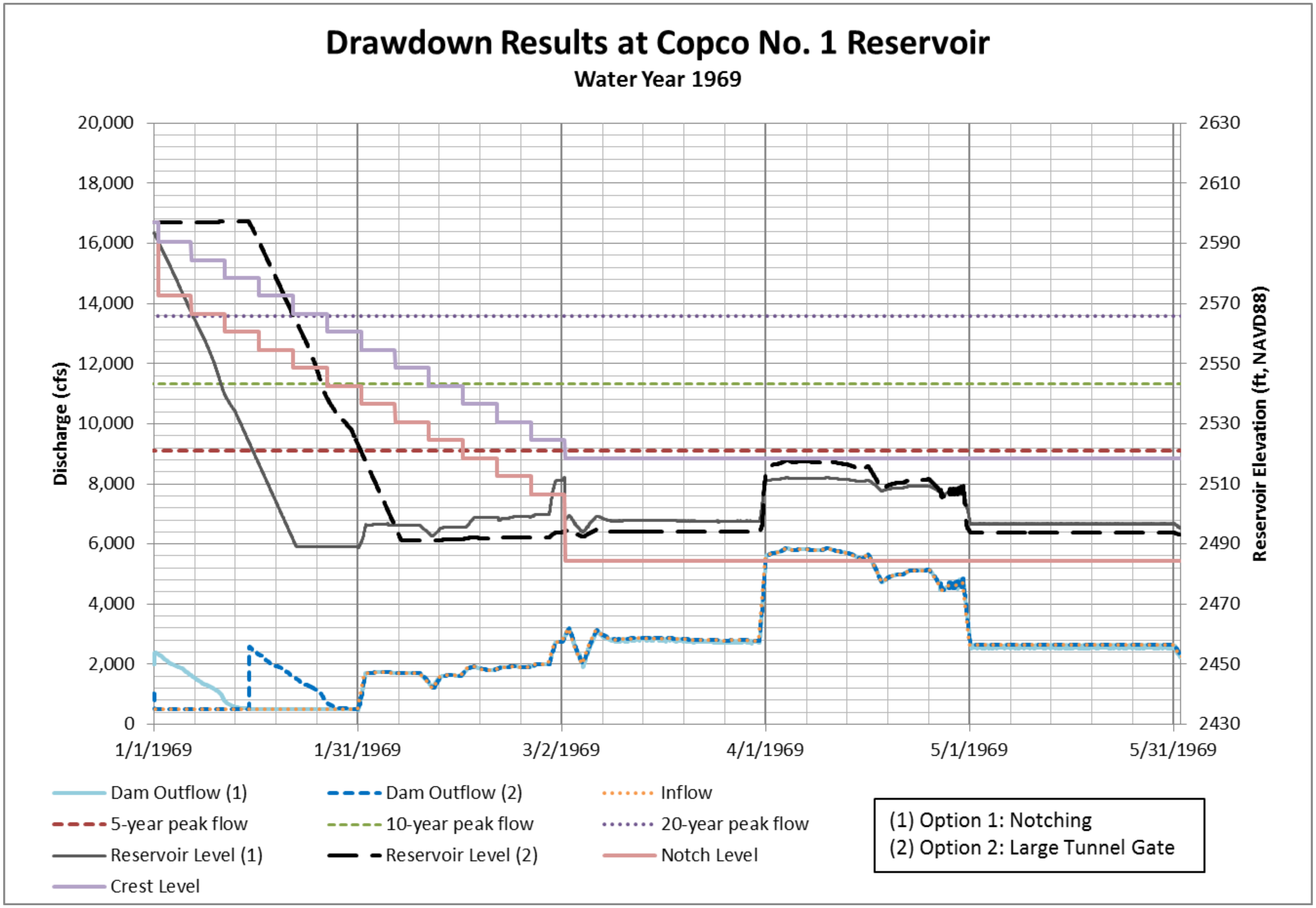

Figure 3-10 Copco No. 1 Reservoir Drawdown, Water Year 1969

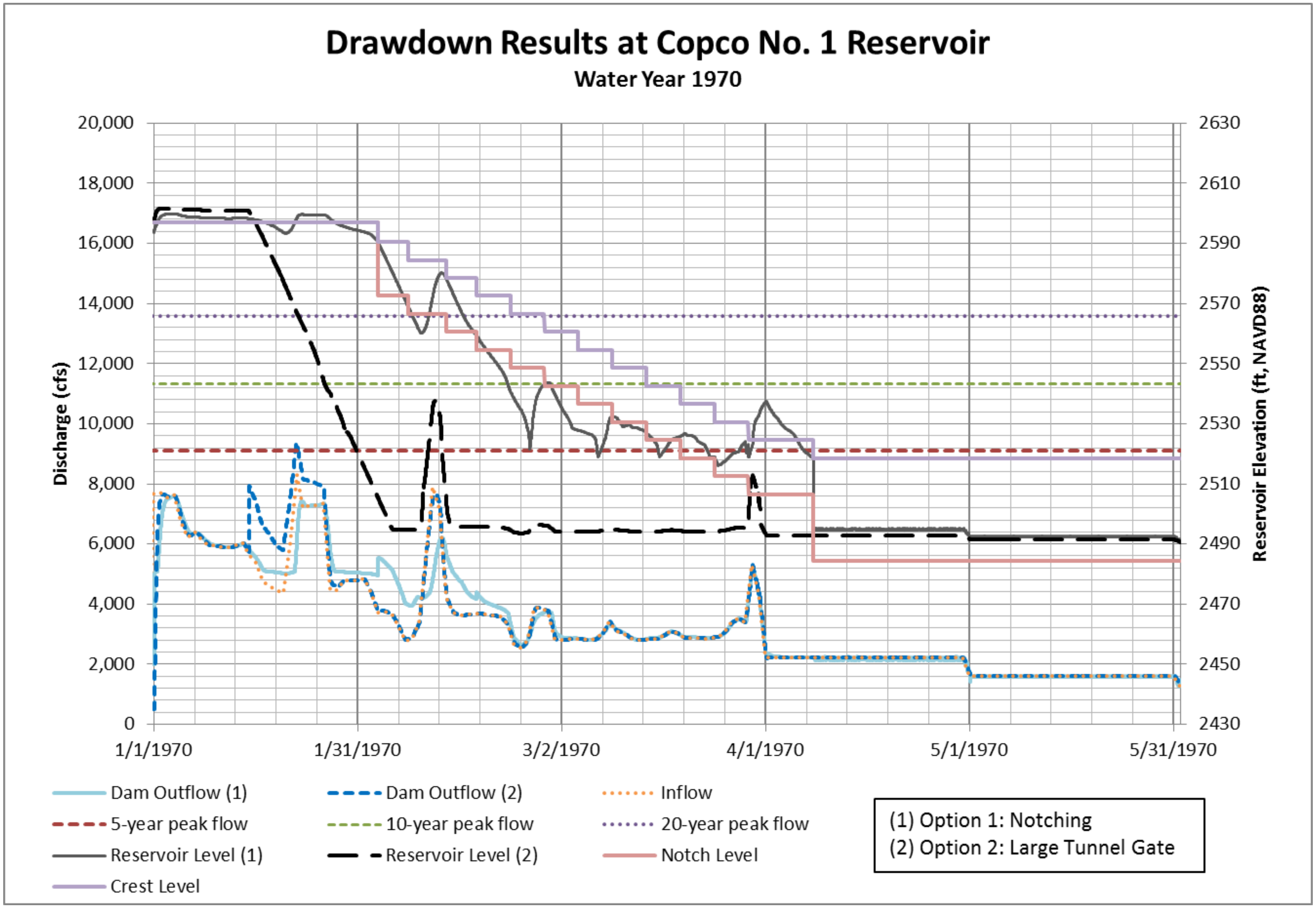

Figure 3-11 Copco No. 1 Reservoir Drawdown, Water Year 1970

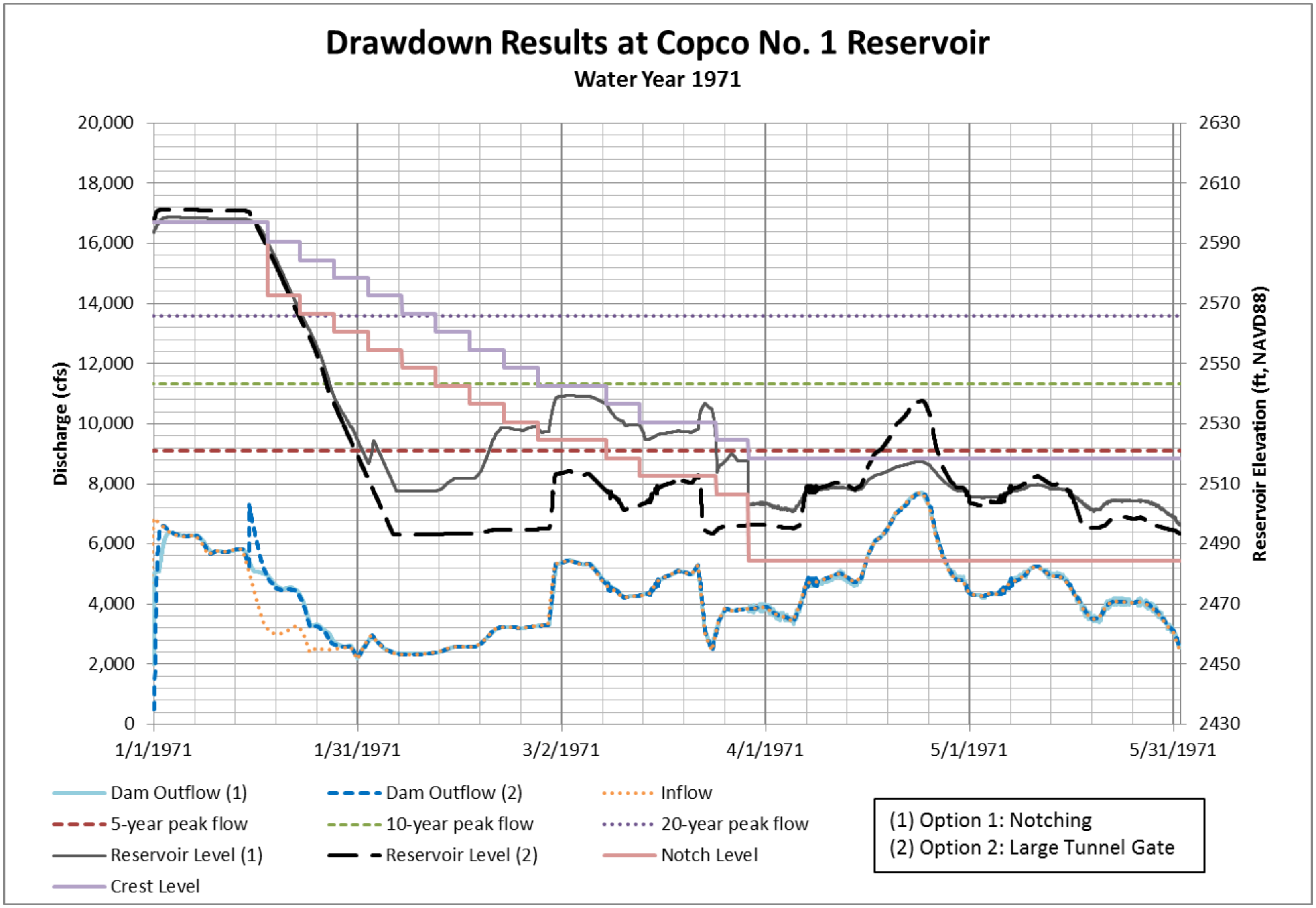

Figure 3-12 Copco No. 1 Reservoir Drawdown, Water Year 1971

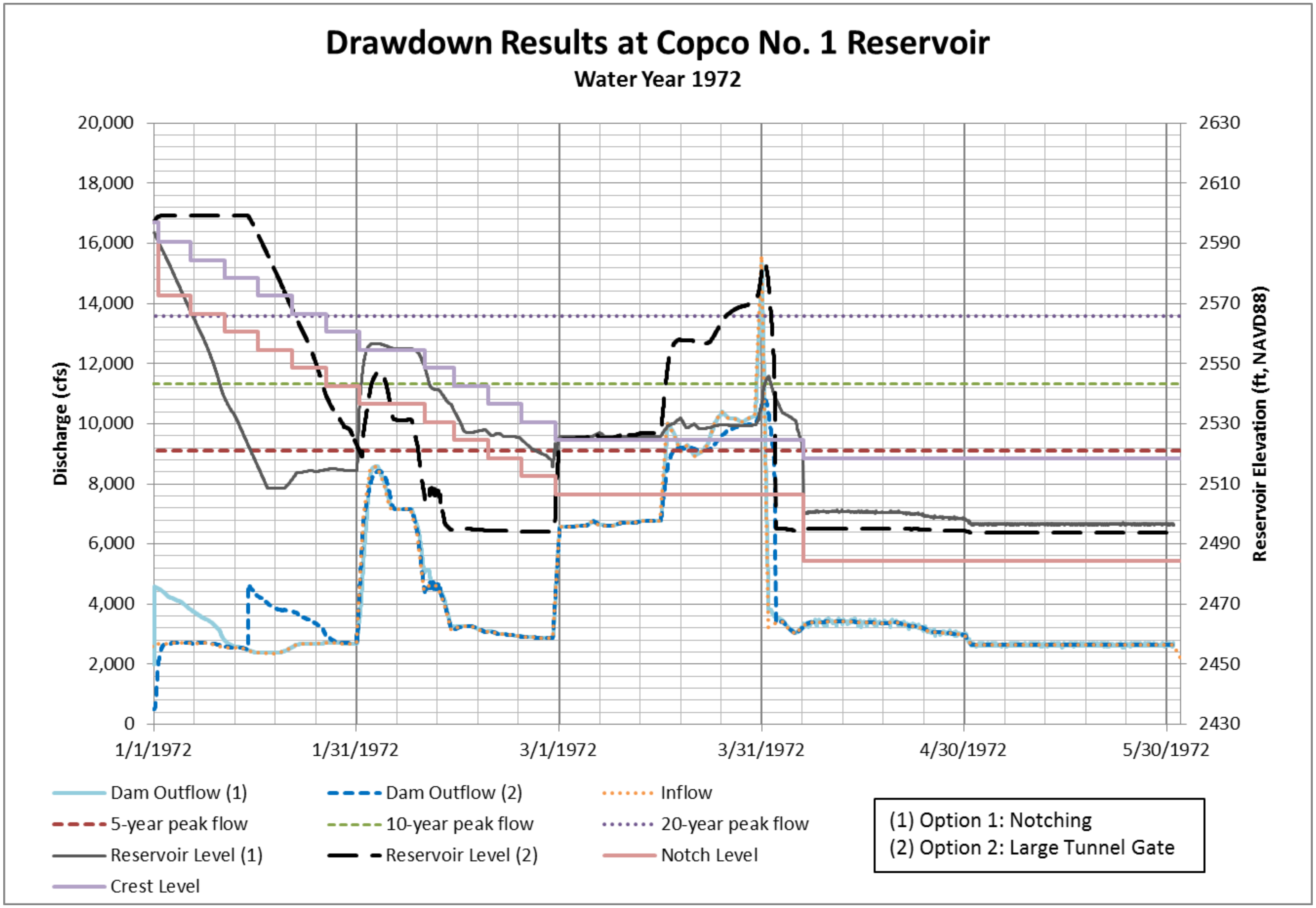

Figure 3-13 Copco No. 1 Reservoir Drawdown, Water Year 1972

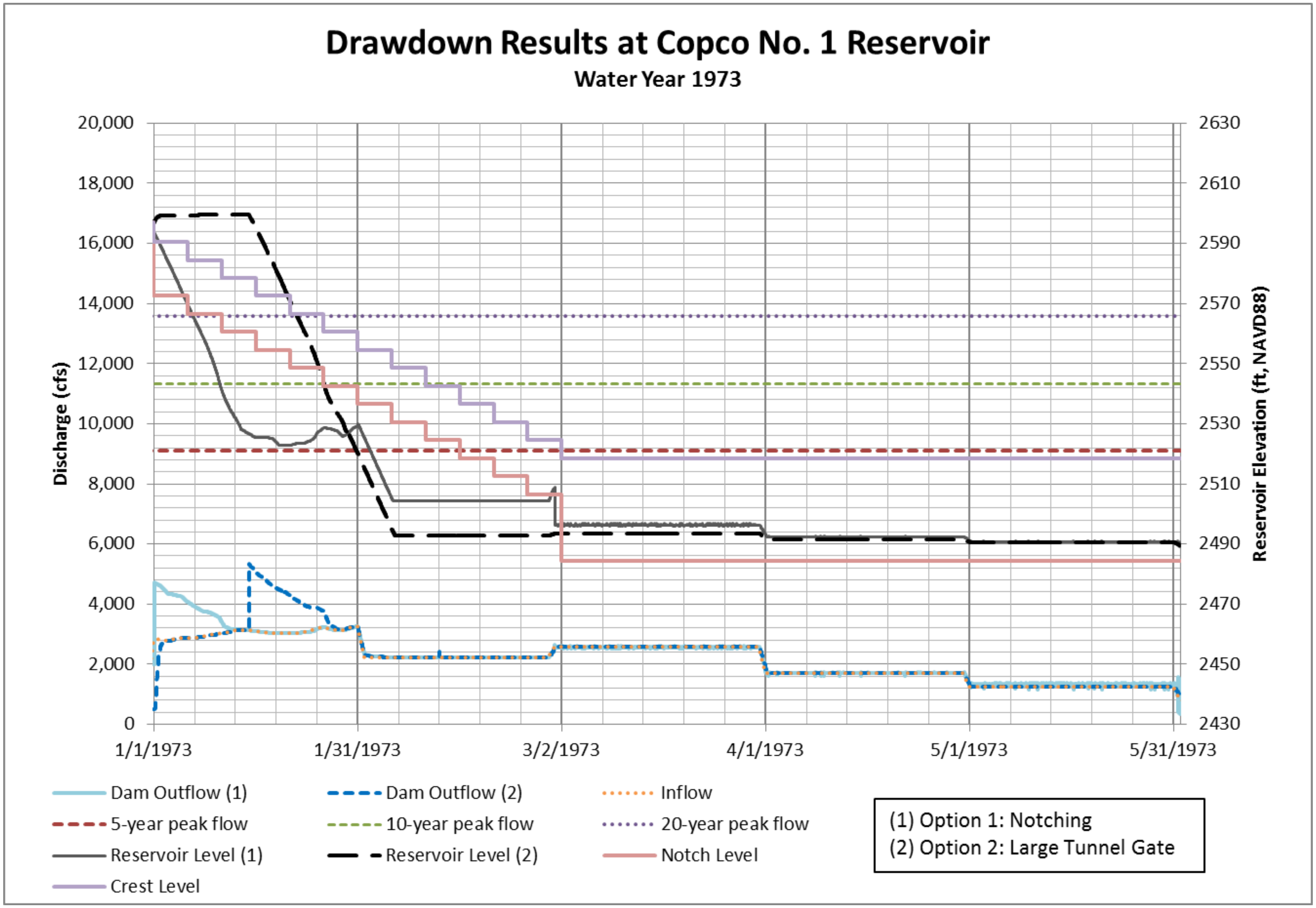

Figure 3-14 Copco No. 1 Reservoir Drawdown, Water Year 1973

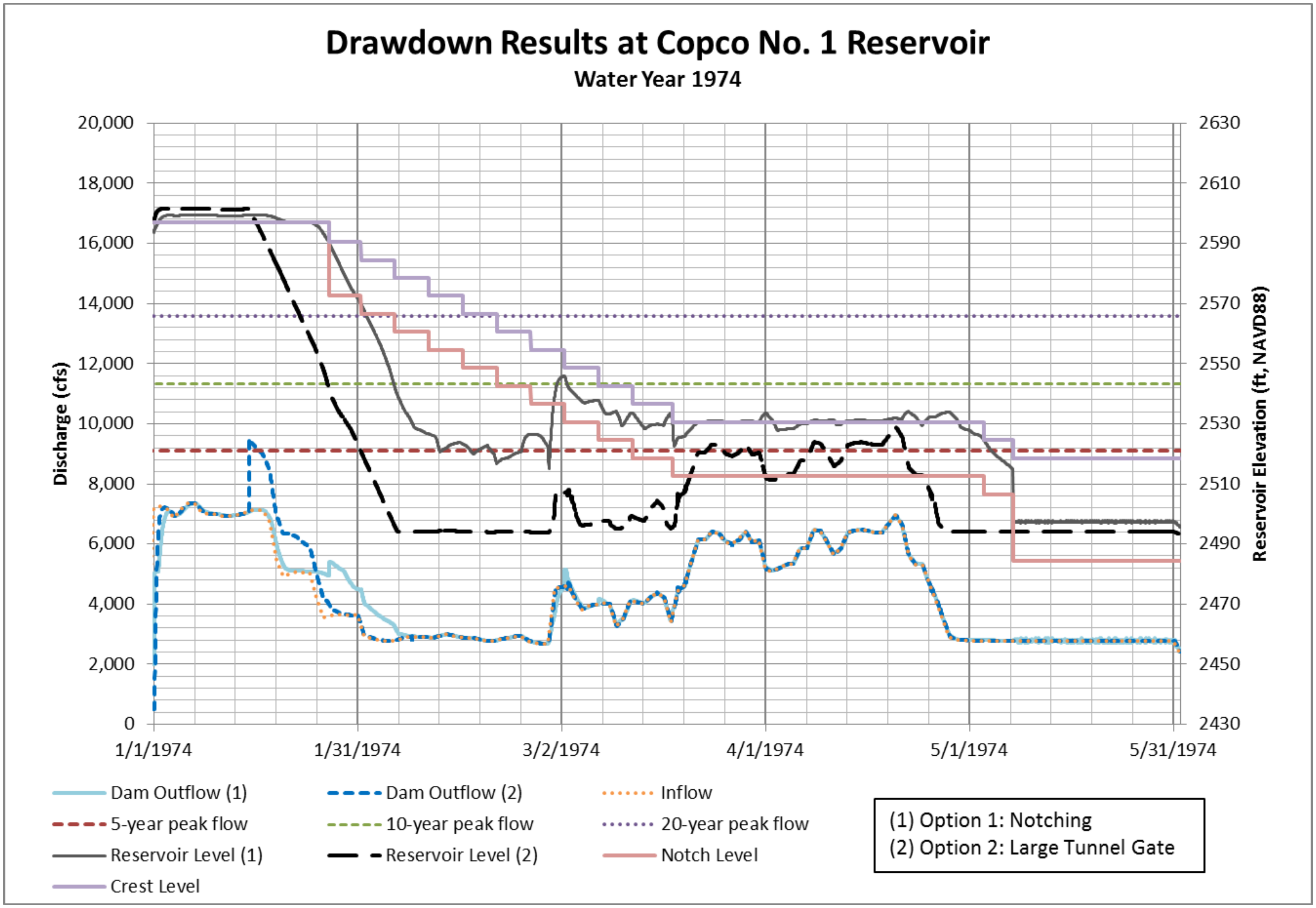

Figure 3-15 Copco No. 1 Reservoir Drawdown, Water Year 1974

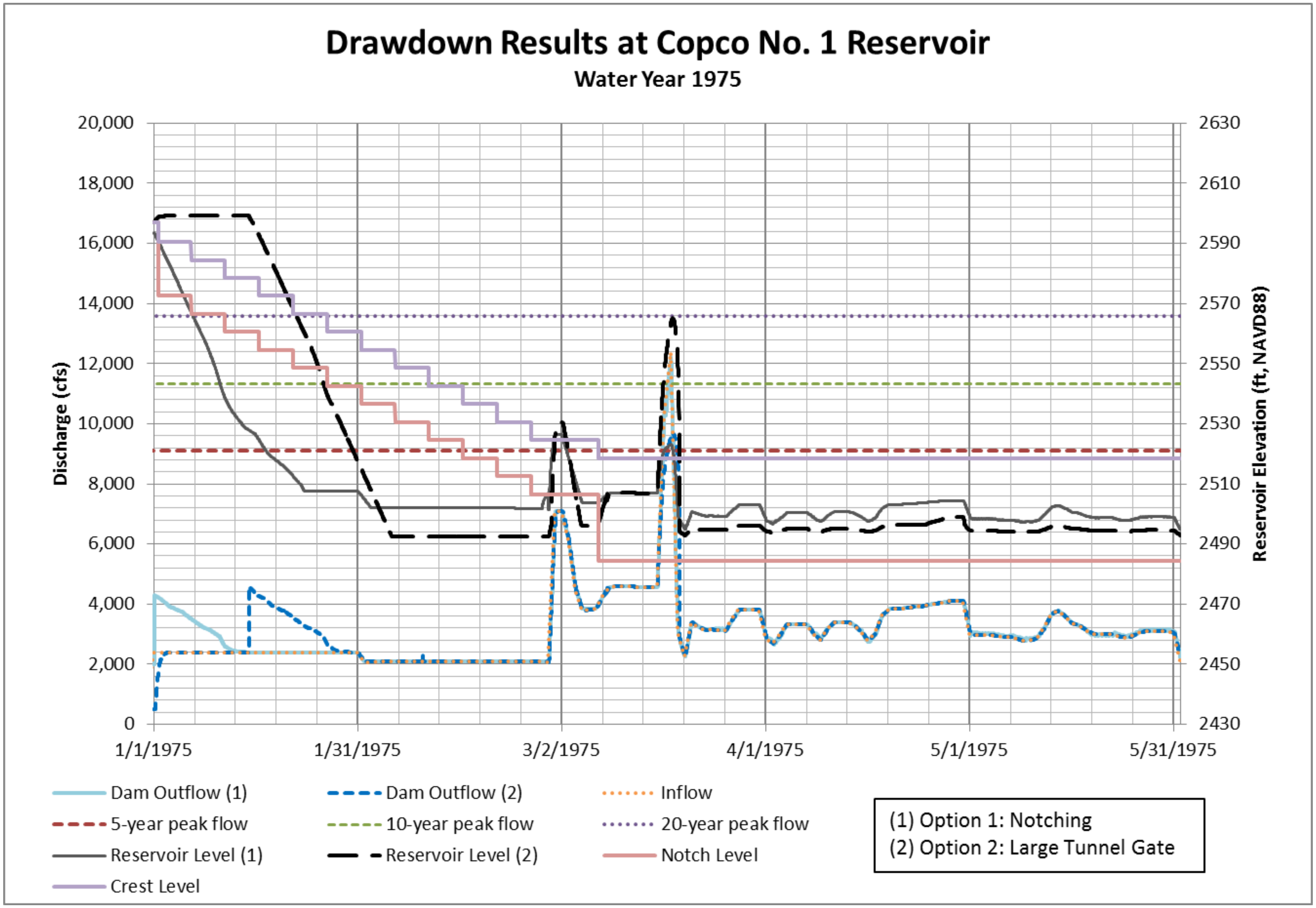

Figure 3-16 Copco No. 1 Reservoir Drawdown, Water Year 1975

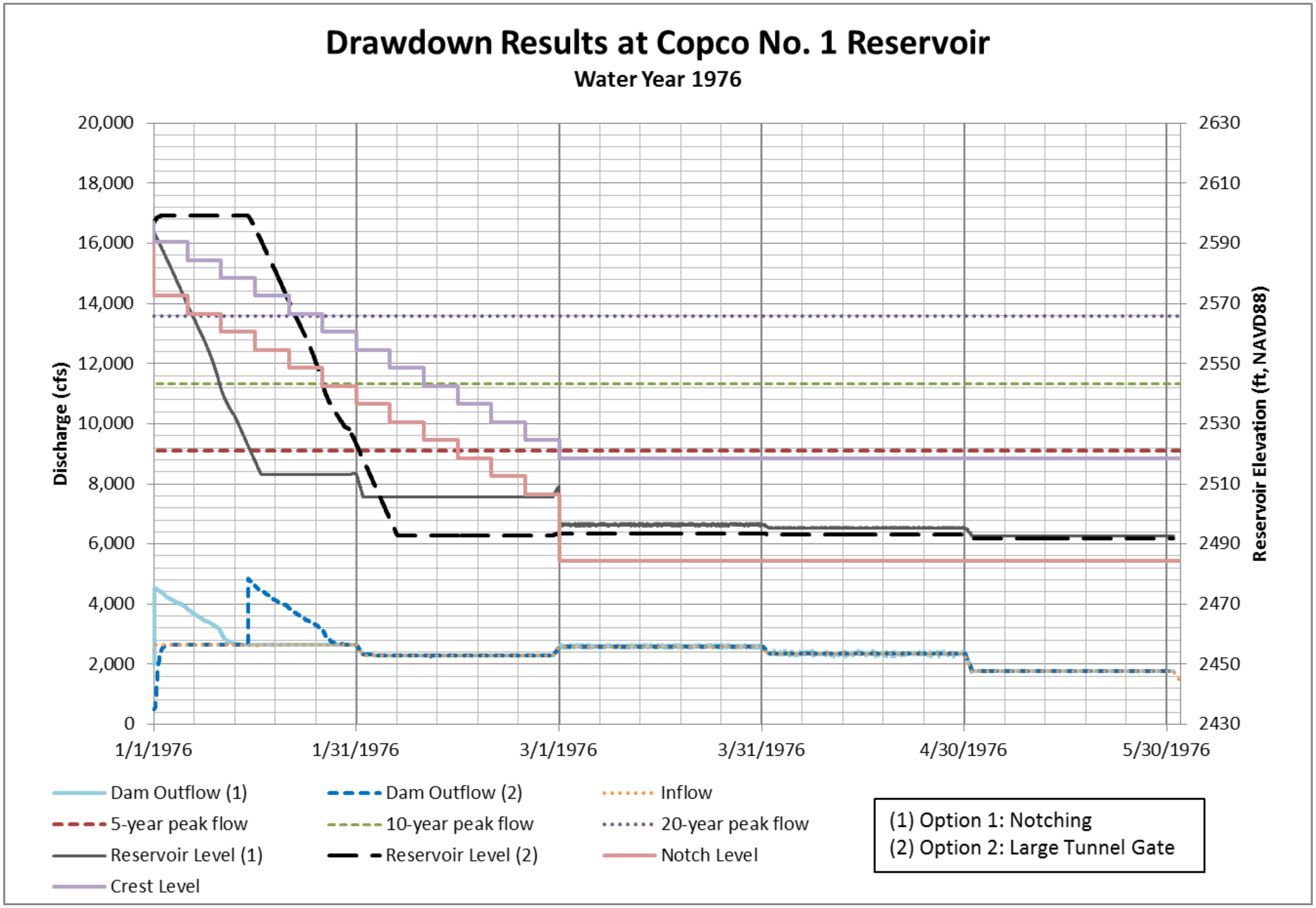

Figure 3-17 Copco No. 1 Reservoir Drawdown, Water Year 1976

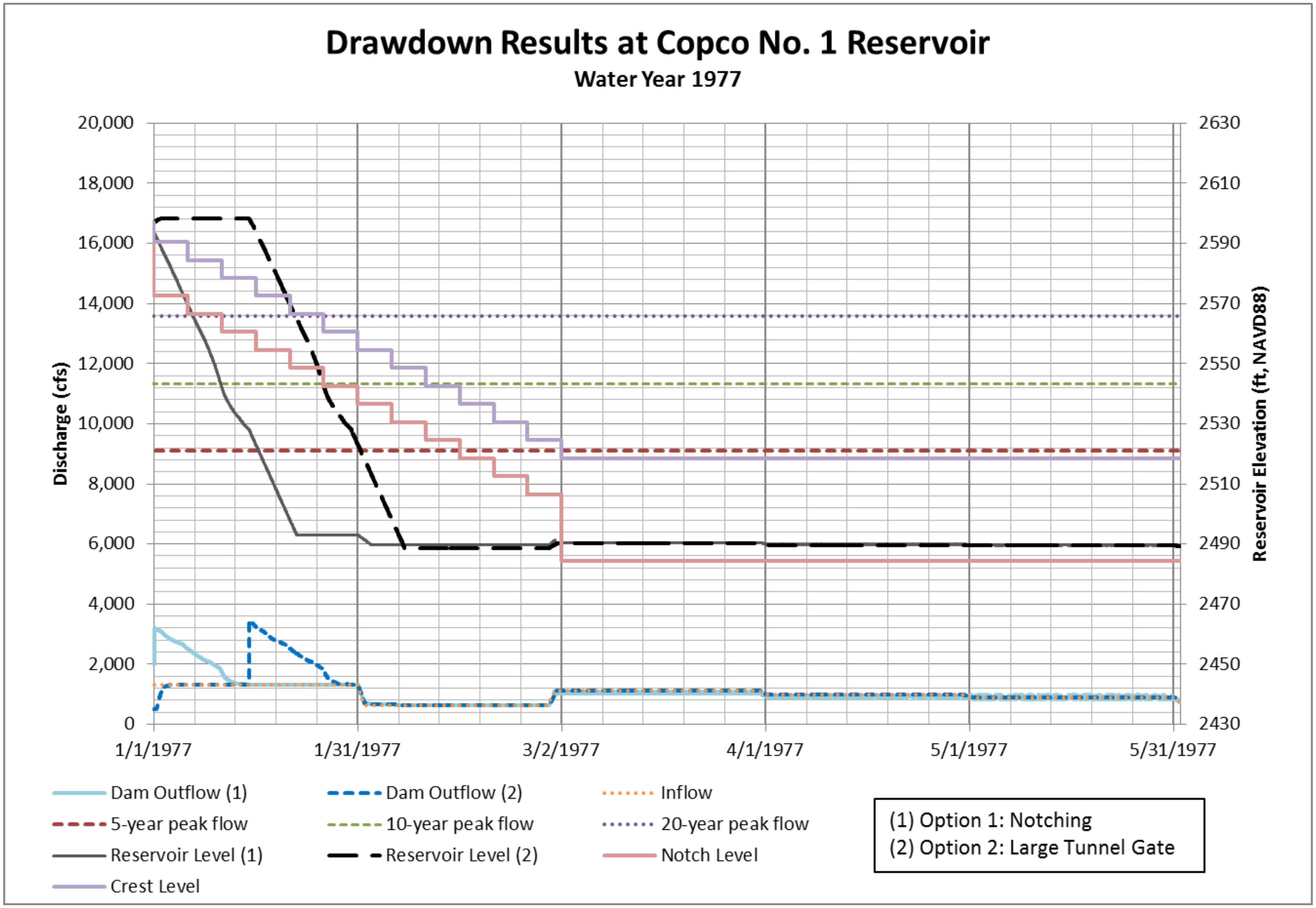

Figure 3-18 Copco No. 1 Reservoir Drawdown, Water Year 1977

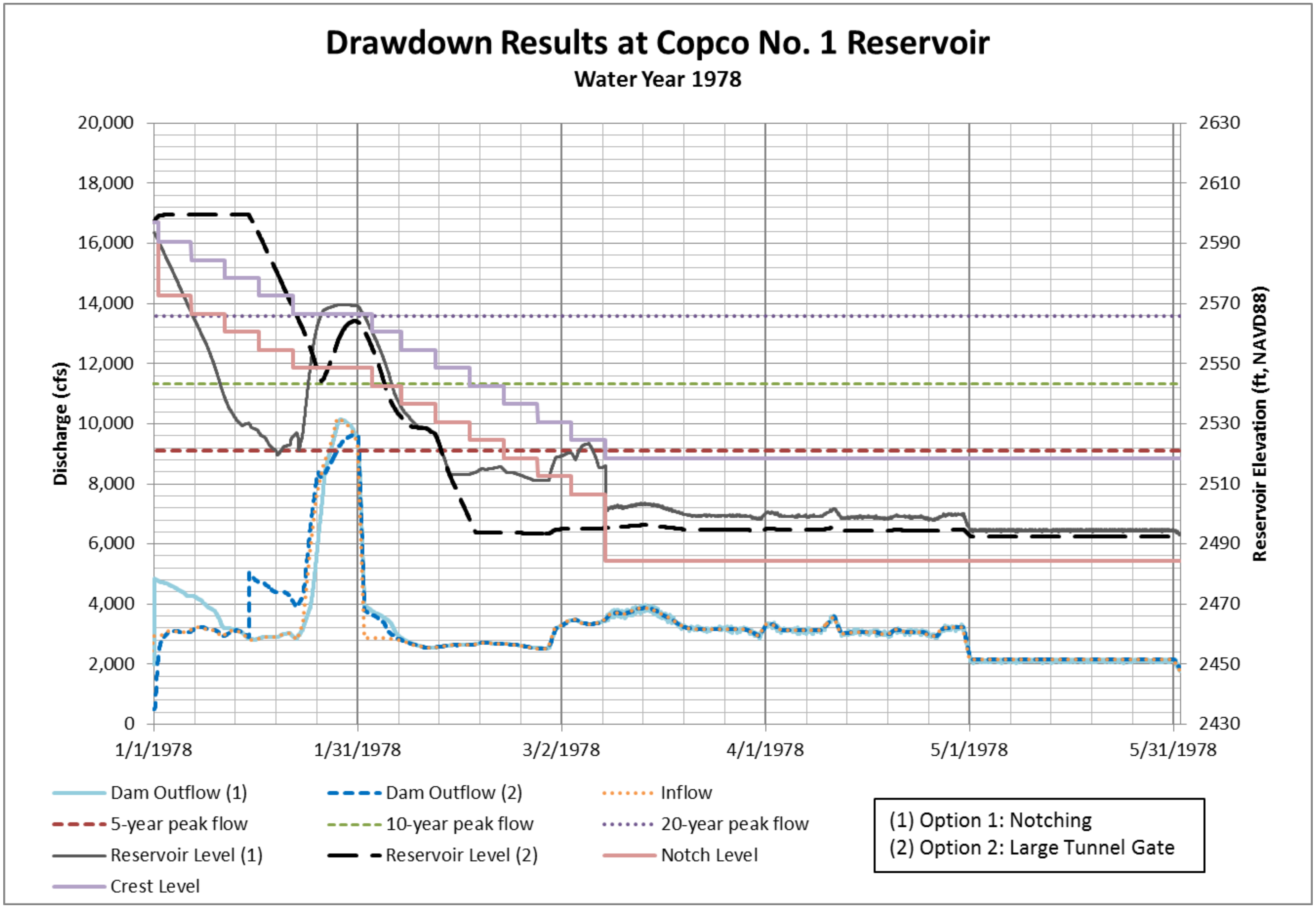

Figure 3-19 Copco No. 1 Reservoir Drawdown, Water Year 1978

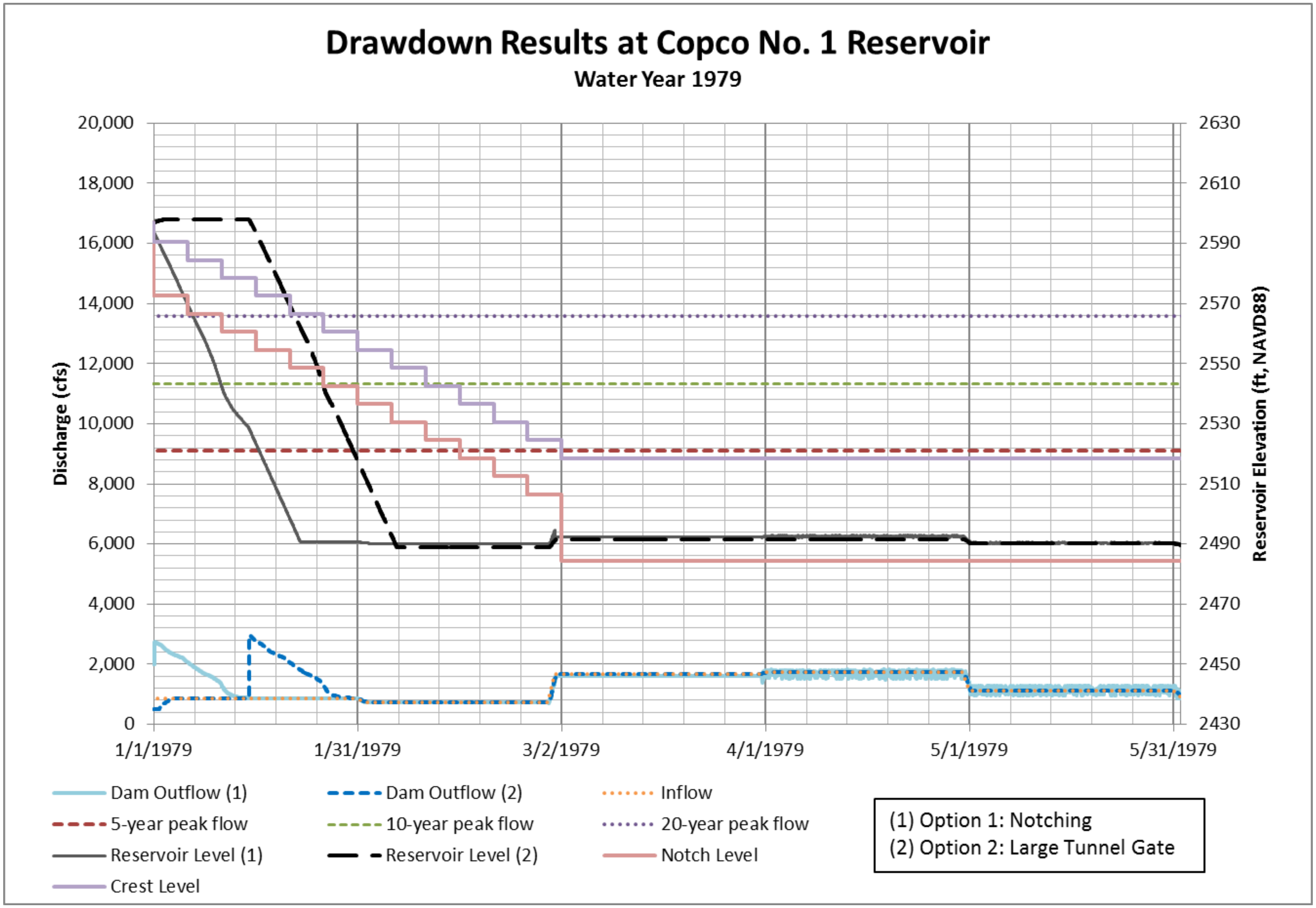

Figure 3-20 Copco No. 1 Reservoir Drawdown, Water Year 1979

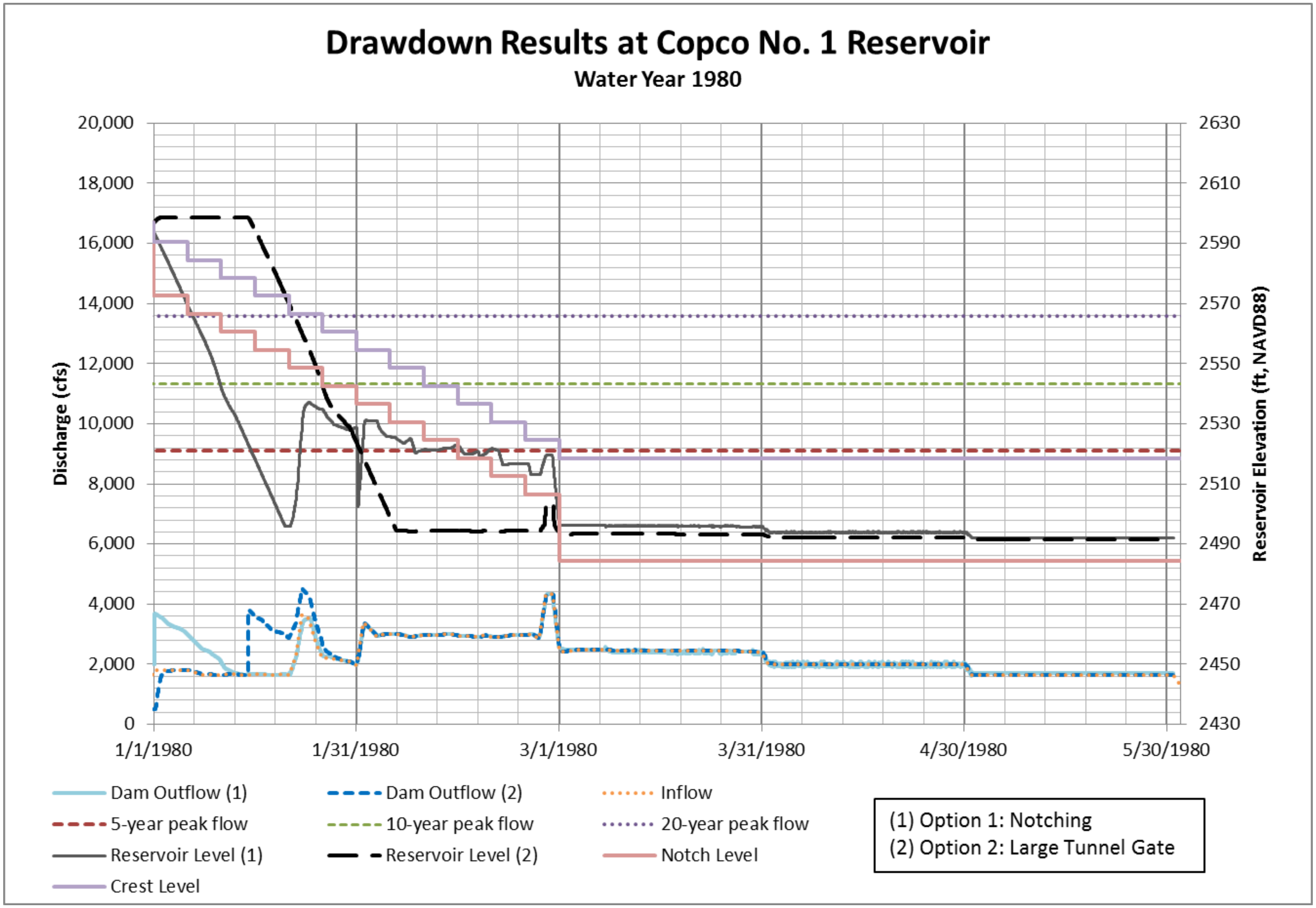

Figure 3-21 Copco No. 1 Reservoir Drawdown, Water Year 1980

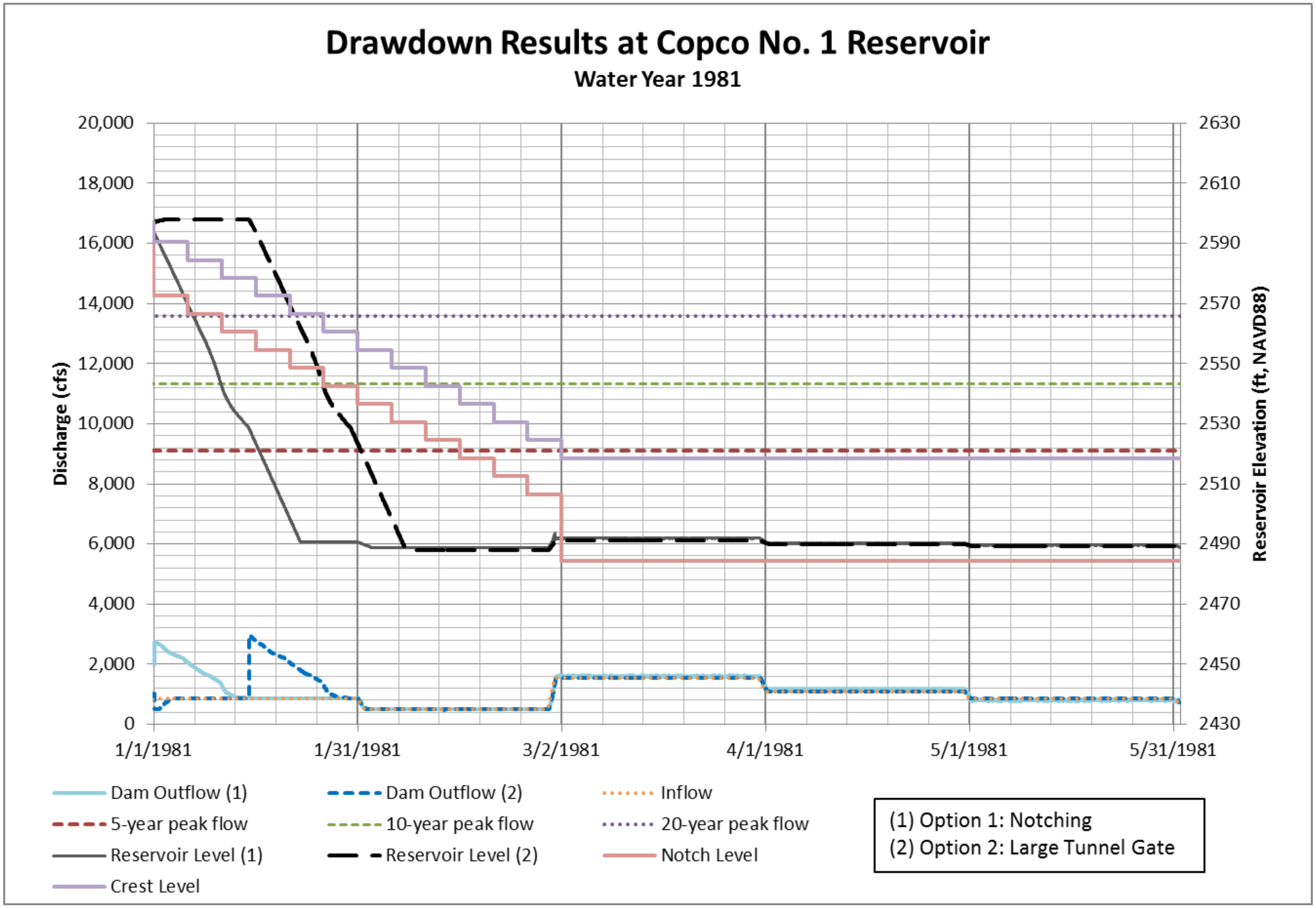

Figure 3-22 Copco No. 1 Reservoir Drawdown, Water Year 1981

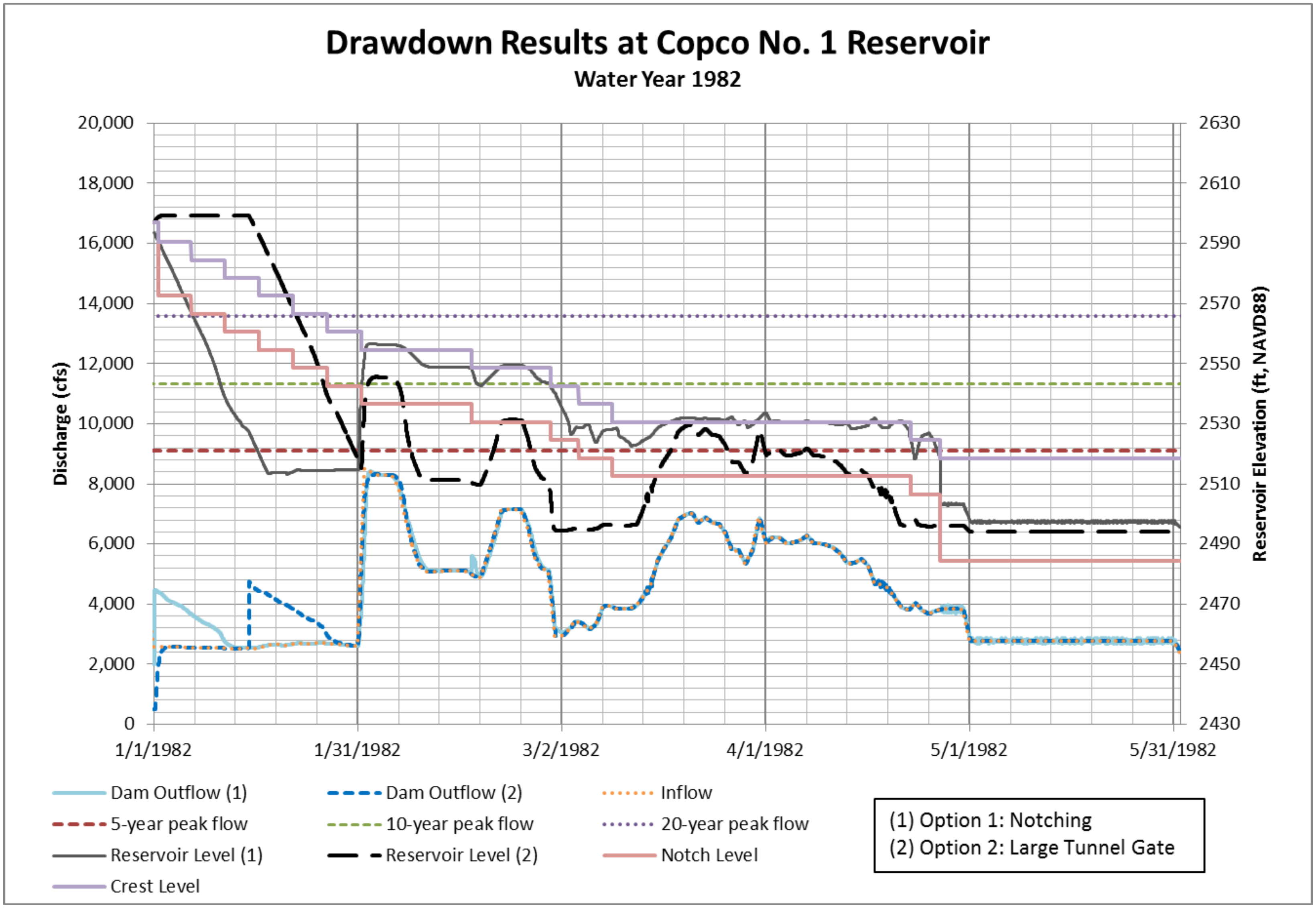

Figure 3-23 Copco No. 1 Reservoir Drawdown, Water Year 1982

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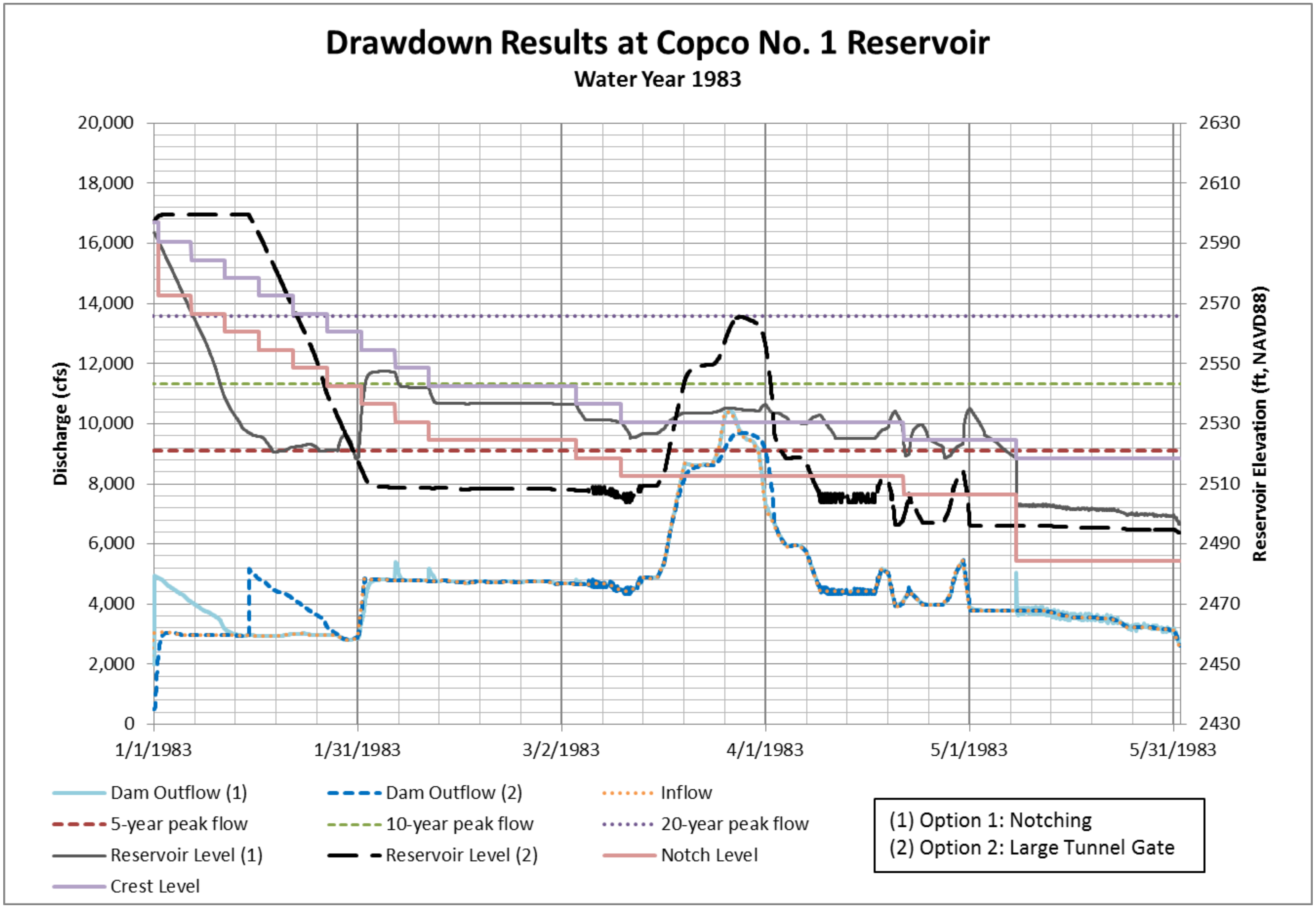

Figure 3-24 Copco No. 1 Reservoir Drawdown, Water Year 1983

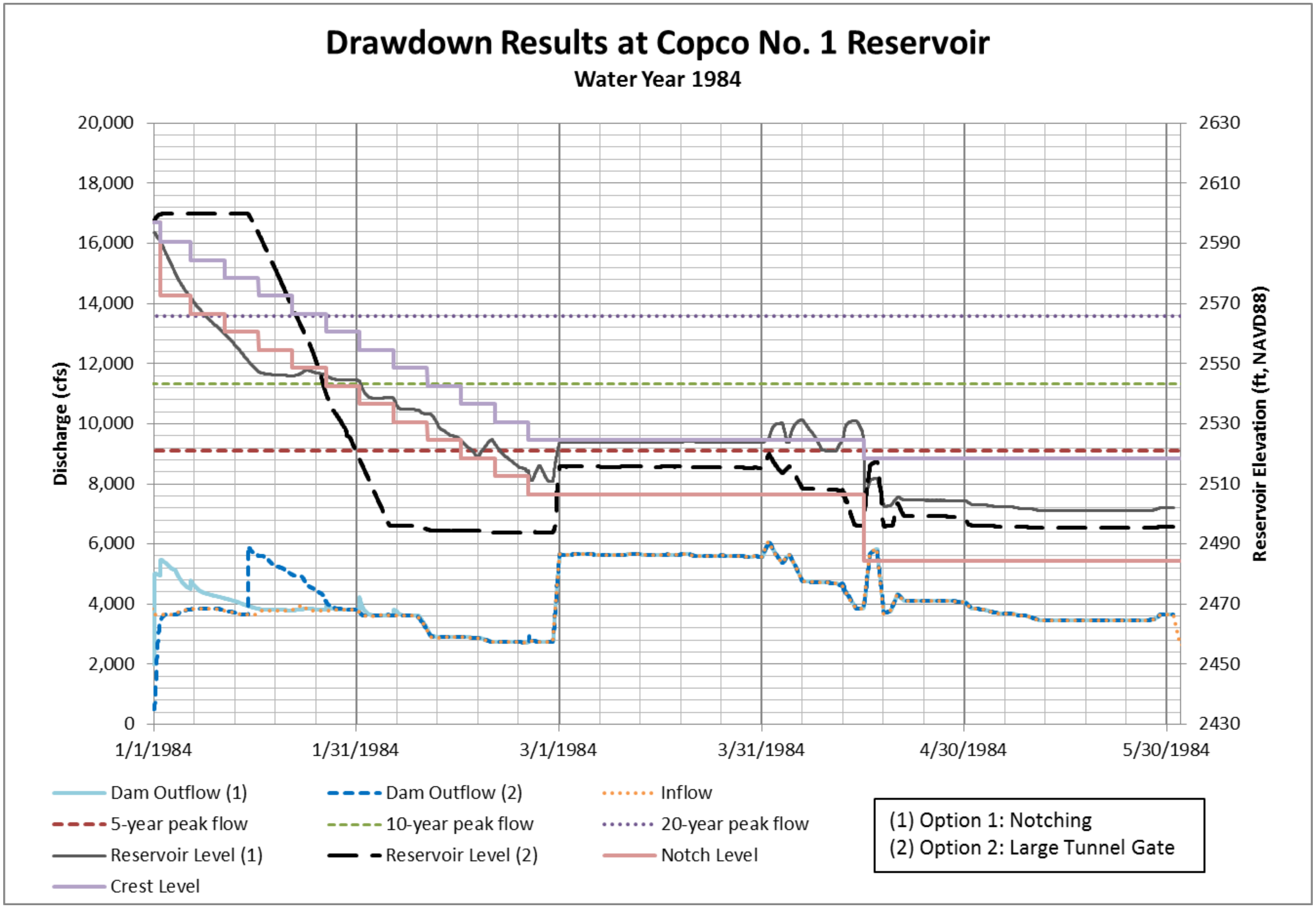

Figure 3-25 Copco No. 1 Reservoir Drawdown, Water Year 1984

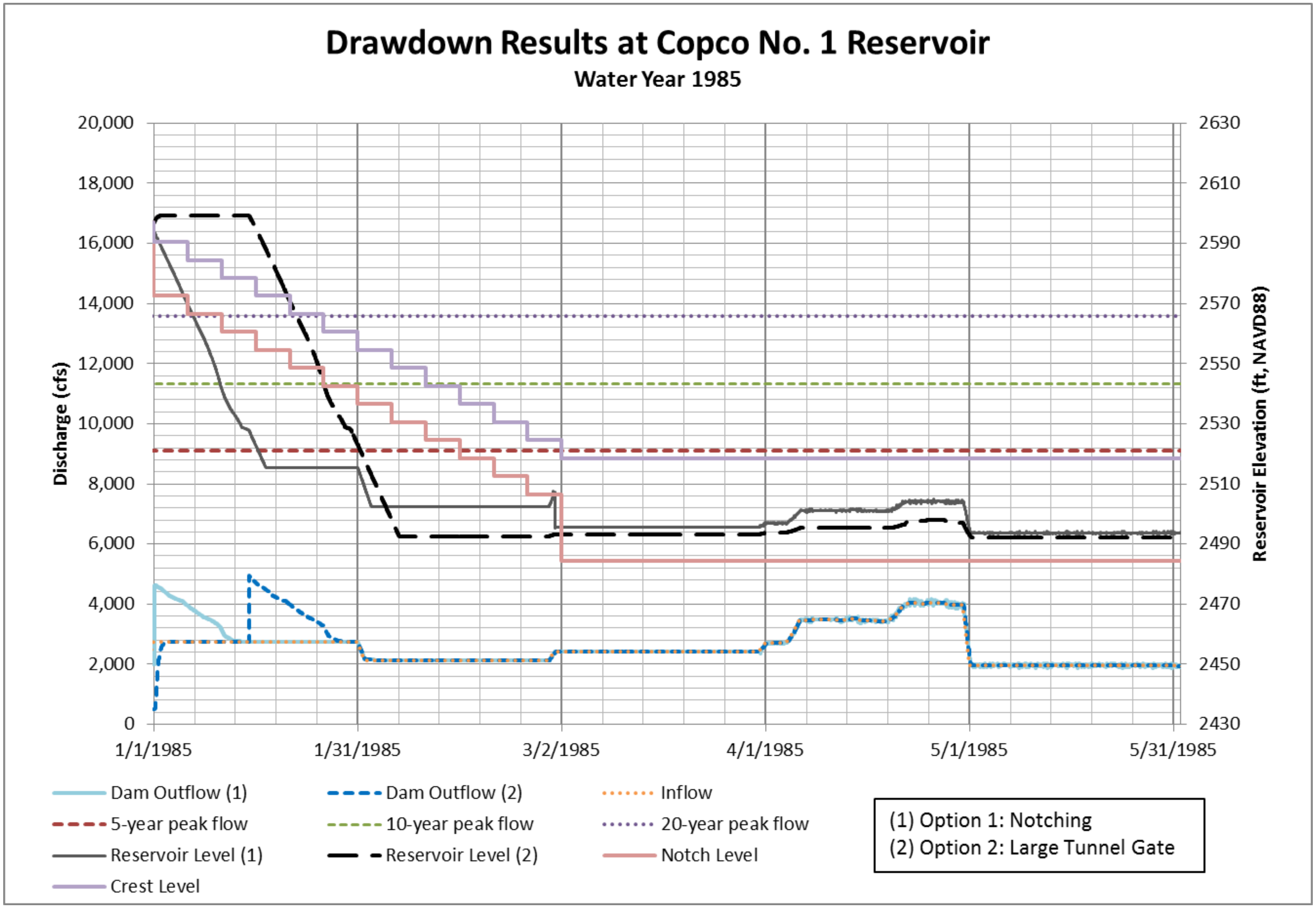

Figure 3-26 Copco No. 1 Reservoir Drawdown, Water Year 1985

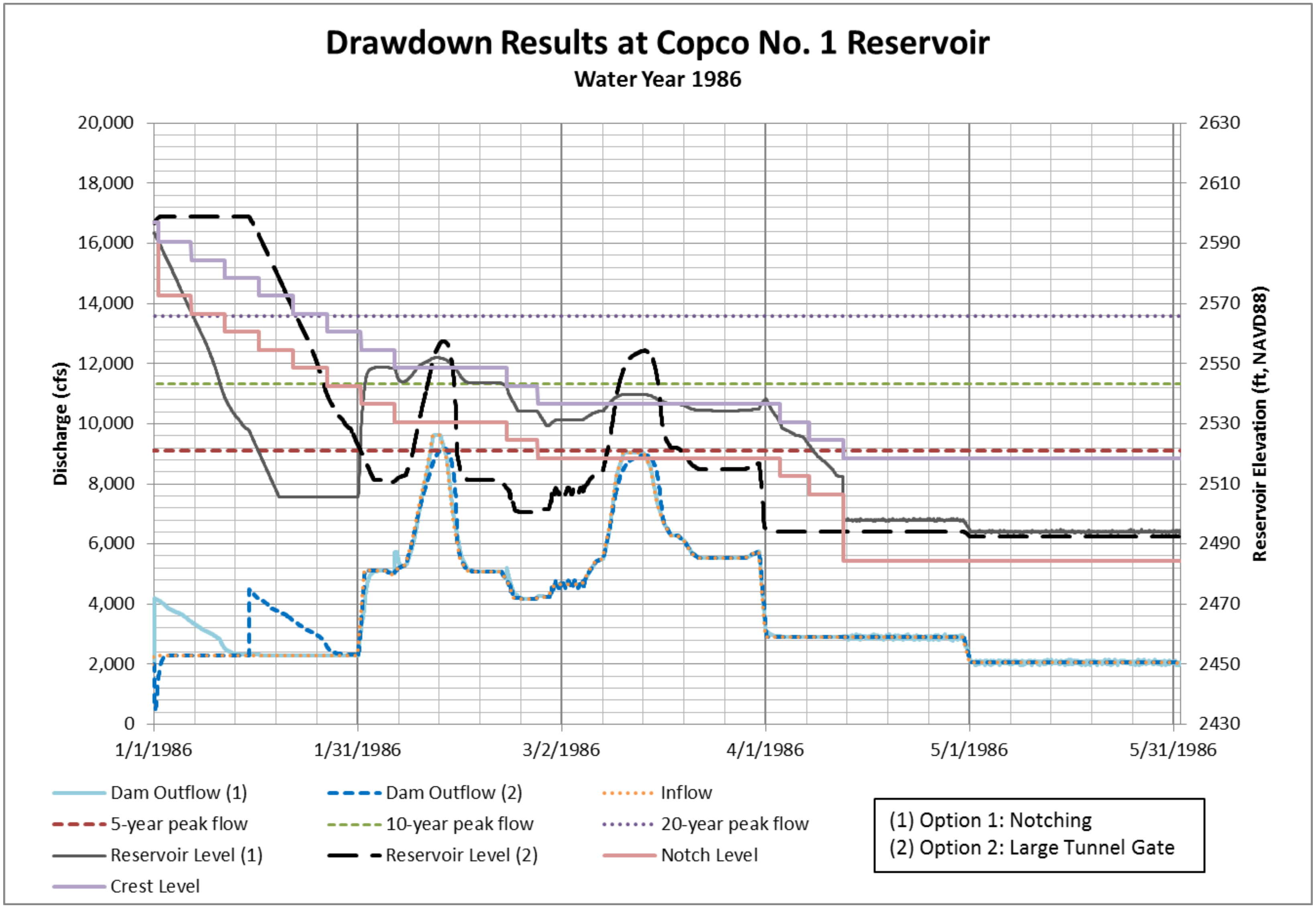

Figure 3-27 Copco No. 1 Reservoir Drawdown, Water Year 1986

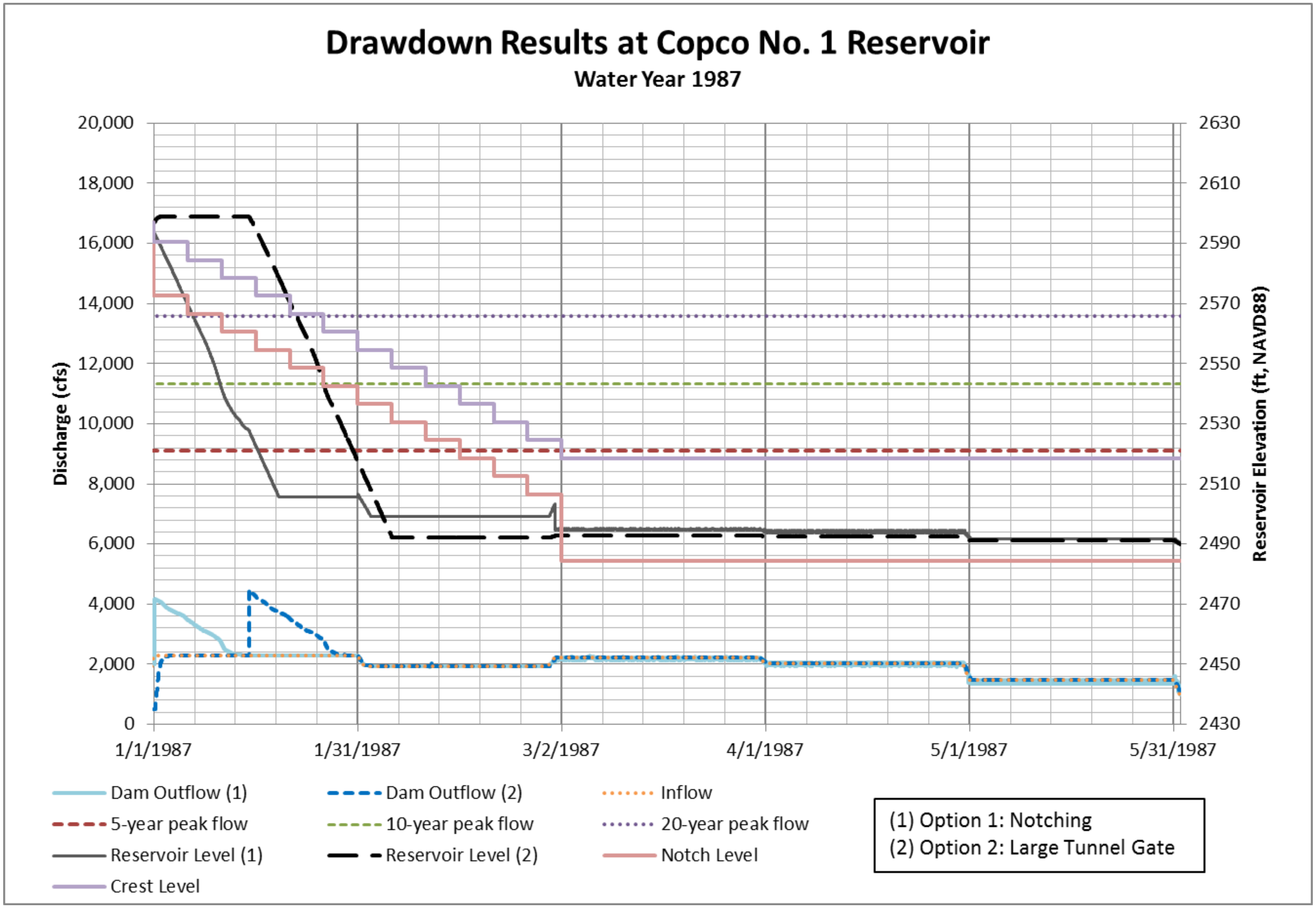

Figure 3-28 Copco No. 1 Reservoir Drawdown, Water Year 1987

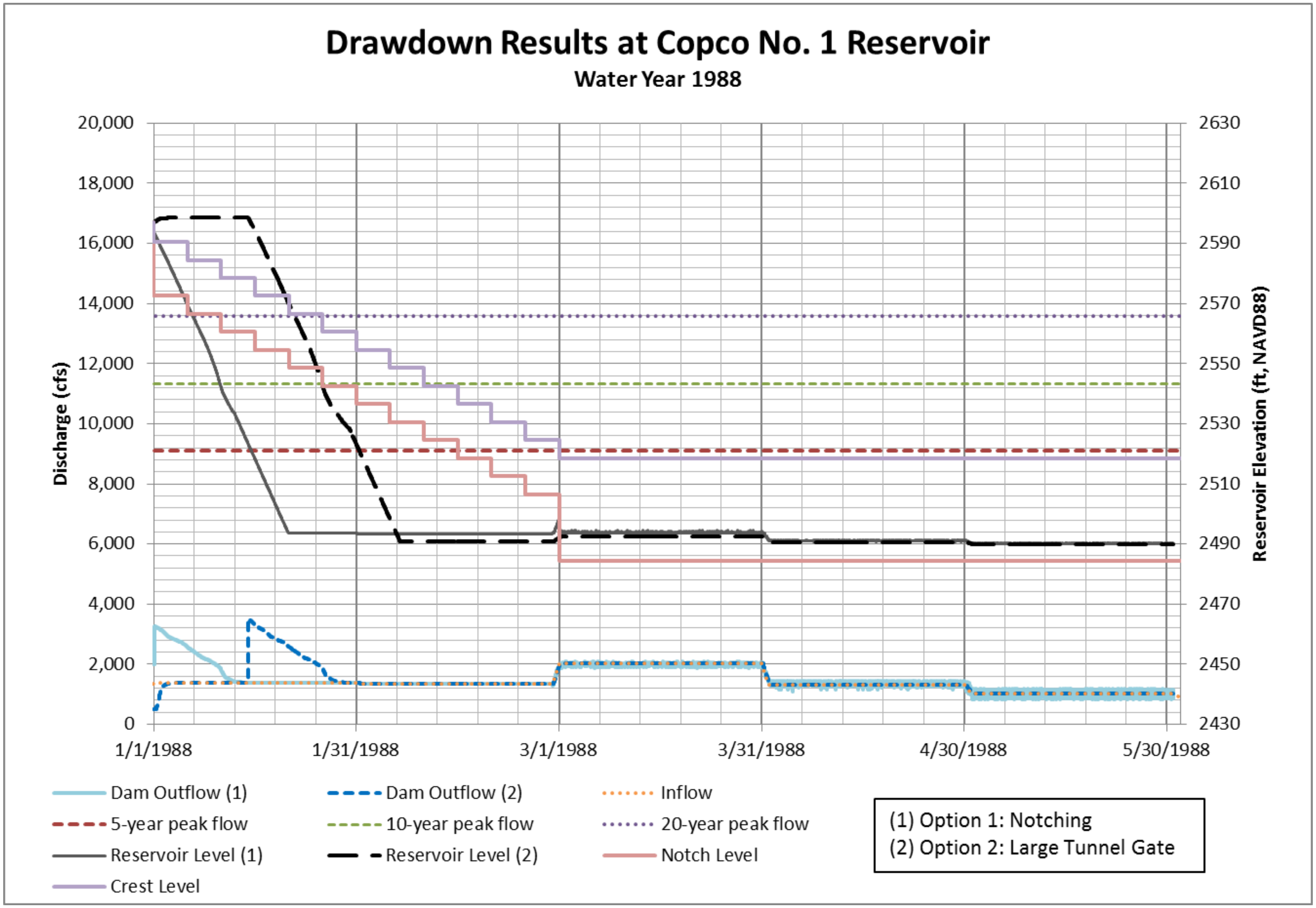

Figure 3-29 Copco No. 1 Reservoir Drawdown, Water Year 1988

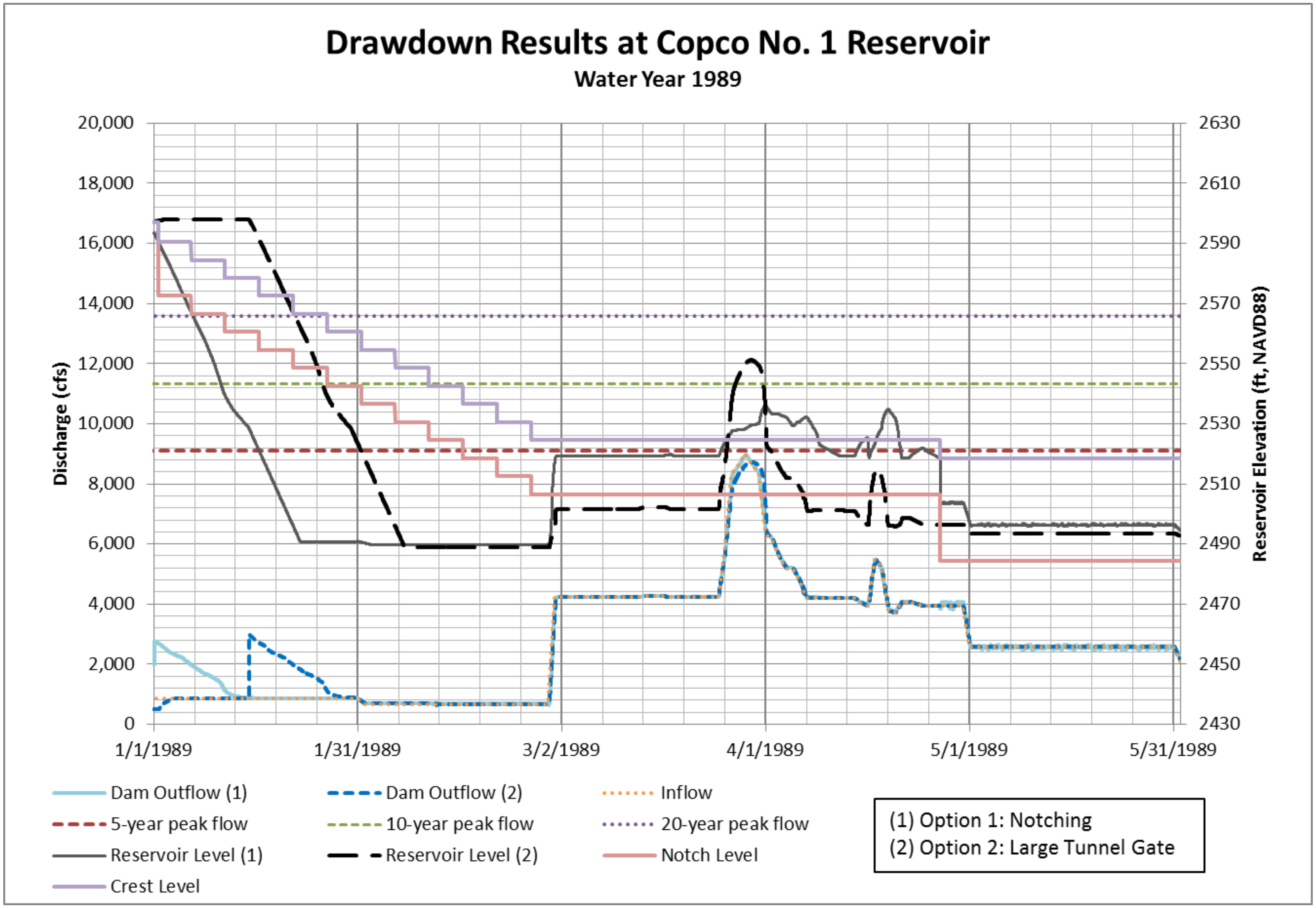

Figure 3-30 Copco No. 1 Reservoir Drawdown, Water Year 1989

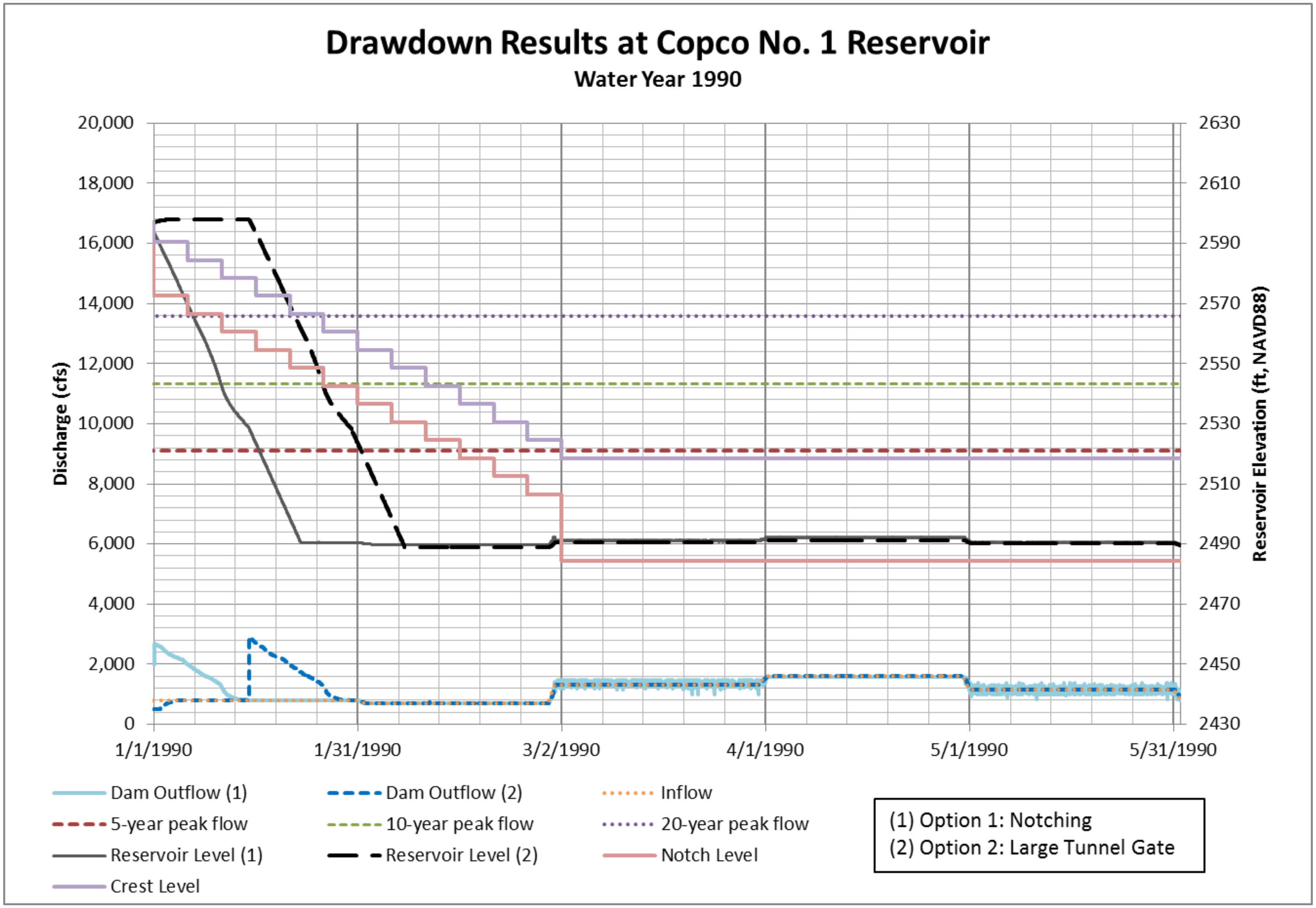

Figure 3-31 Copco No. 1 Reservoir Drawdown, Water Year 1990

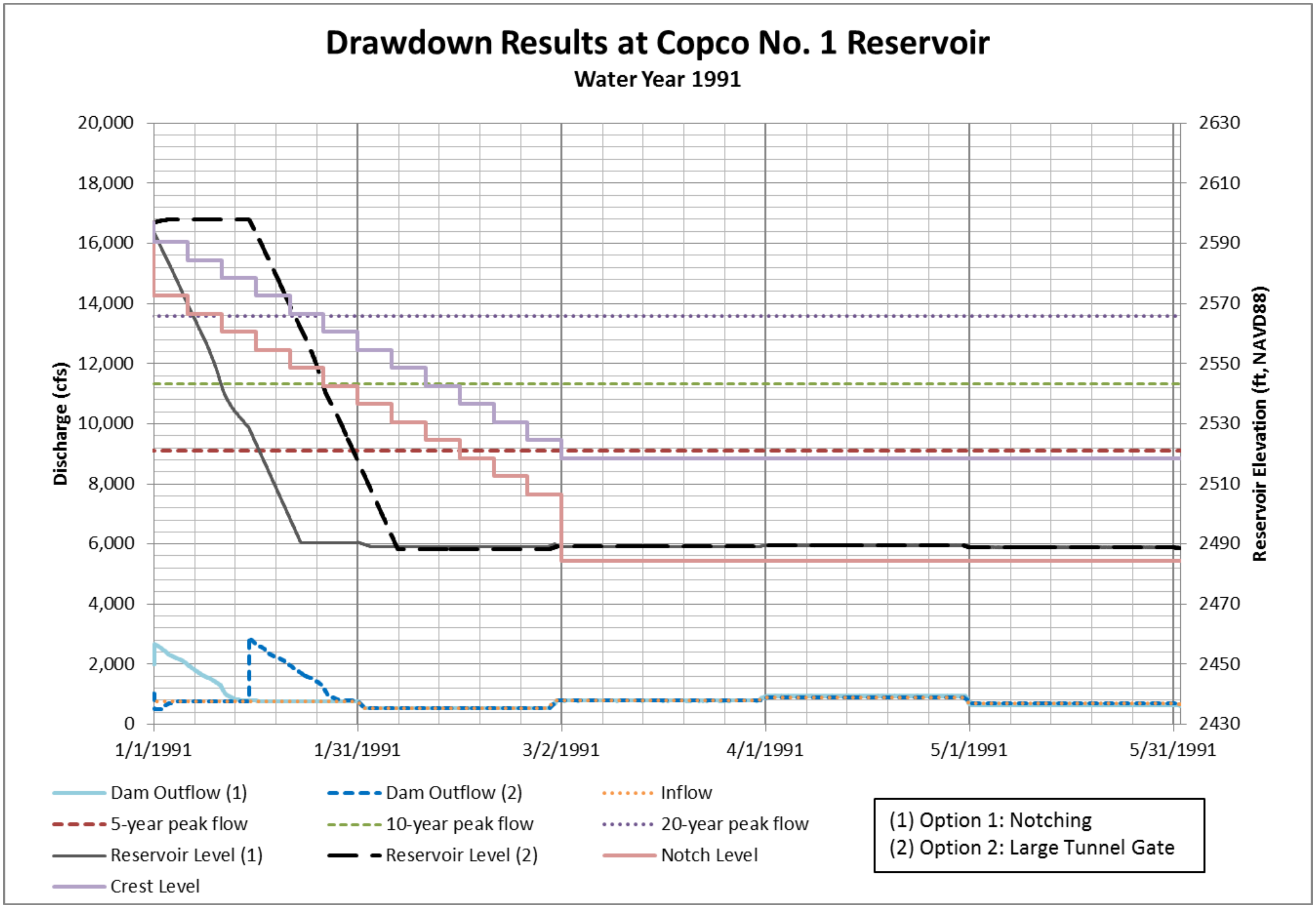

Figure 3-32 Copco No. 1 Reservoir Drawdown, Water Year 1991

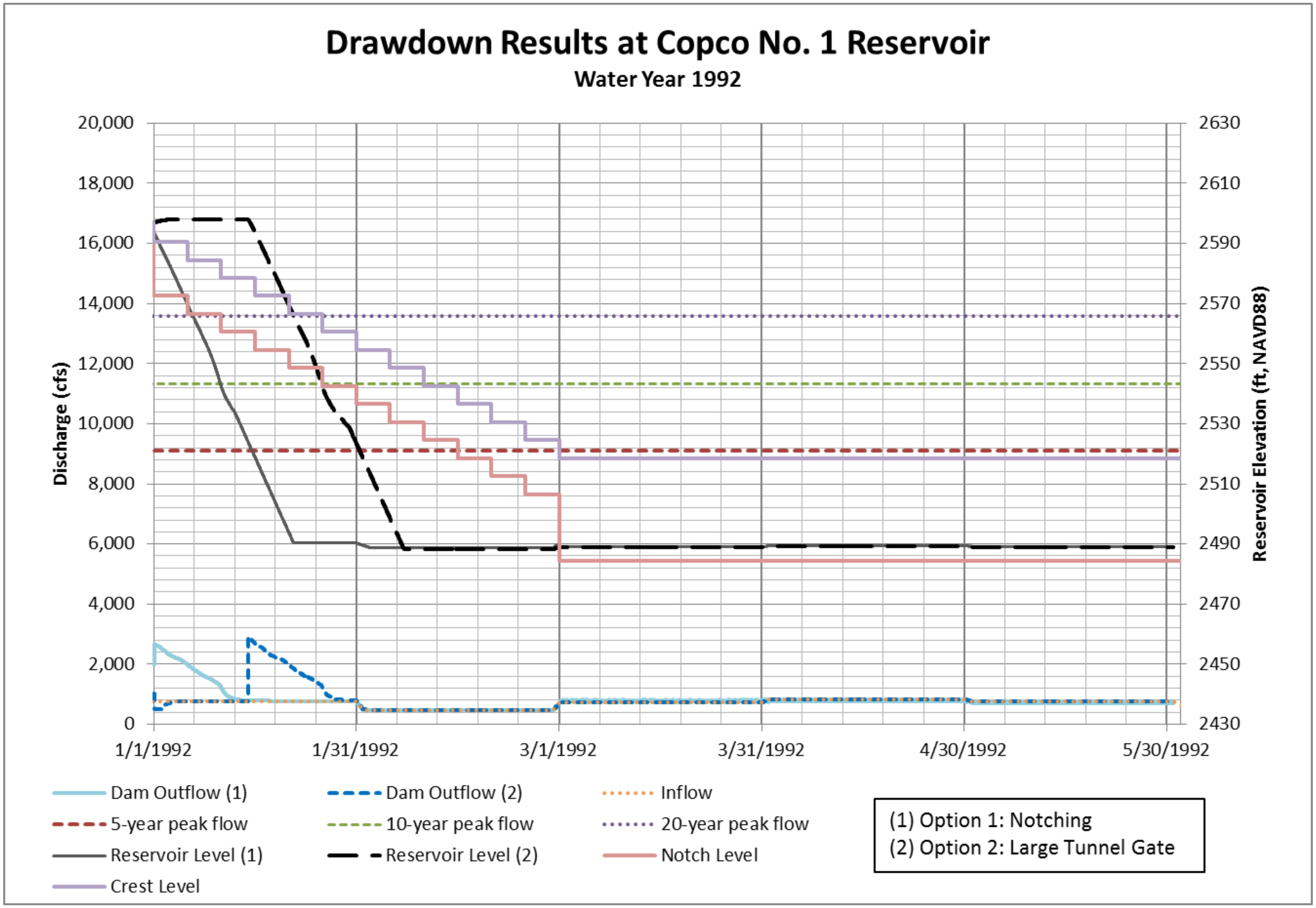

Figure 3-33 Copco No. 1 Reservoir Drawdown, Water Year 1992

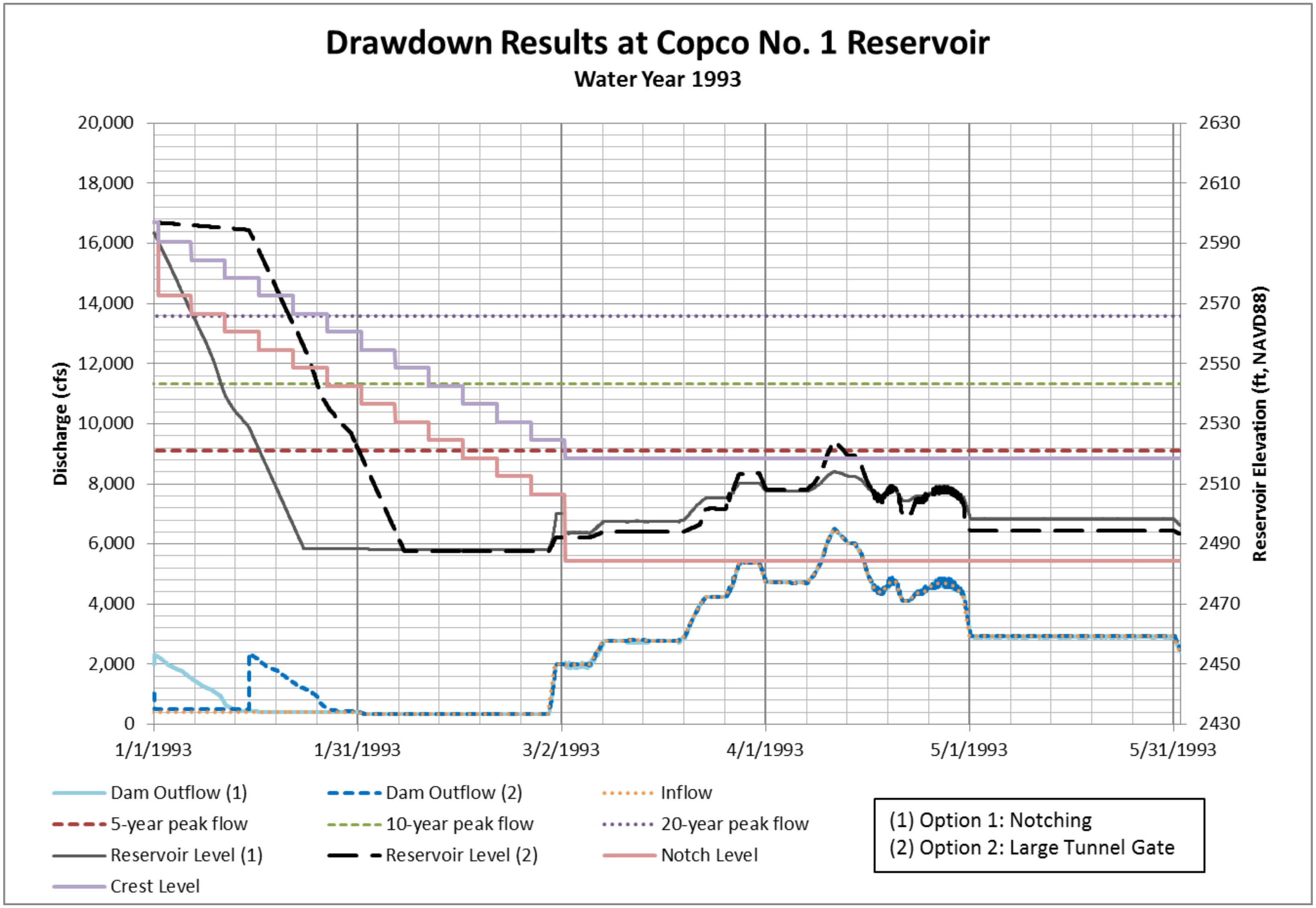

Figure 3-34 Copco No. 1 Reservoir Drawdown, Water Year 1993

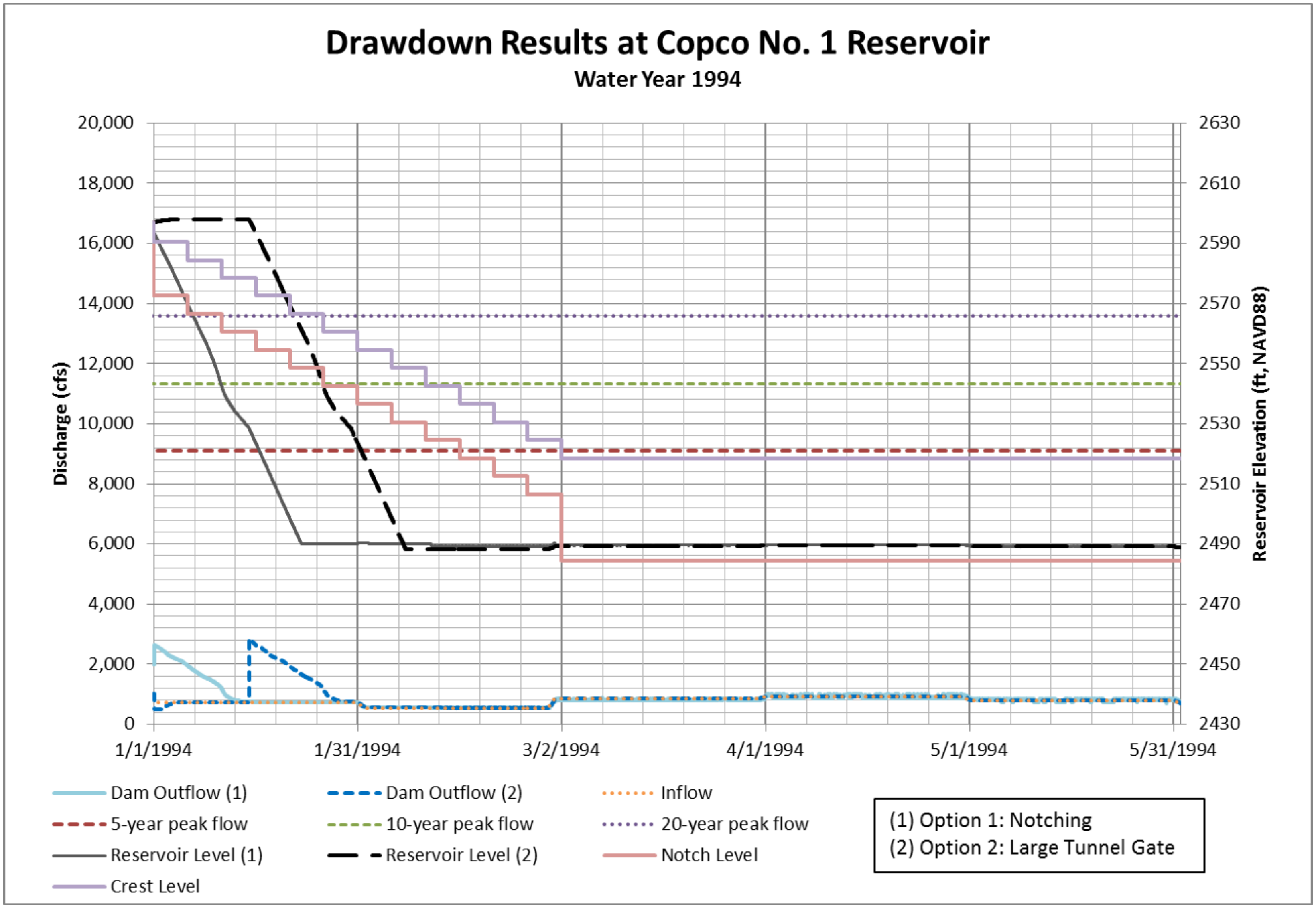

Figure 3-35 Copco No. 1 Reservoir Drawdown, Water Year 1994

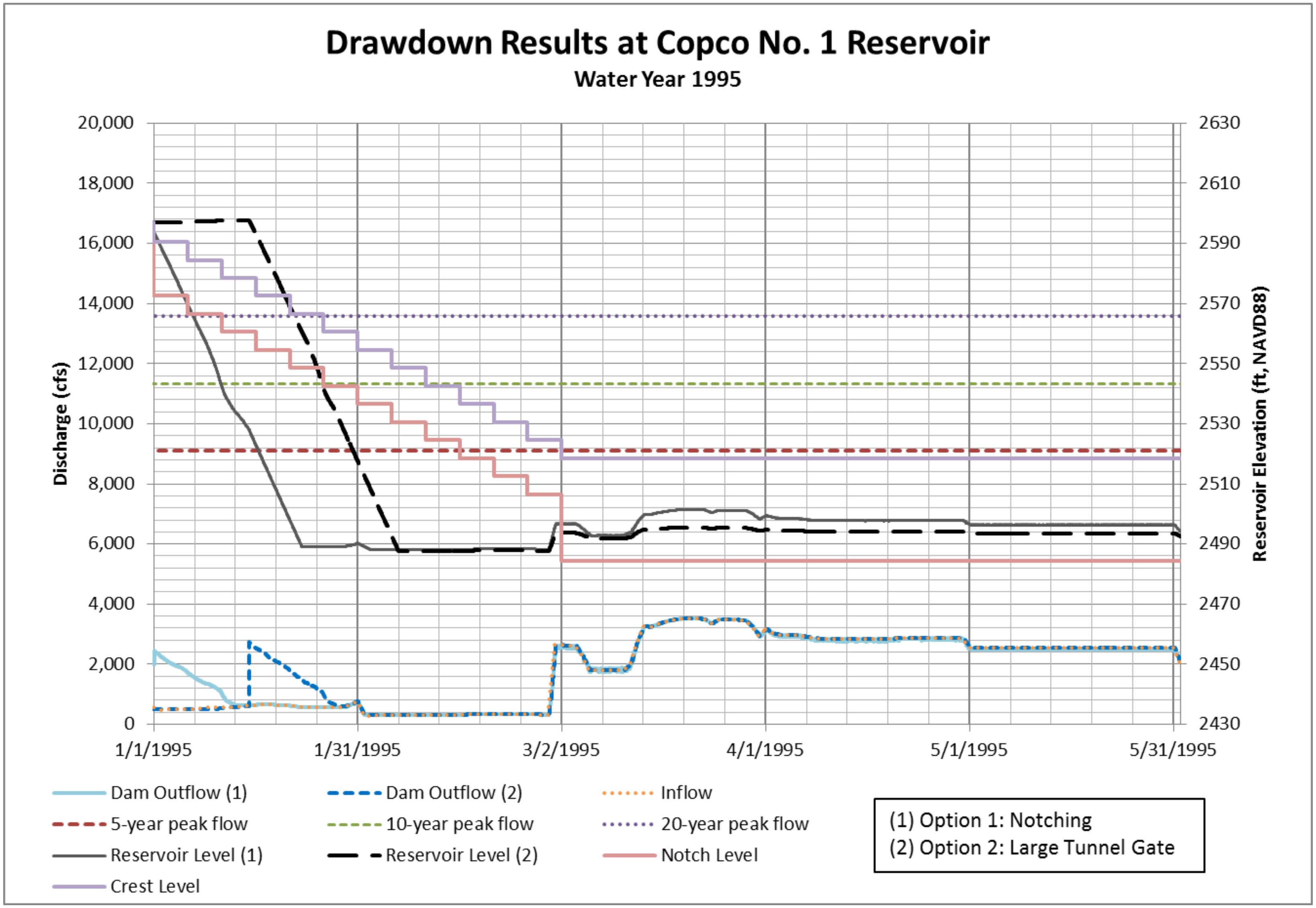

Figure 3-36 Copco No. 1 Reservoir Drawdown, Water Year 1995

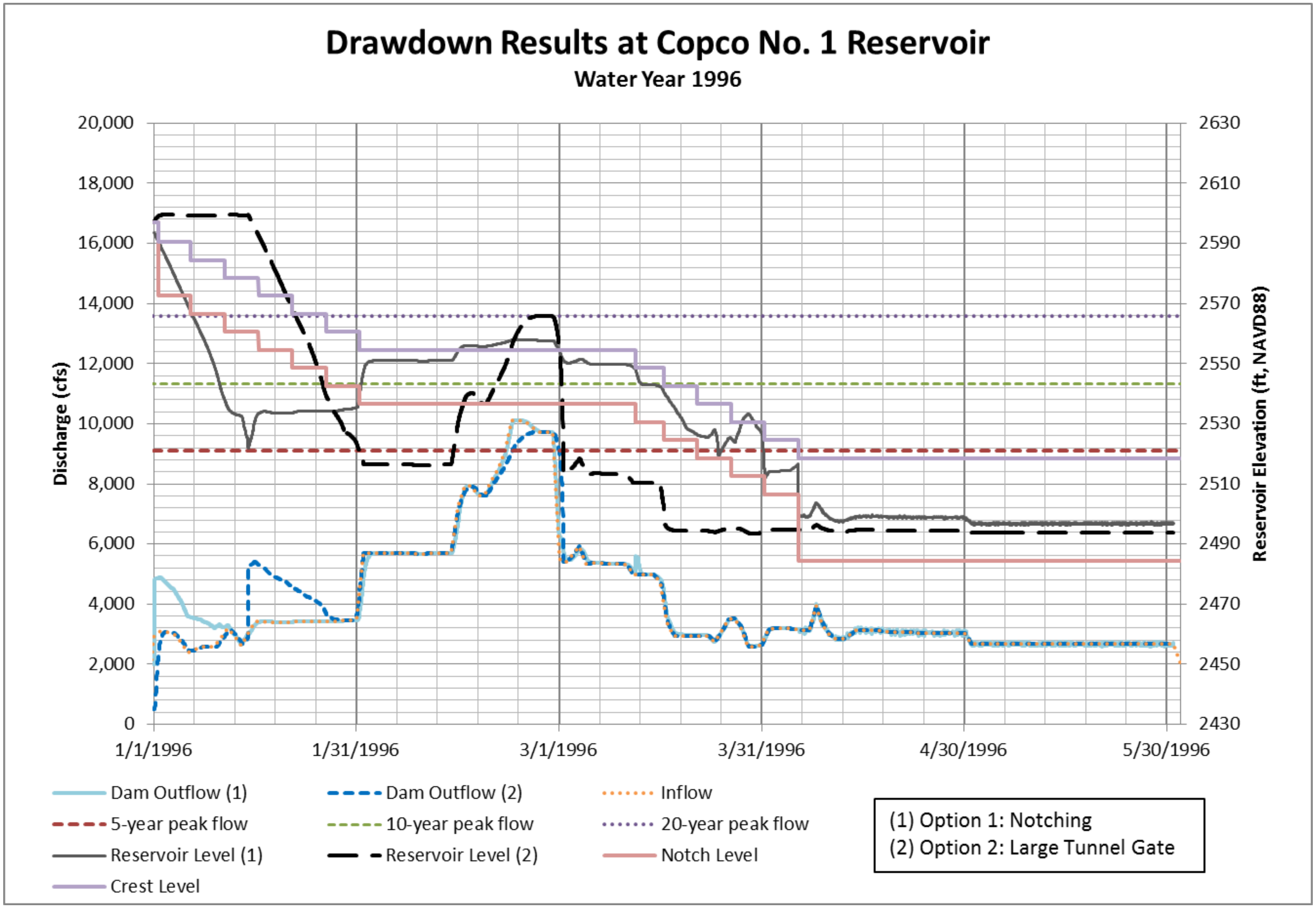

Figure 3-37 Copco No. 1 Reservoir Drawdown, Water Year 1996

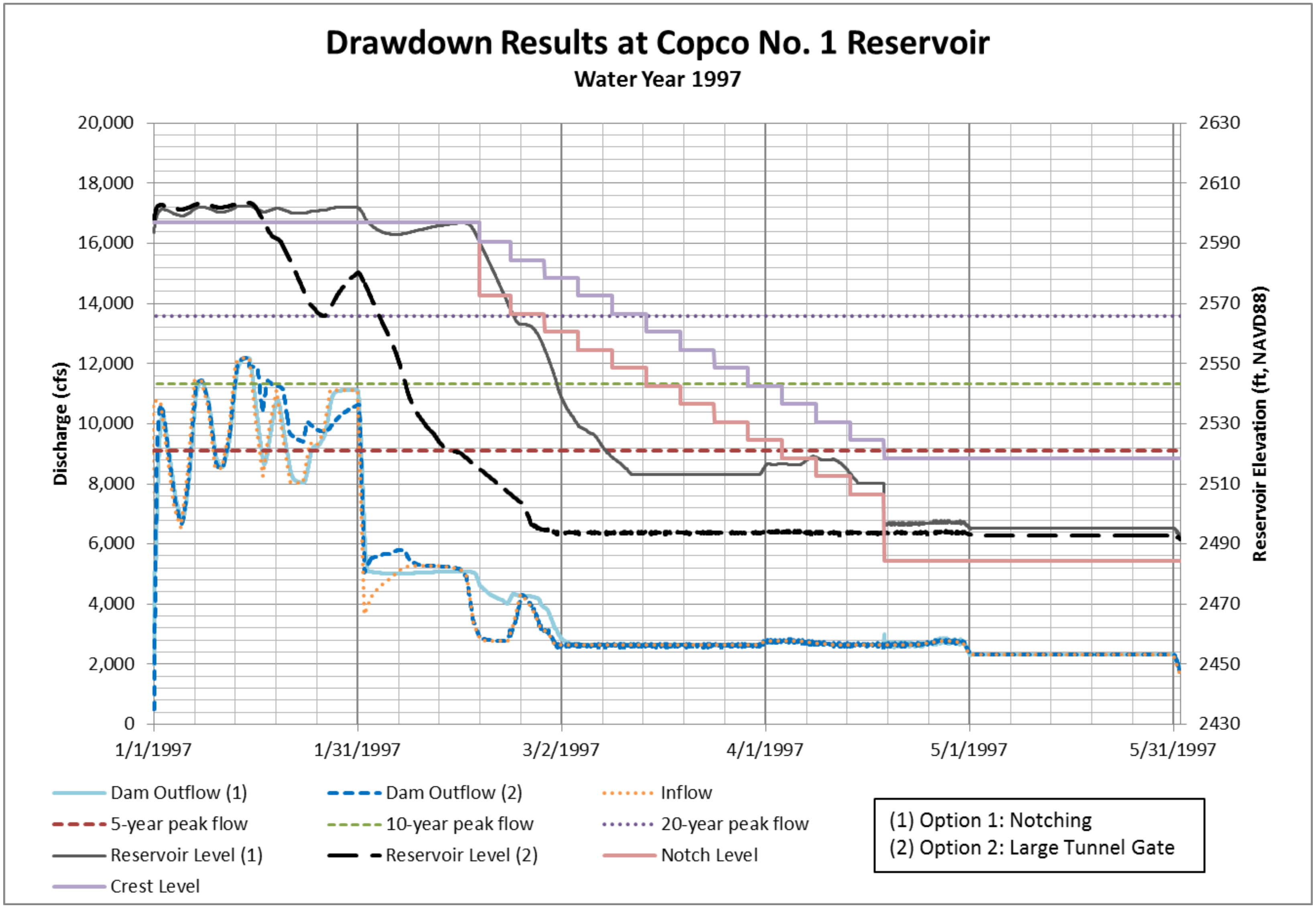

Figure 3-38 Copco No. 1 Reservoir Drawdown, Water Year 1997

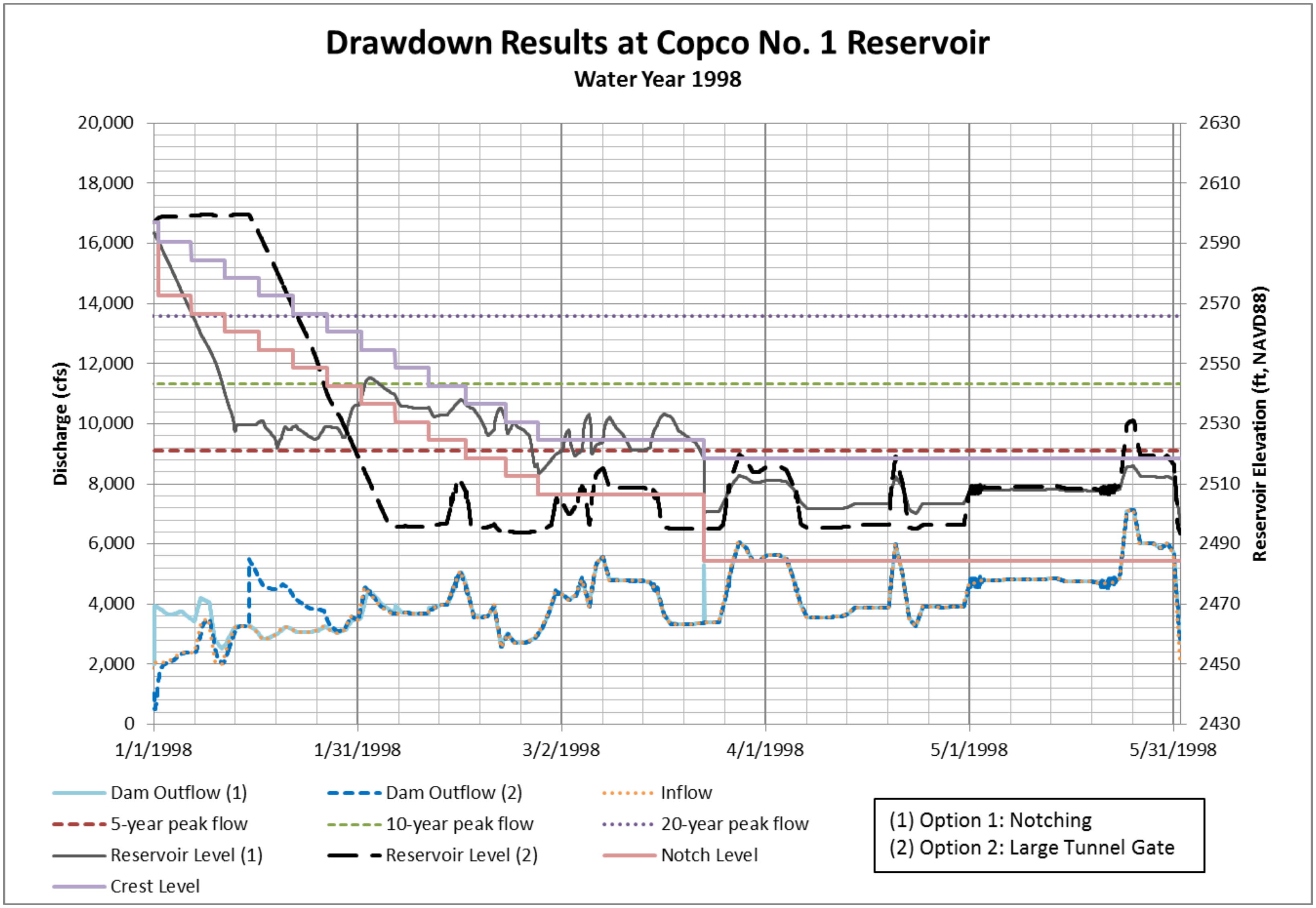

Figure 3-39 Copco No. 1 Reservoir Drawdown, Water Year 1998

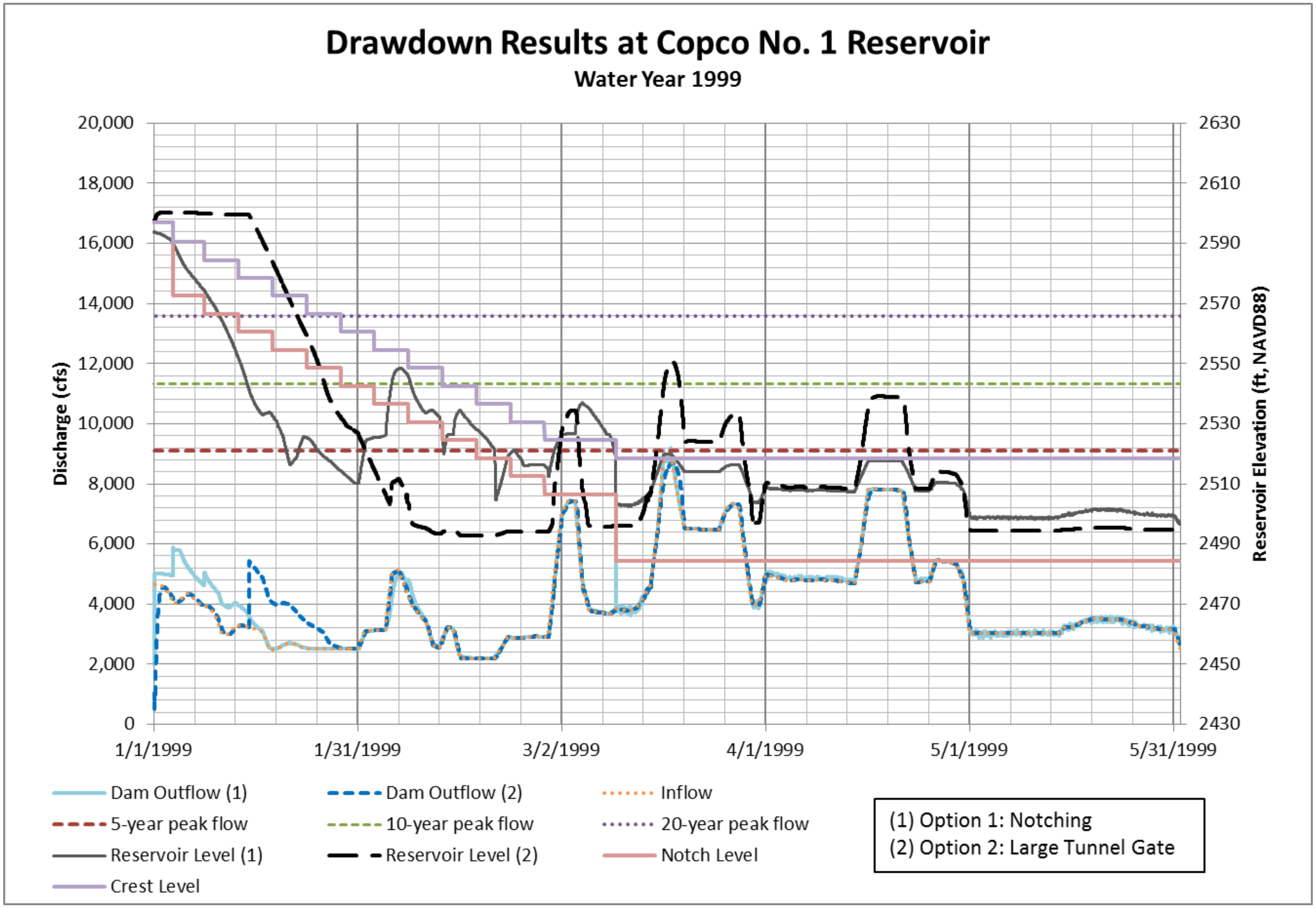

Figure 3-40 Copco No. 1 Reservoir Drawdown, Water Year 1999

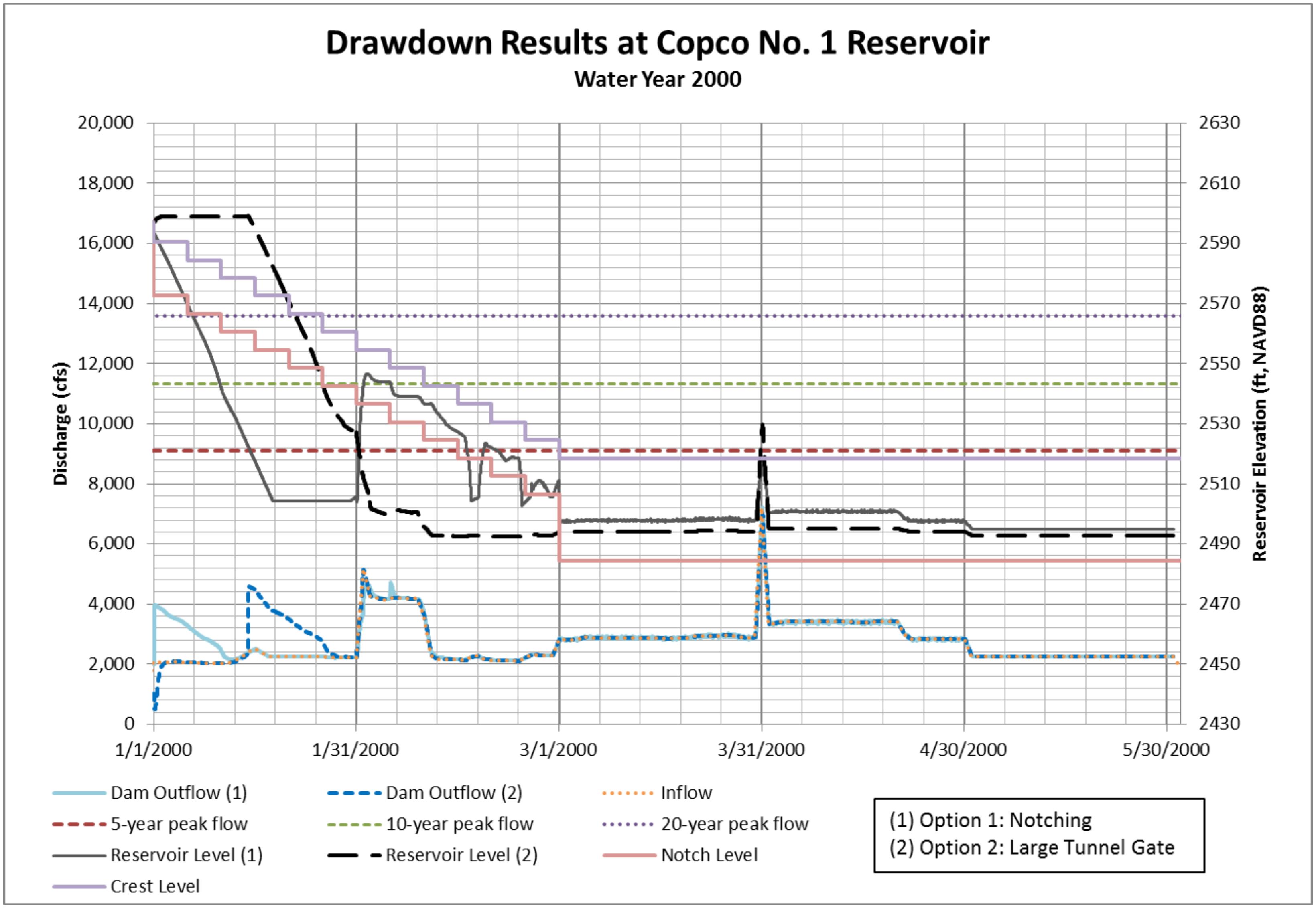

Figure 3-41 Copco No. 1 Reservoir Drawdown, Water Year 2000

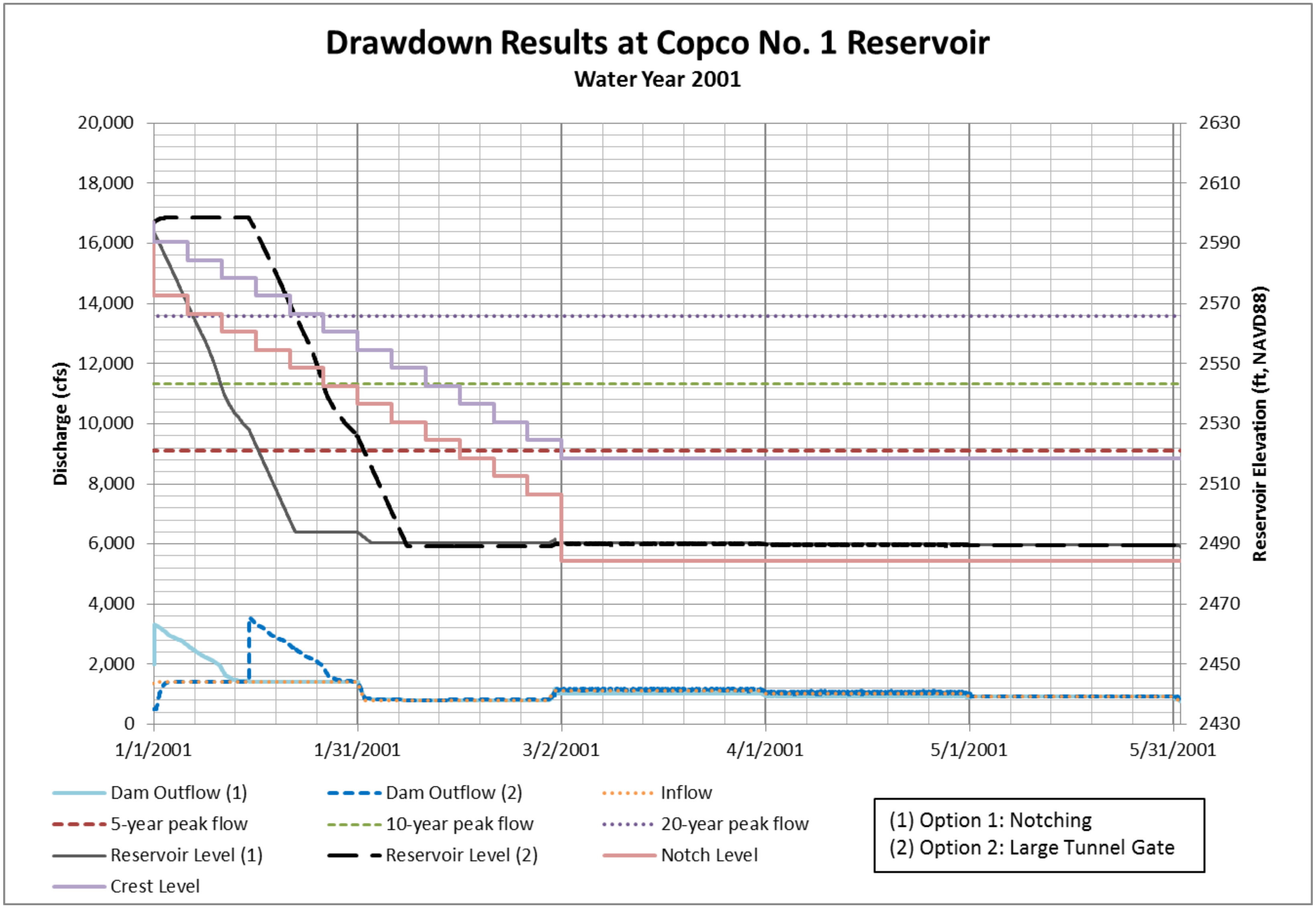

Figure 3-42 Copco No. 1 Reservoir Drawdown, Water Year 2001

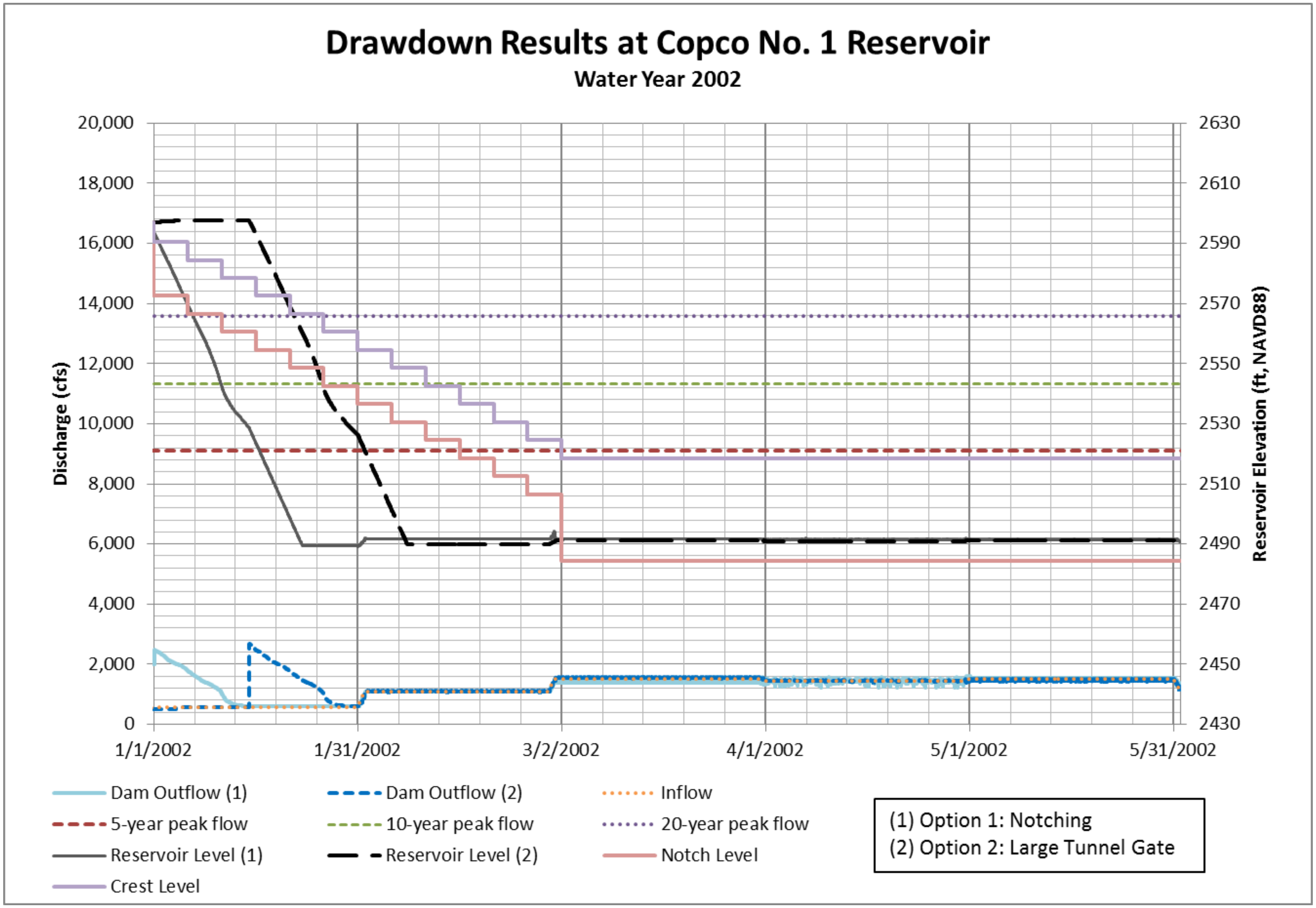

Figure 3-43 Copco No. 1 Reservoir Drawdown, Water Year 2002

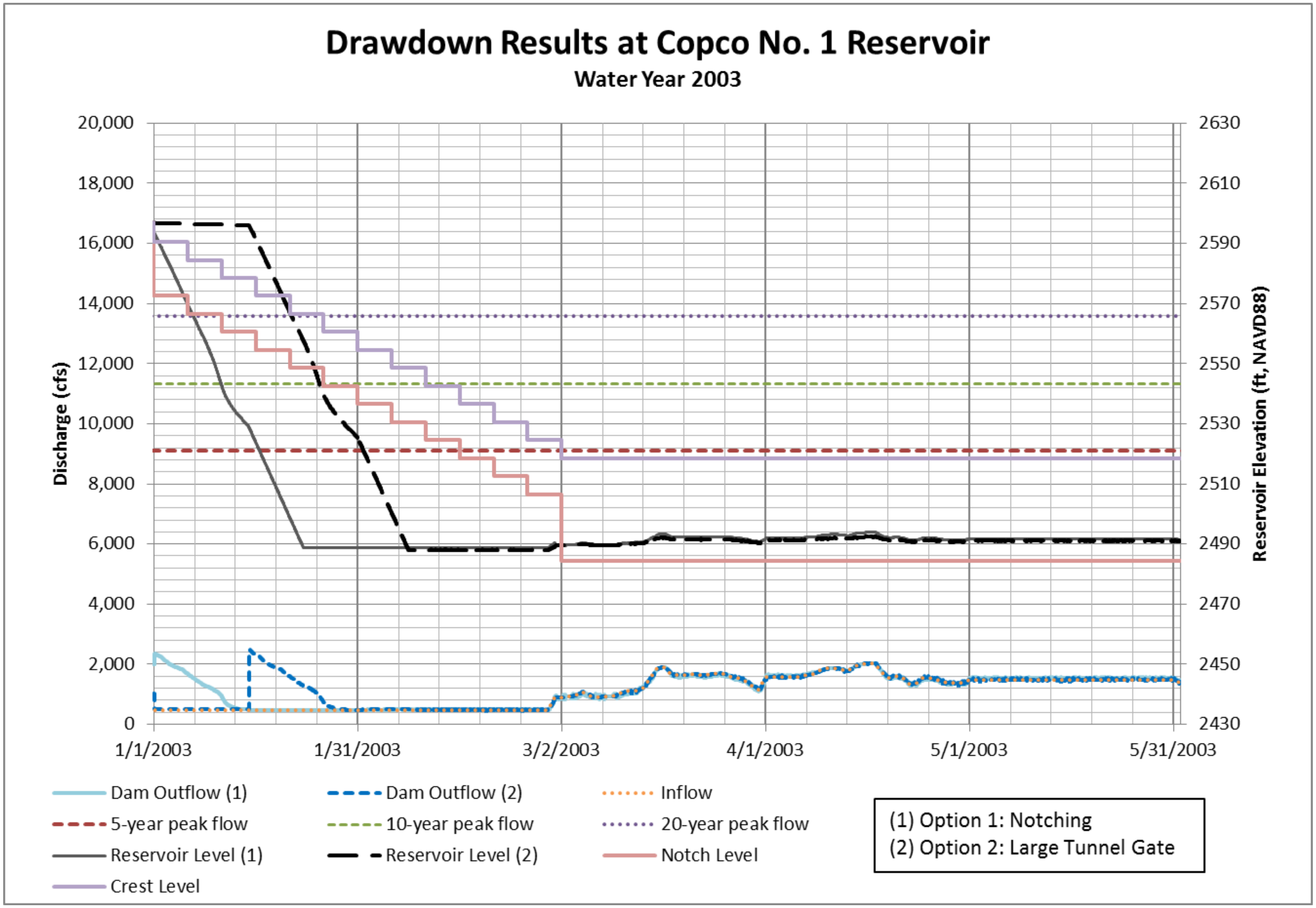

Figure 3-44 Copco No. 1 Reservoir Drawdown, Water Year 2003

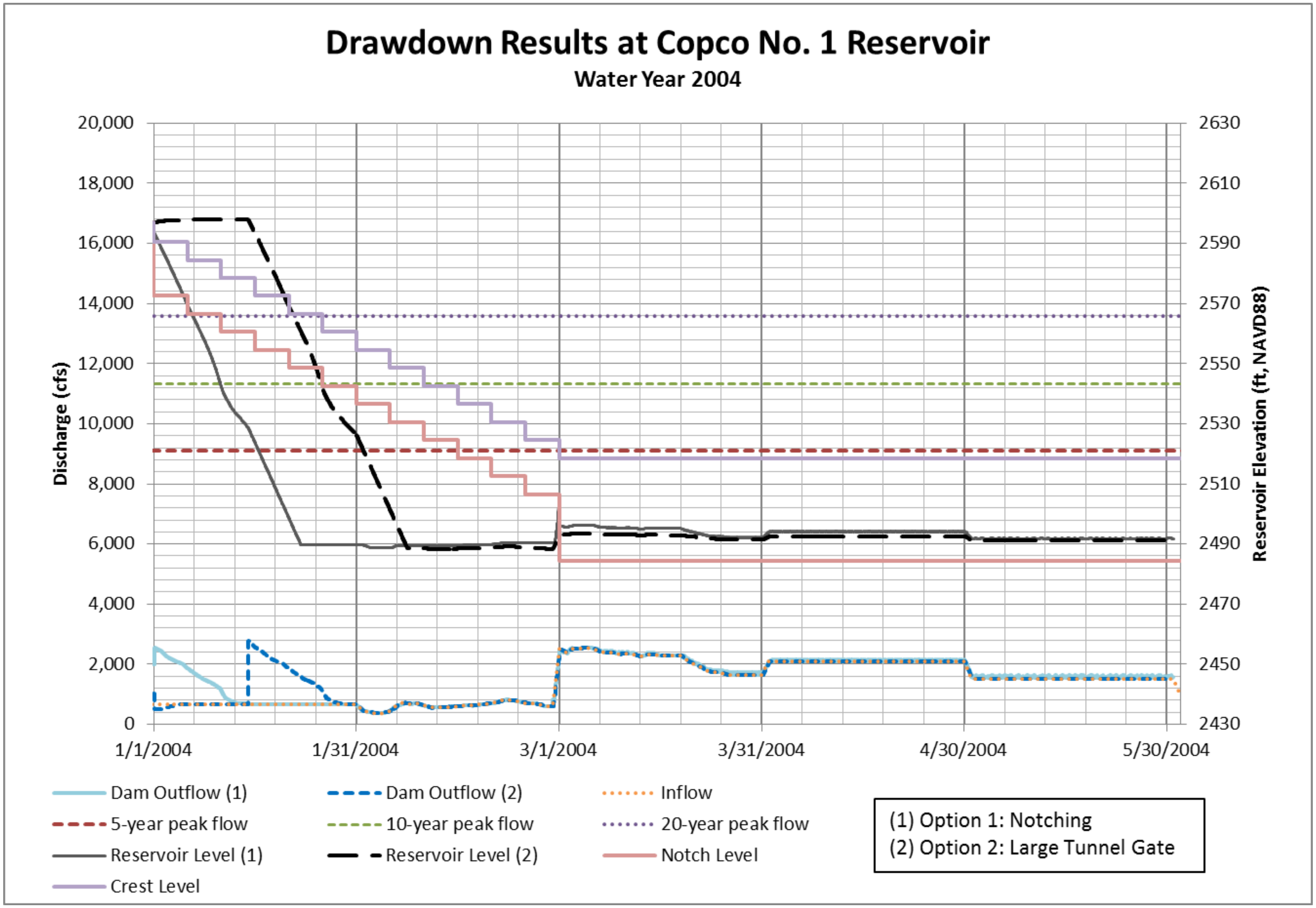

Figure 3-45 Copco No. 1 Reservoir Drawdown, Water Year 2004

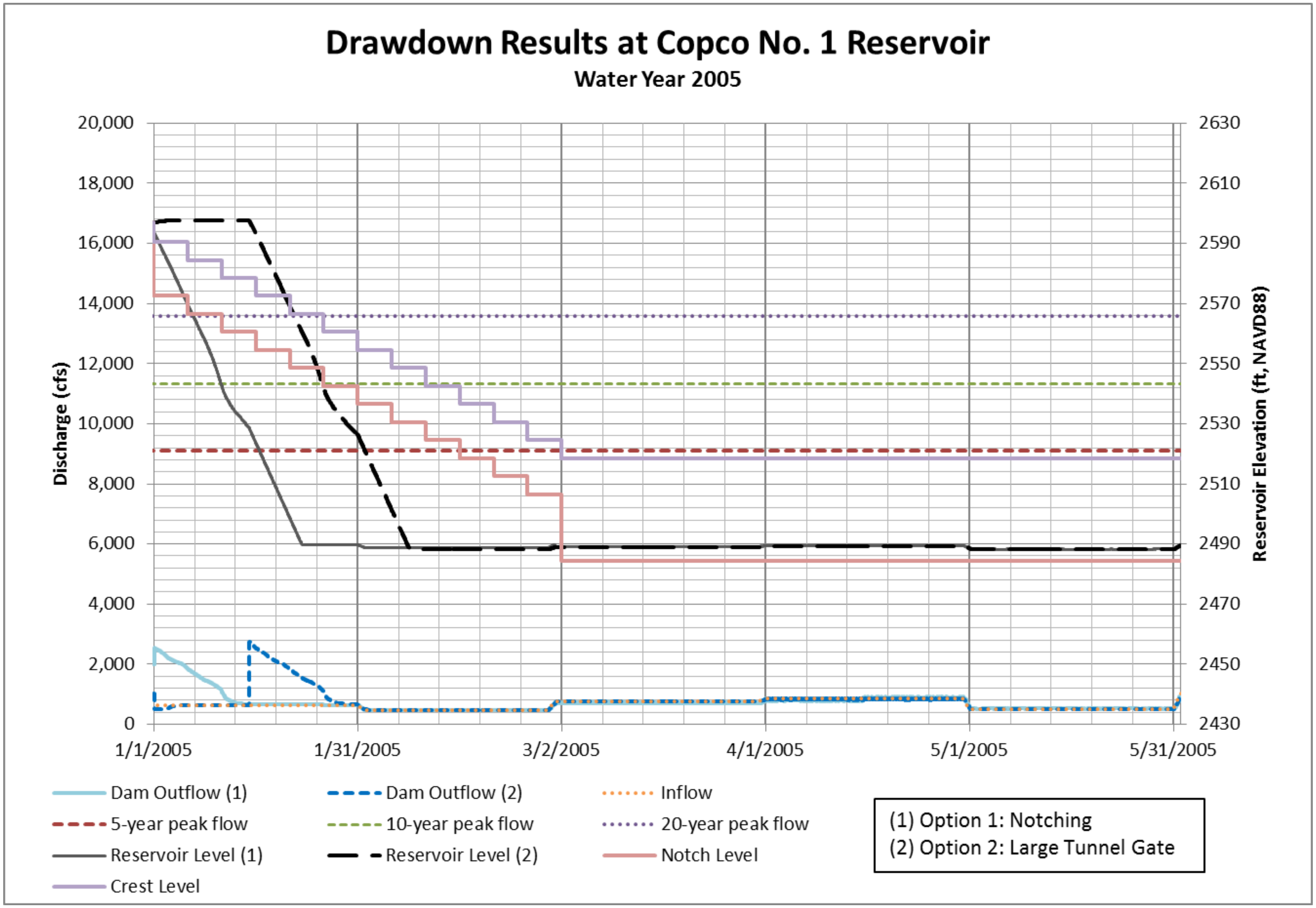

Figure 3-46 Copco No. 1 Reservoir Drawdown, Water Year 2005

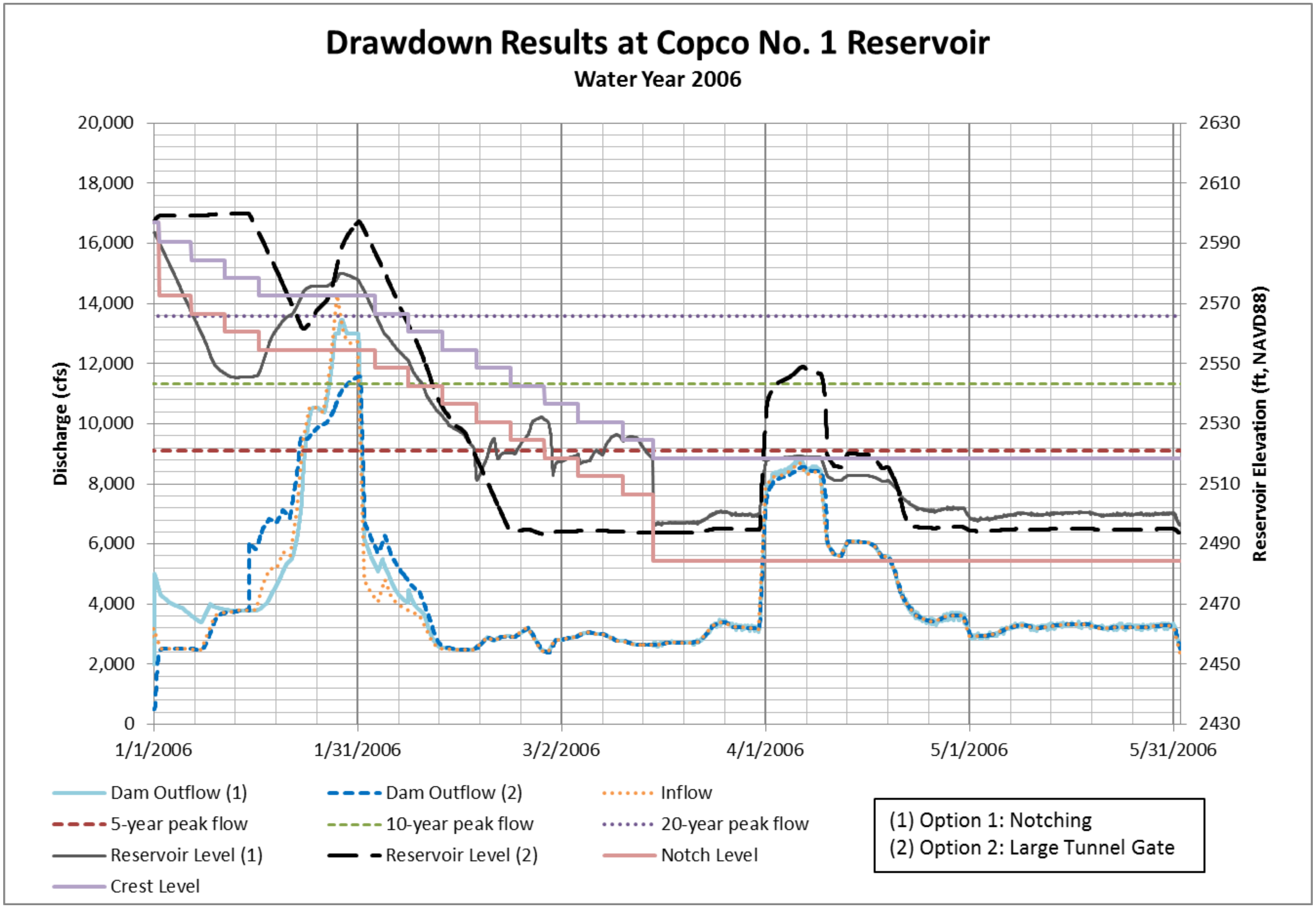

Figure 3-47 Copco No. 1 Reservoir Drawdown, Water Year 2006

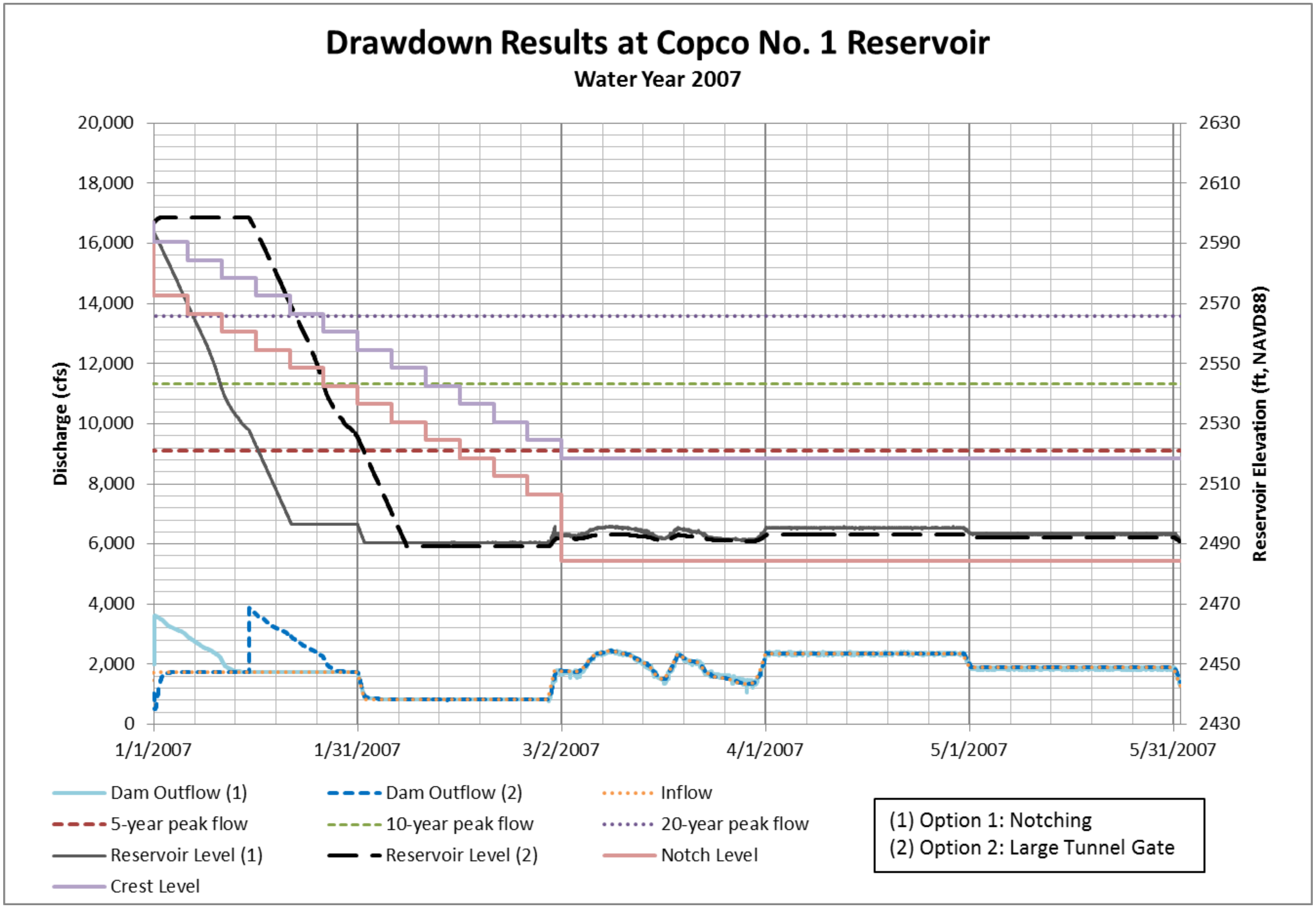

Figure 3-48 Copco No. 1 Reservoir Drawdown, Water Year 2007

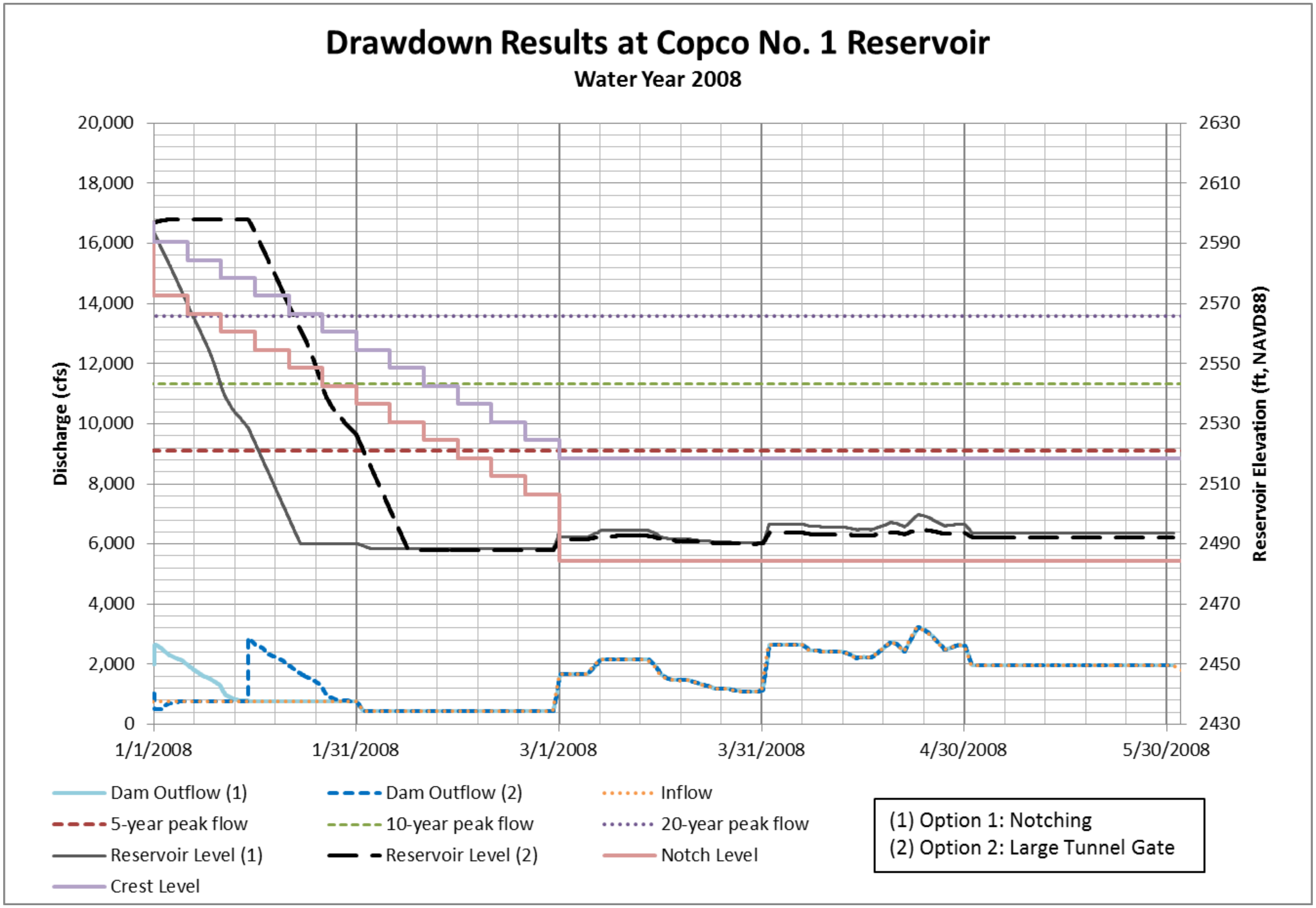

Figure 3-49 Copco No. 1 Reservoir Drawdown, Water Year 2008

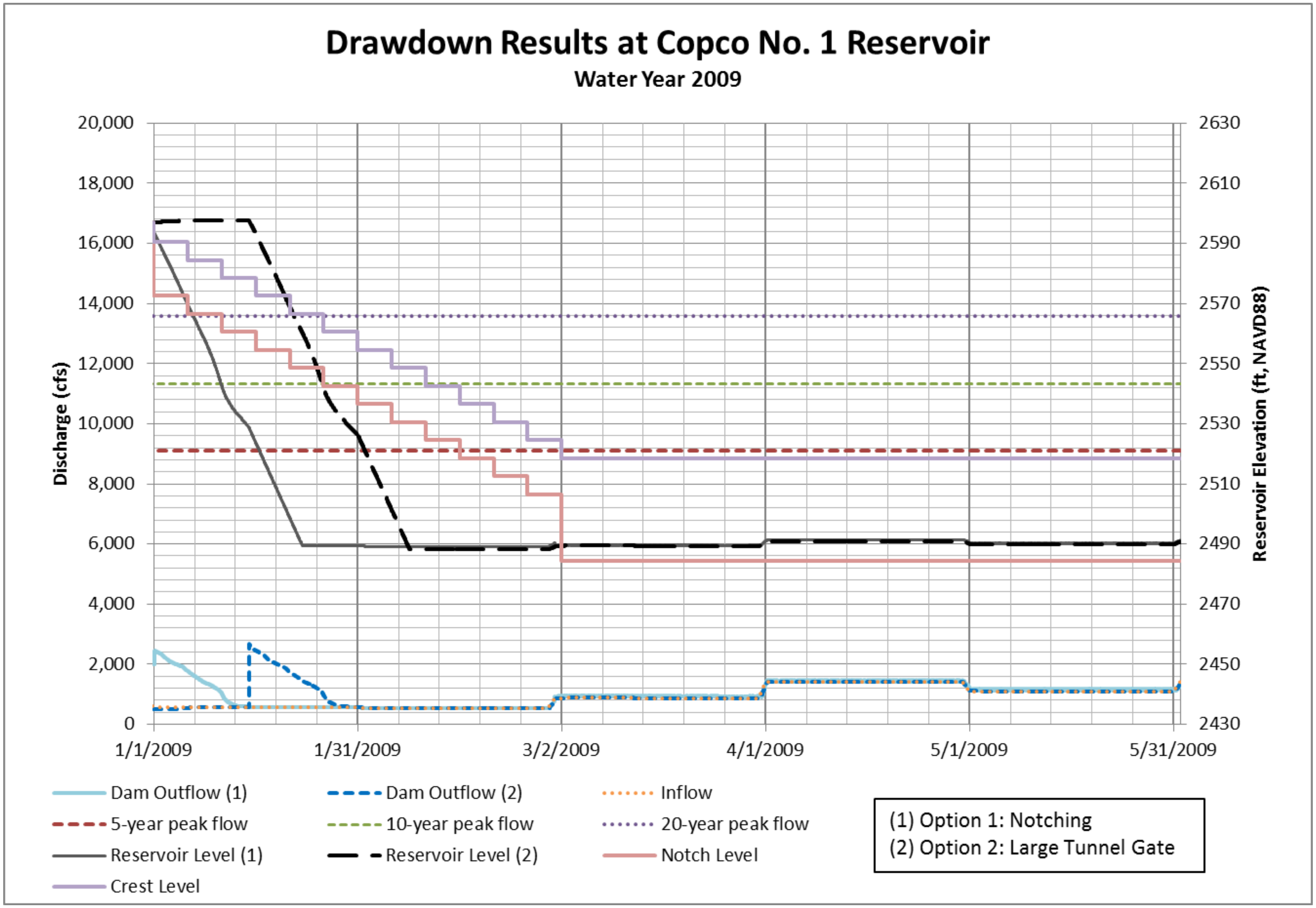

Figure 3-50 Copco No. 1 Reservoir Drawdown, Water Year 2009

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Chapter 4: Iron Gate Reservoir

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4. IRON GATE RESERVOIR

Reservoir drawdown at Iron Gate will begin from normal operating elevation 2331.3 feet on January 1, 2021 by making controlled releases through the modified diversion tunnel. Reservoir drawdown will be limited to a maximum of 5 feet per day to maintain embankment and reservoir rim slope stability. The maximum additional discharge downstream of Iron Gate Dam due to drawdown activities is about 4,000 cfs. The total discharge capacity of the modified diversion tunnel with the reservoir at spillway crest elevation 2331.3 is about 10,000 cfs. For reference, the 5-year flow event downstream of Iron Gate Dam is 10,900 cfs.

4.1 Results

Figures 4-1 through 4-49 show results for drawdown of Iron Gate Reservoir. Due to their close physical proximity, KRRC modeled the Iron Gate Reservoir drawdown in conjunction with the Copco Lake drawdown. There are different results at Iron Gate Reservoir depending on which drawdown option at Copco No. 1 Dam is chosen. References to Options 1 and 2 in the plots are the resulting effects at Iron Gate based on either Option 1 or 2 being implemented at Copco No. 1 Dam. Since KRRC proposes Option 2 for the Project, the remaining results discuss only Option 2.

During representative drier years (for example1973 and 1979), Iron Gate Reservoir was easily drawn down by early February, and it did not refill after that point.

During the wetter years such as 2006 and 1986, the model shows Iron Gate Reservoir almost completely drawn down by March 1, but it partially refilled later in the year when storms occurred. The majority of the accumulated sediment will mobilize during the initial drawdown, and subsequent reservoir filling and drawdown is expected to cause only moderate increases in high suspended sediment (relative to background) (USBR 2012c).

For the wettest year, 1966, the model shows the reservoir draws down by early March, but the probability of a storm of this magnitude occurring in the drawdown year is low.

During the wetter years (for example 1966, 2006, 1986, and 1970), flows are higher than what would be expected via the spillway alone (i.e., without drawdown), but the increases are mainly limited to those periods when flows are below the 10-year flood elevation. KRRC does not anticipate that sediment concentrations resulting from the proposed drawdown procedure and associated hydraulics would differ from those previously estimated (USBR 2012c).

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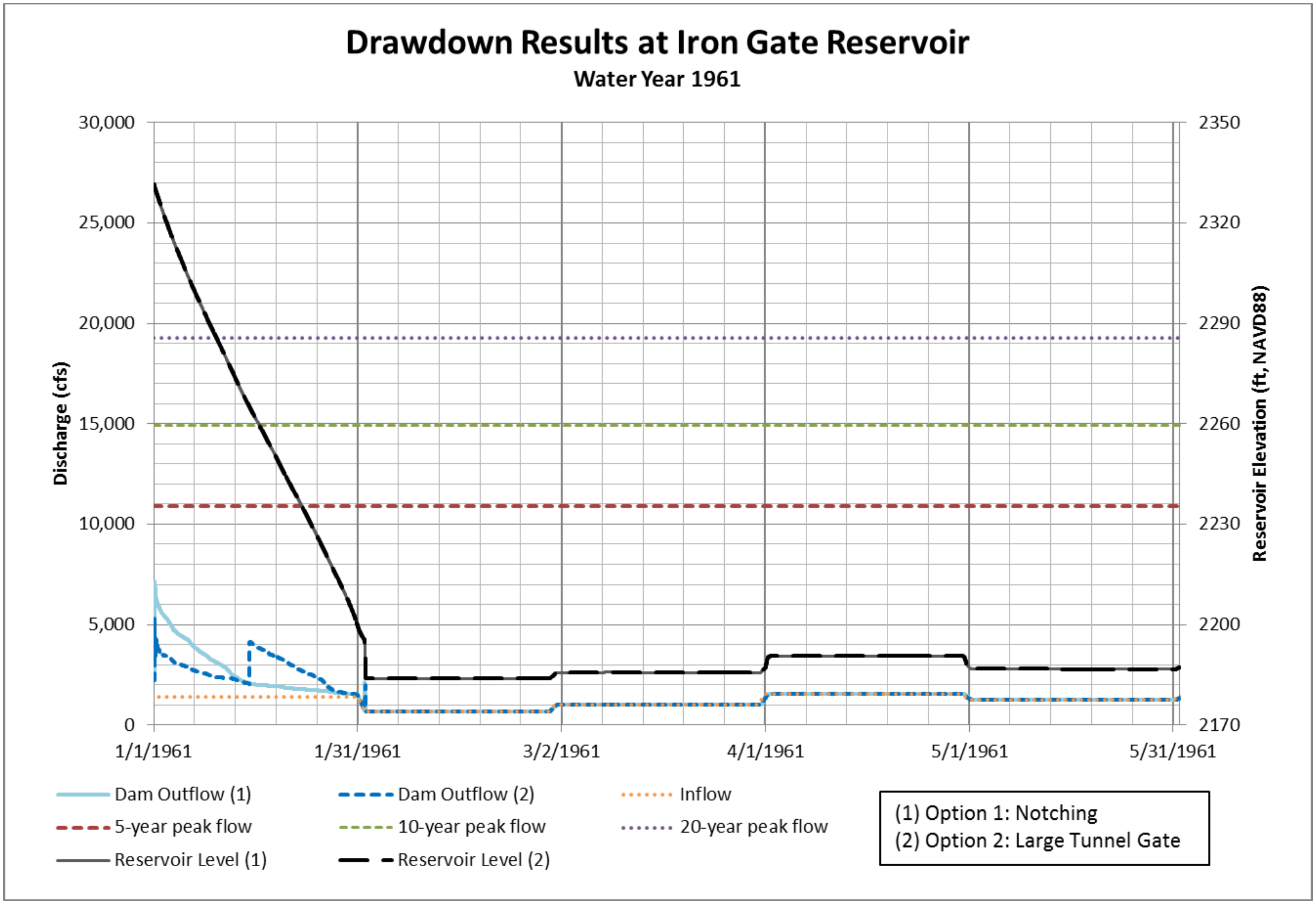

Figure 4-1 Iron Gate Reservoir Drawdown, Water Year 1961

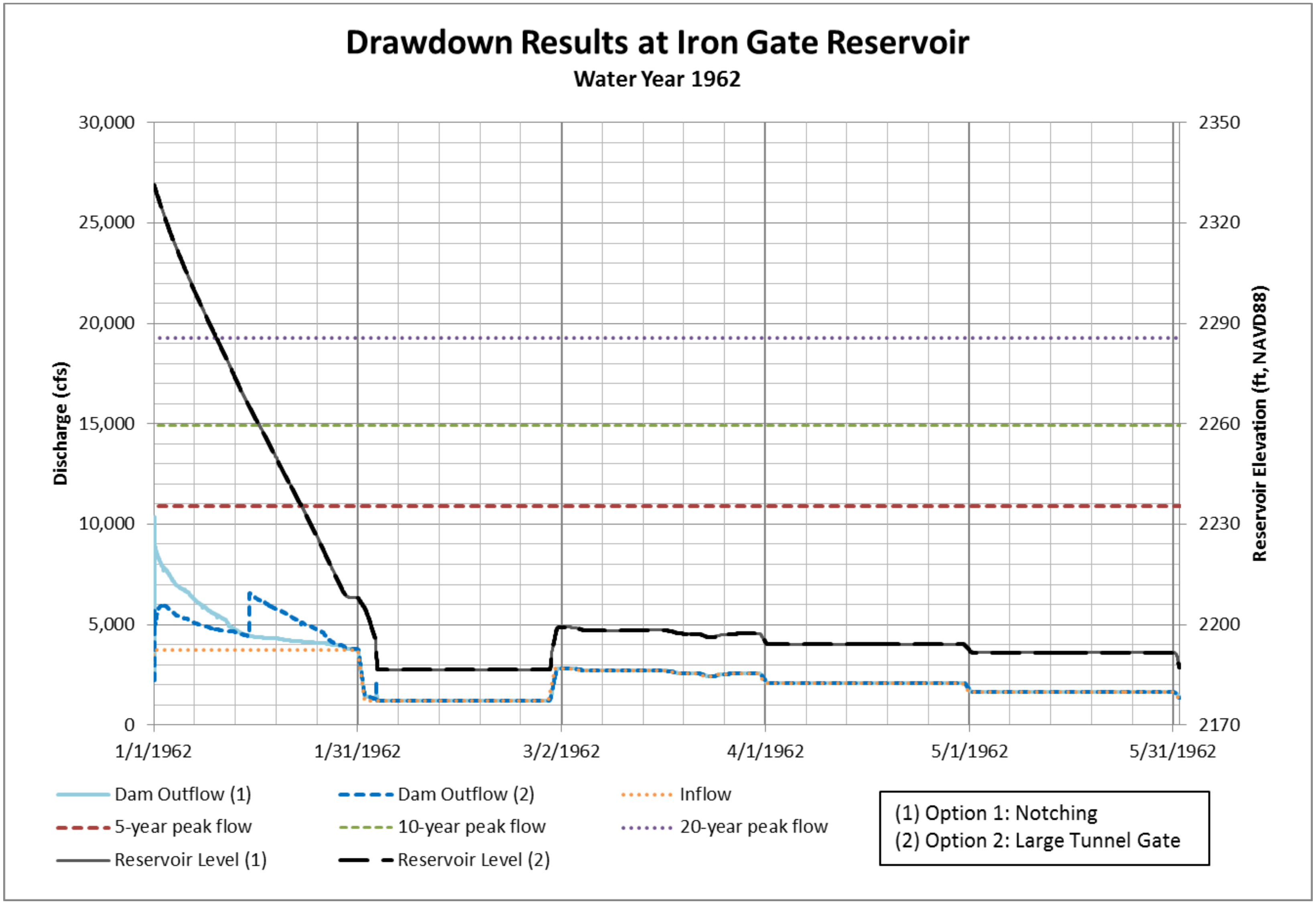

Figure 4-2 Iron Gate Reservoir Drawdown, Water Year 1962

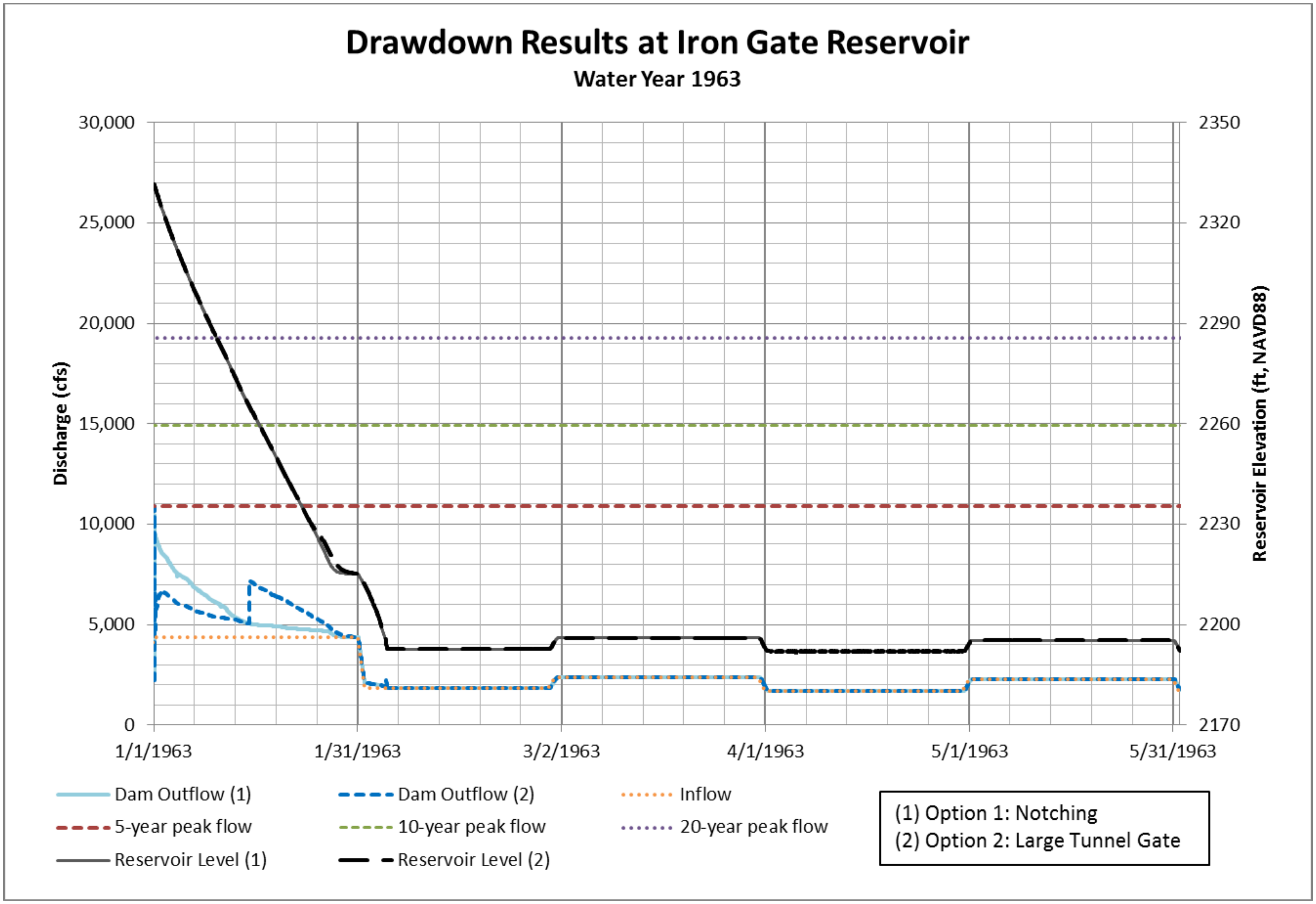

Figure 4-3 Iron Gate Reservoir Drawdown, Water Year 1963

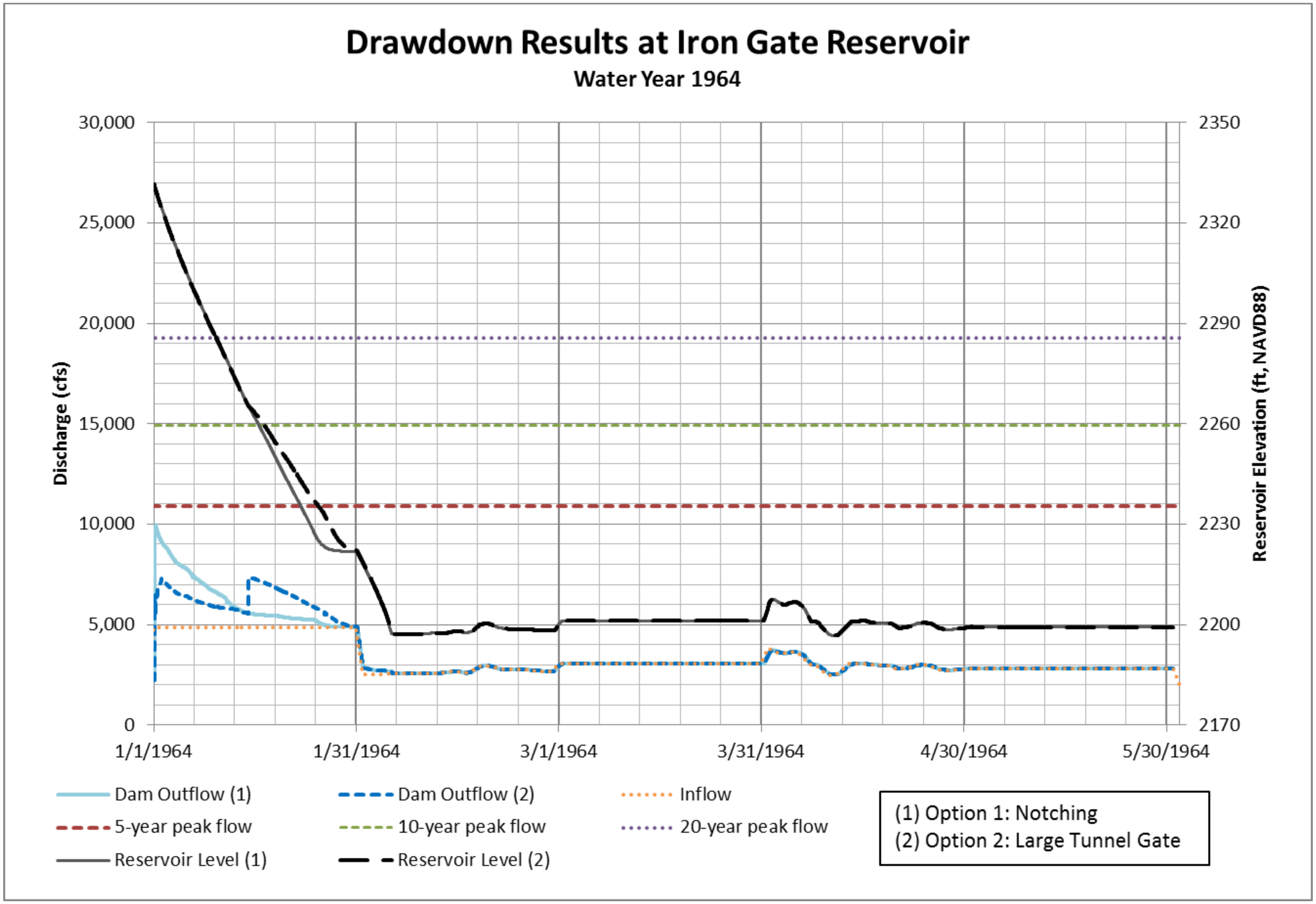

Figure 4-4 Iron Gate Reservoir Drawdown, Water Year 1964

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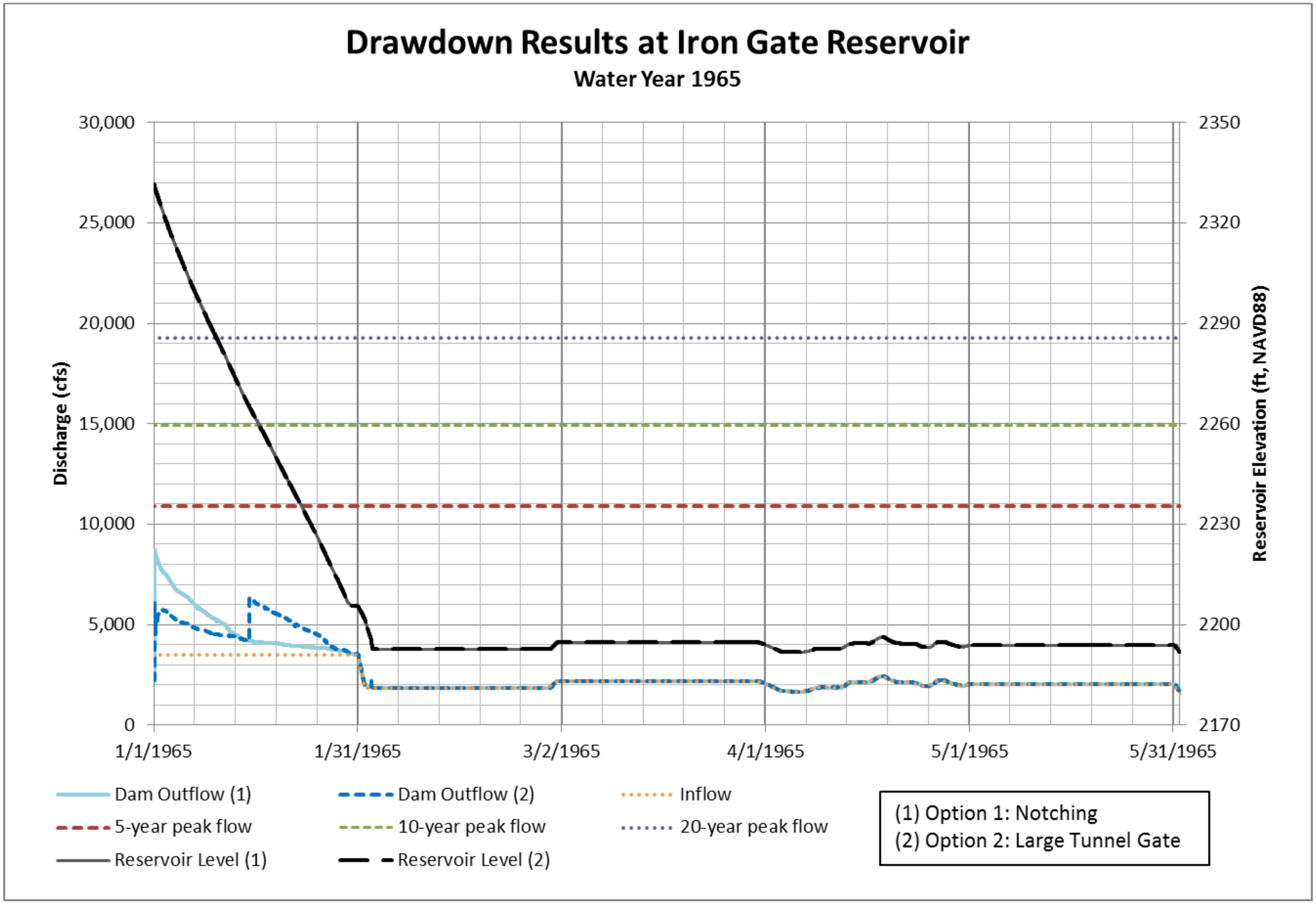

Figure 4-5 Iron Gate Reservoir Drawdown, Water Year 1965

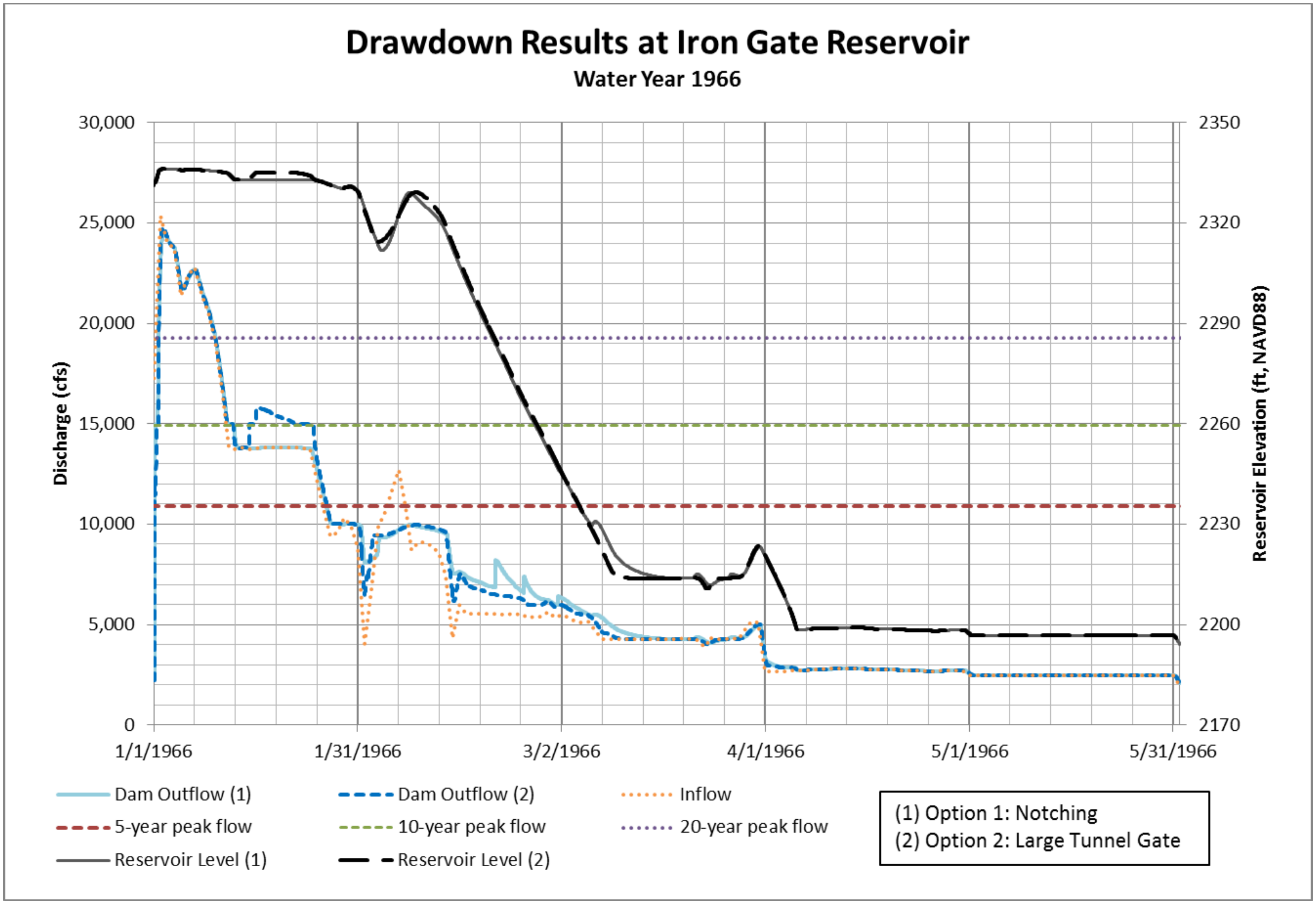

Figure 4-6 **Iron Gate Reservoir Drawdown, Water Year 1966**

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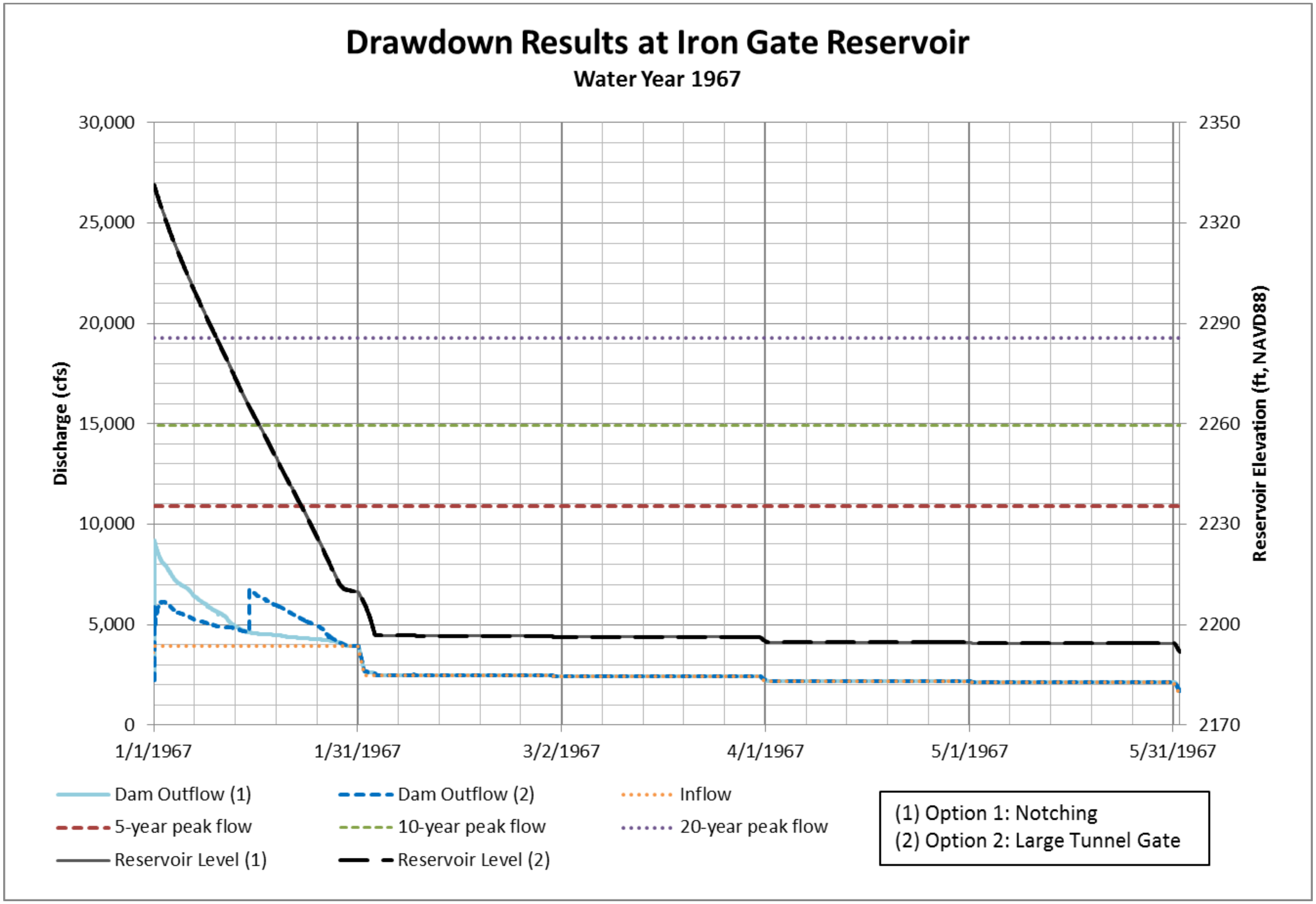

Figure 4-7 Iron Gate Reservoir Drawdown, Water Year 1967

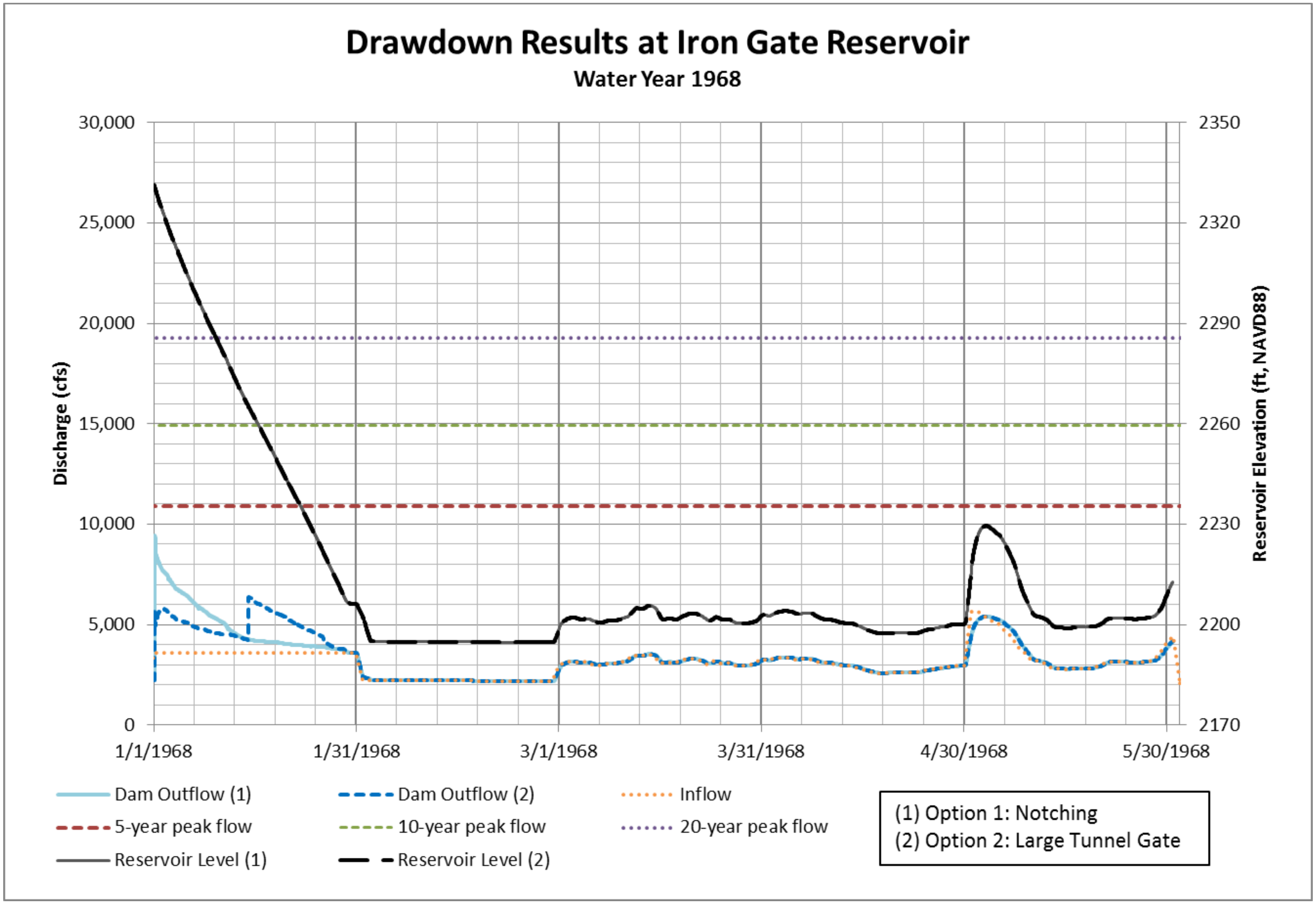

Figure 4-8 **Iron Gate Reservoir Drawdown, Water Year 1968**

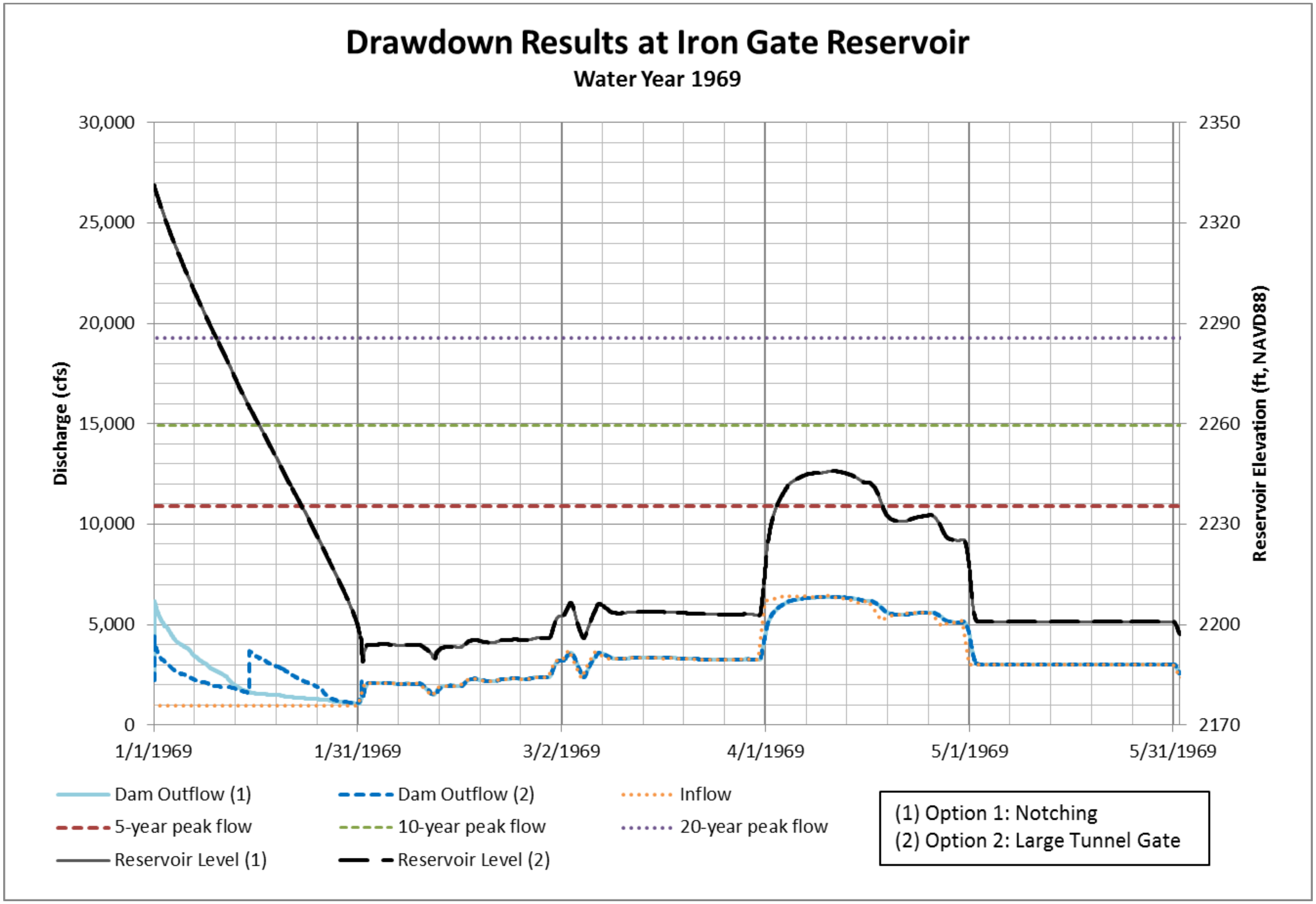

Figure 4-9 Iron Gate Reservoir Drawdown, Water Year 1969

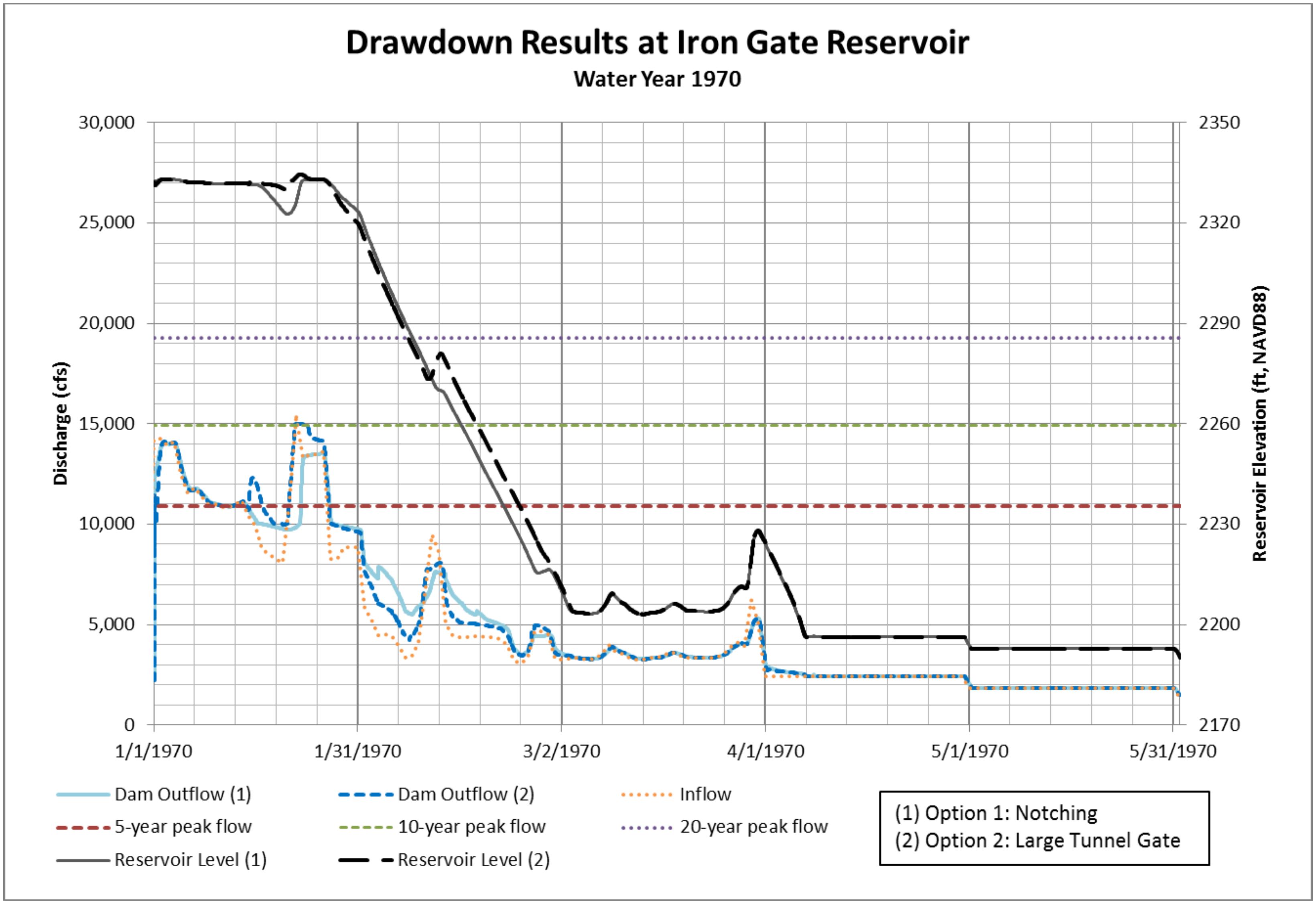

Figure 4-10 Iron Gate Reservoir Drawdown, Water Year 1970

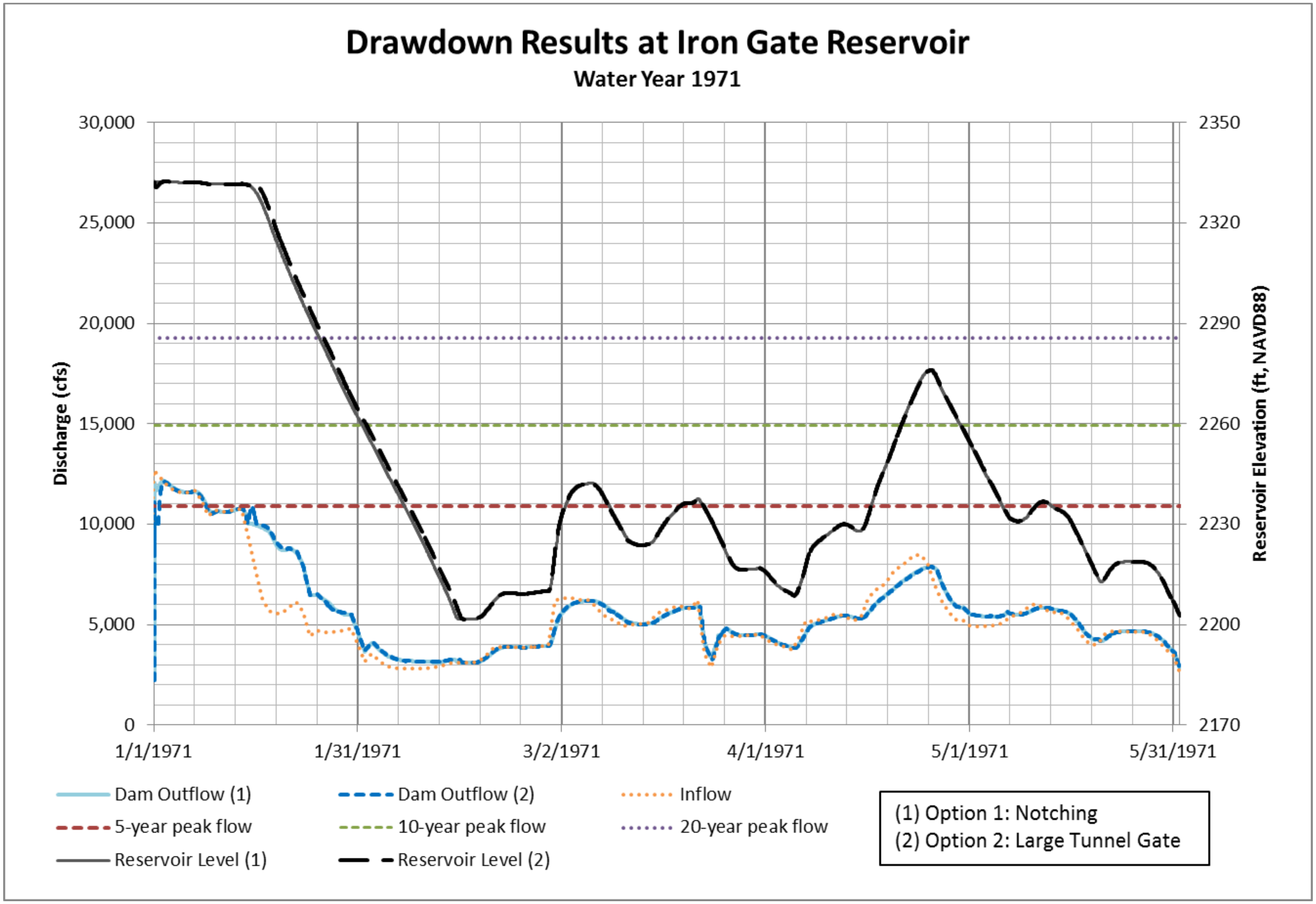

Figure 4-11 Iron Gate Reservoir Drawdown, Water Year 1971

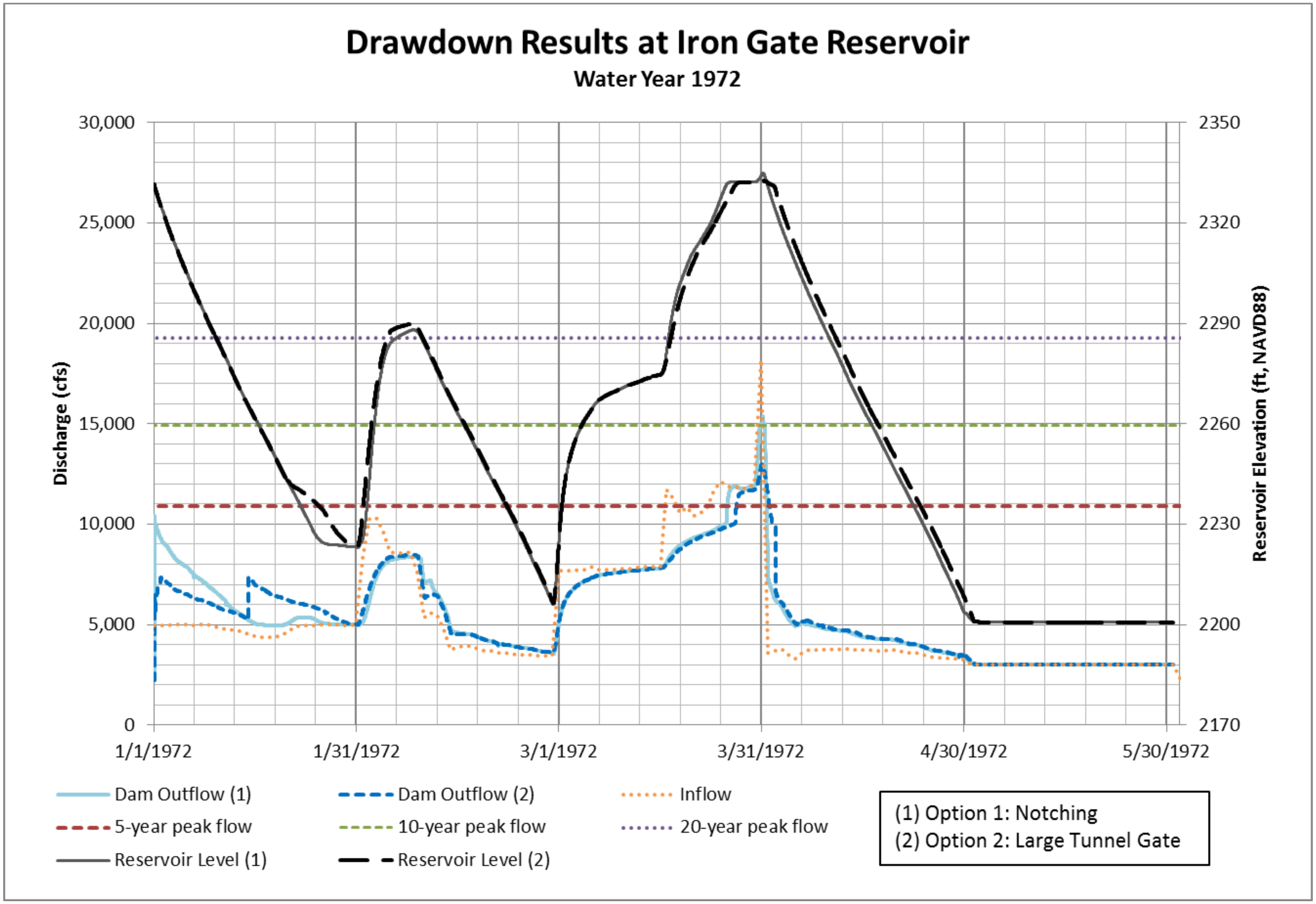

Figure 4-12 Iron Gate Reservoir Drawdown, Water Year 1972

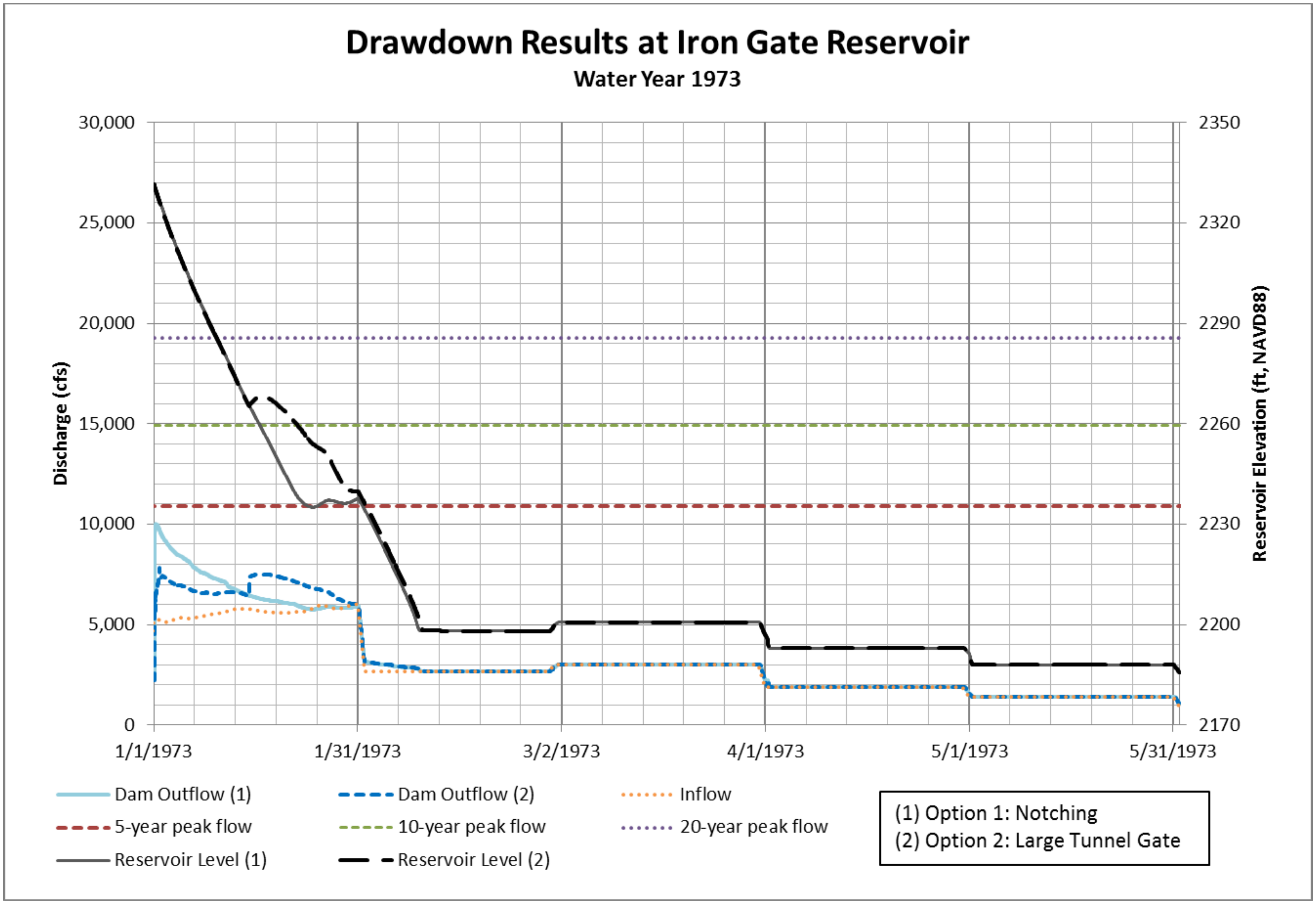

Figure 4-13 Iron Gate Reservoir Drawdown, Water Year 1973

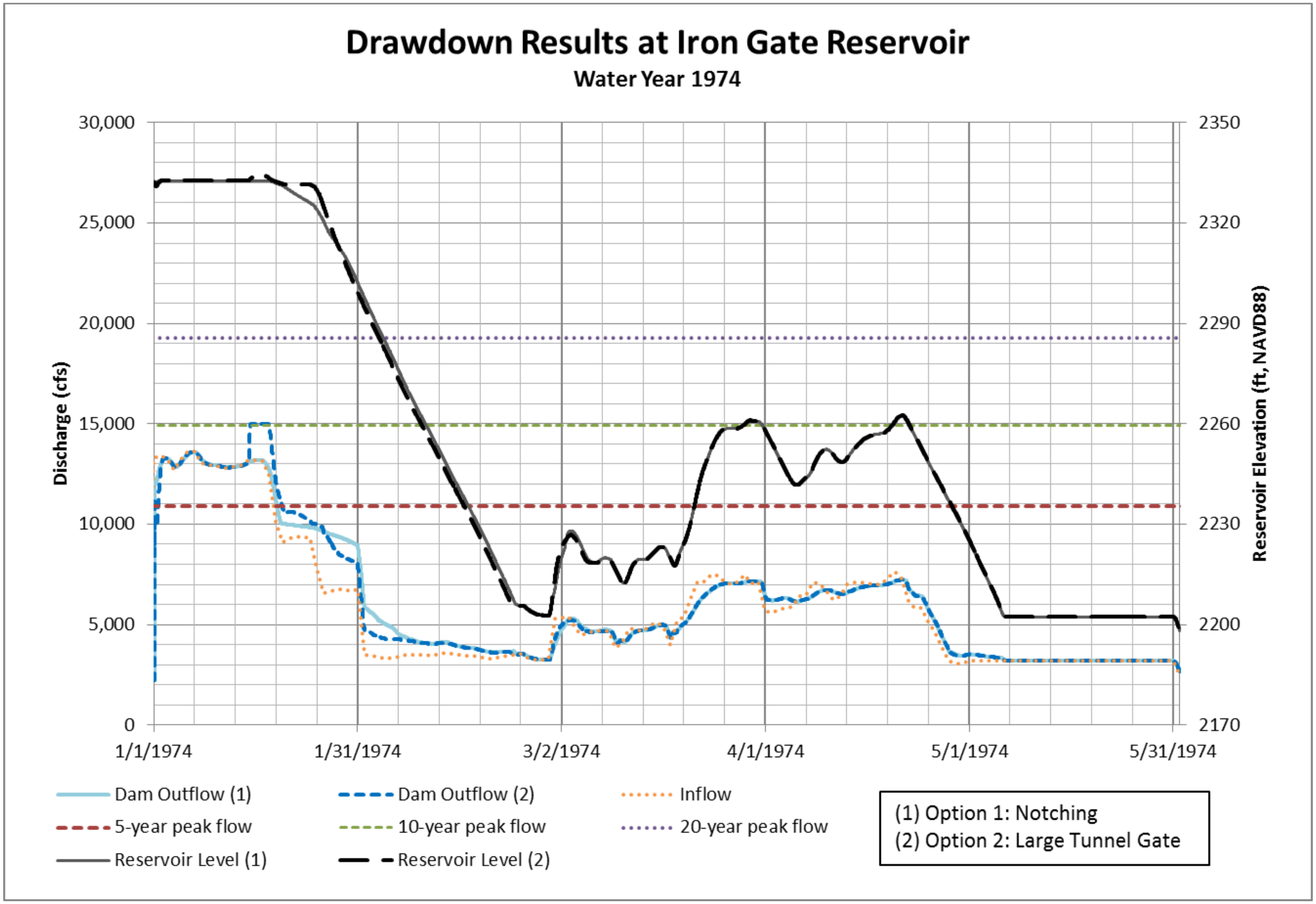

Figure 4-14 Iron Gate Reservoir Drawdown, Water Year 1974

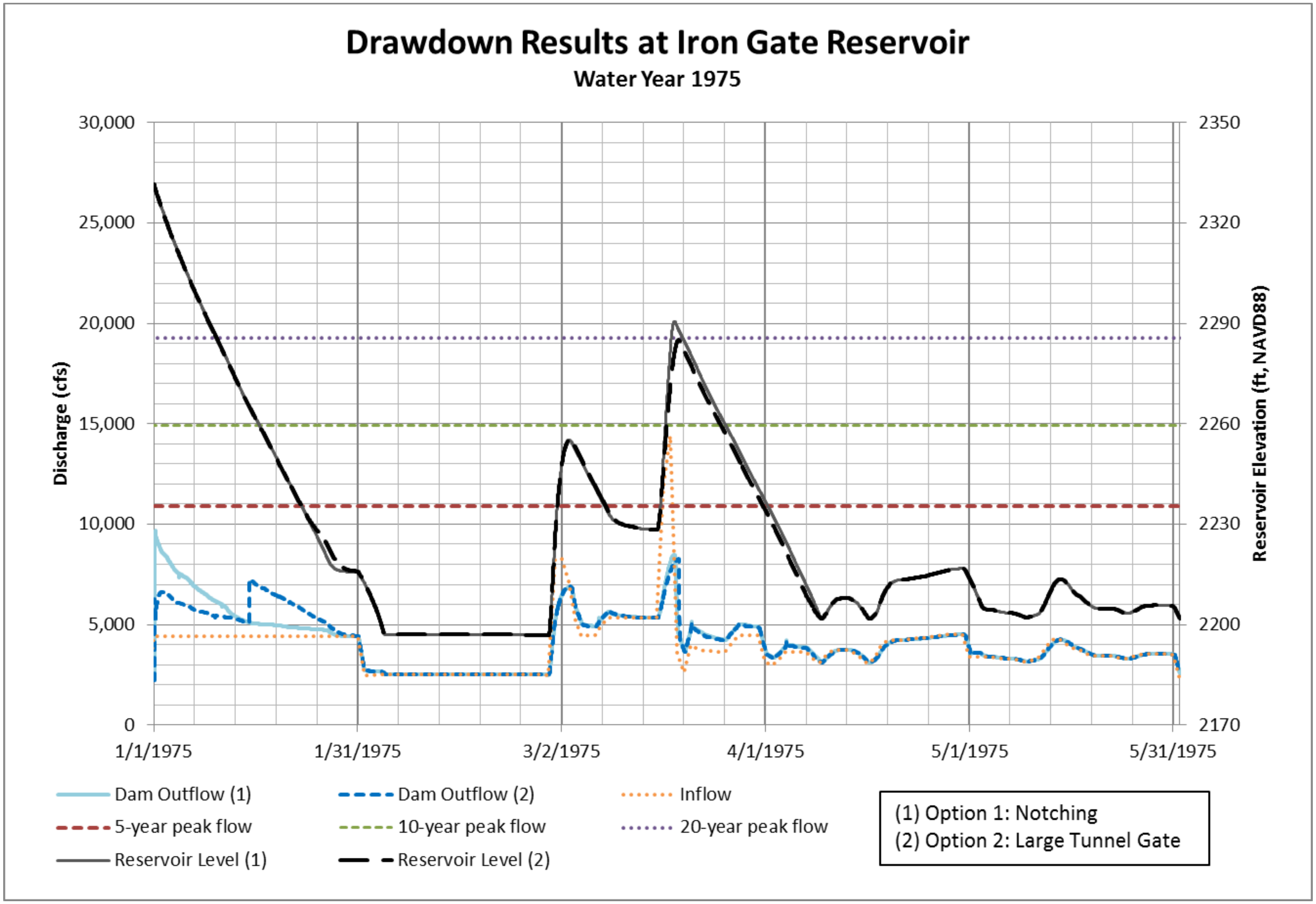

Figure 4-15 Iron Gate Reservoir Drawdown, Water Year 1975

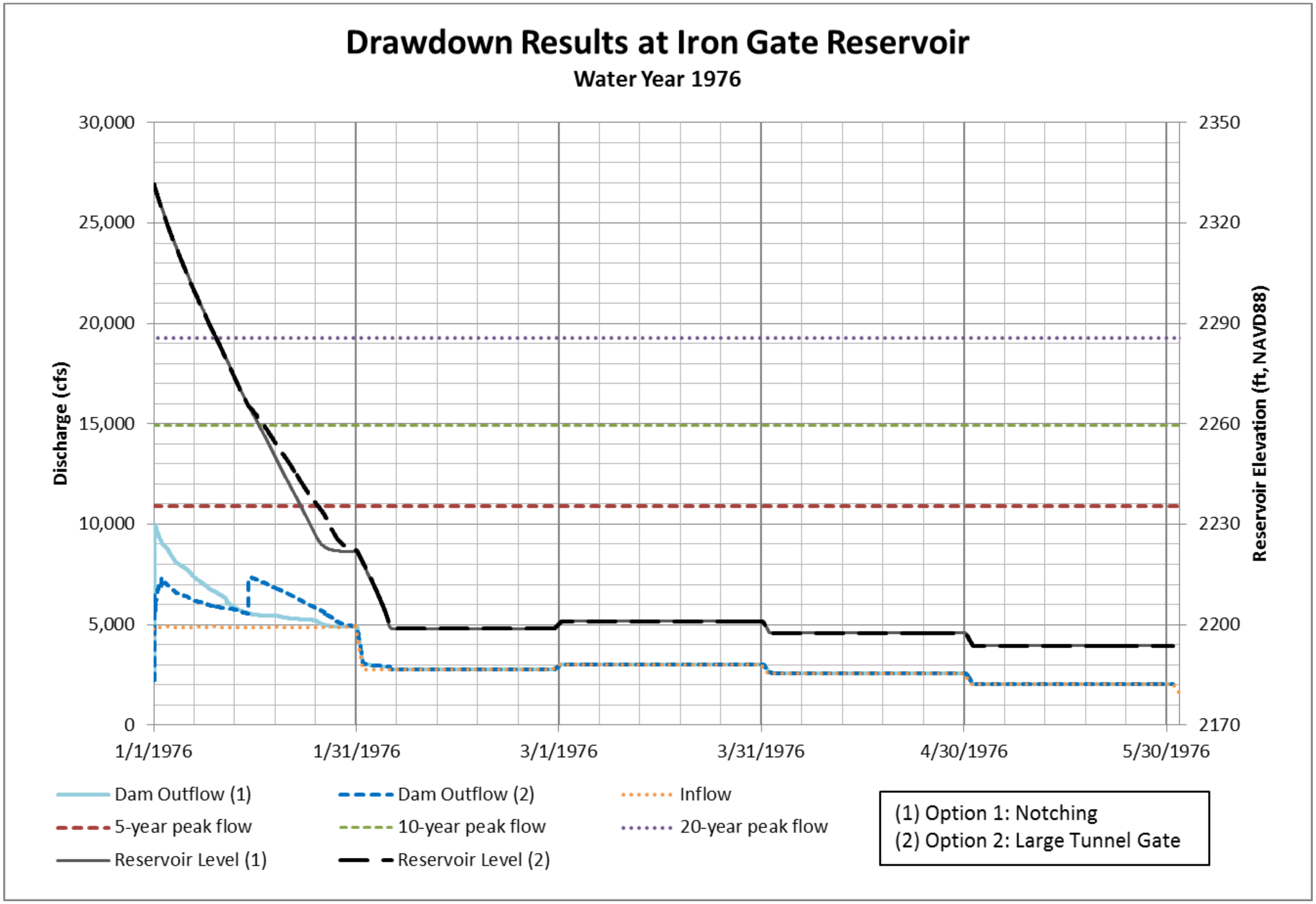

Figure 4-16 Iron Gate Reservoir Drawdown, Water Year 1976

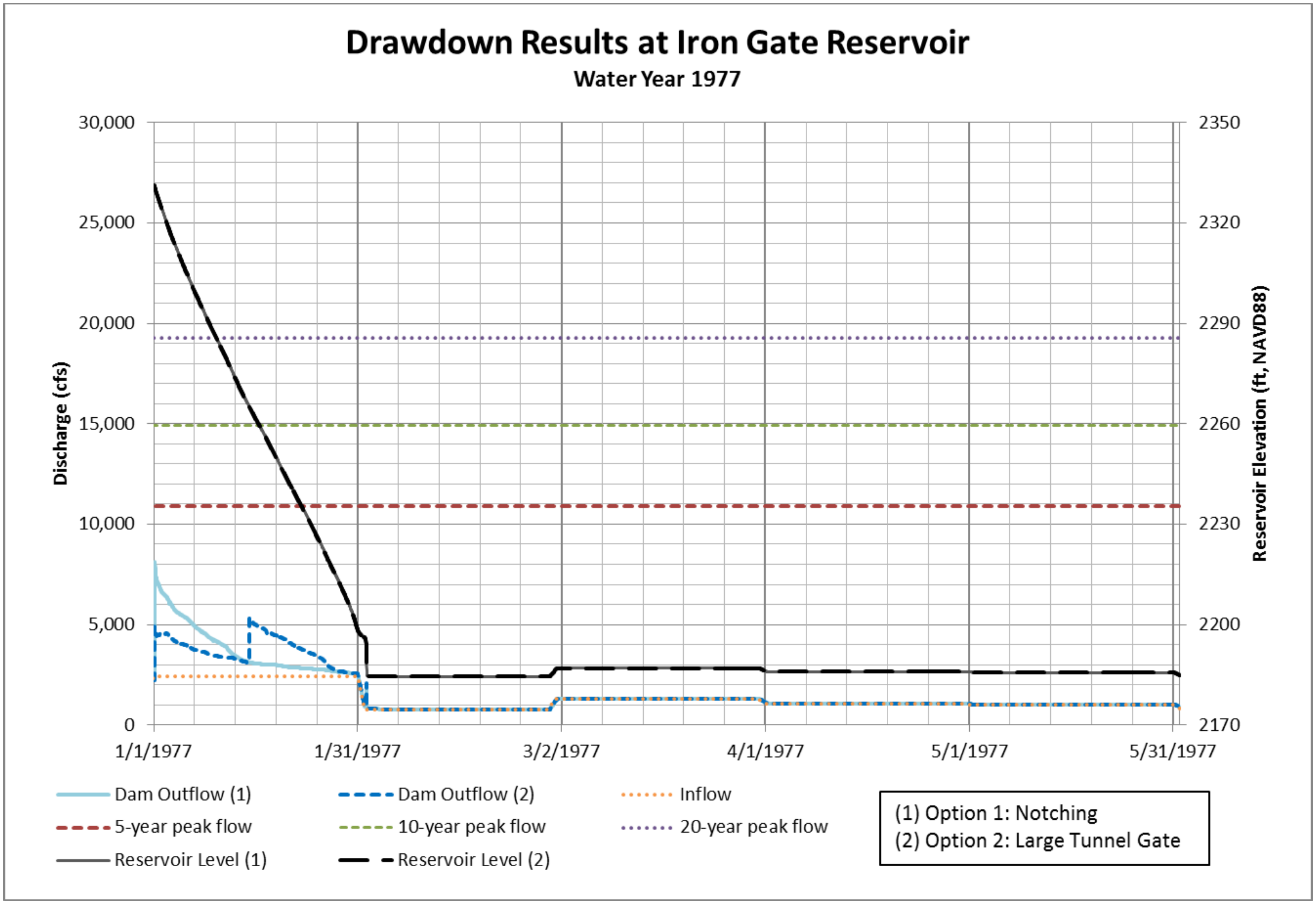

Figure 4-17 Iron Gate Reservoir Drawdown, Water Year 1977

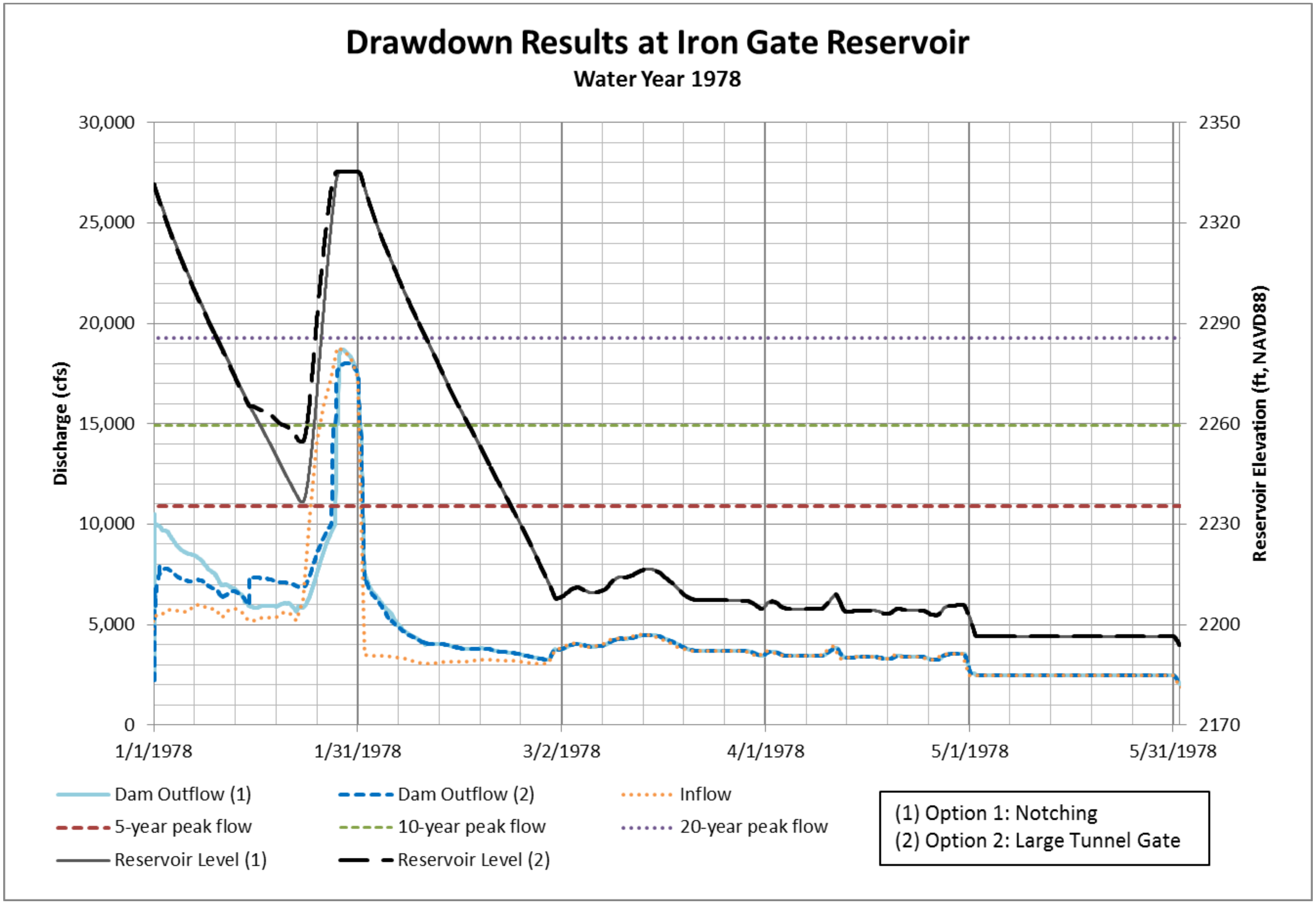

Figure 4-18 Iron Gate Reservoir Drawdown, Water Year 1978

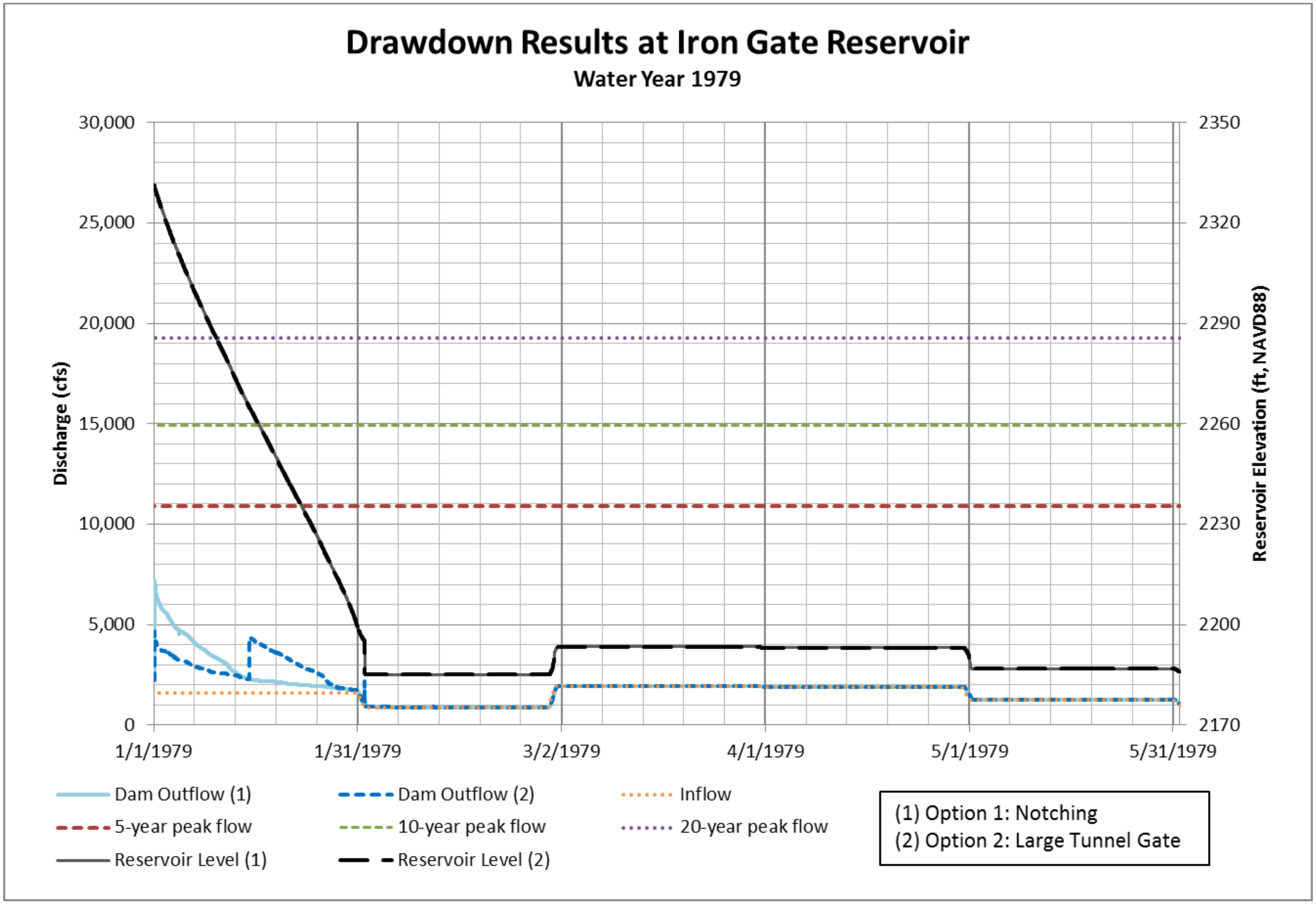

Figure 4-19 Iron Gate Reservoir Drawdown, Water Year 1979

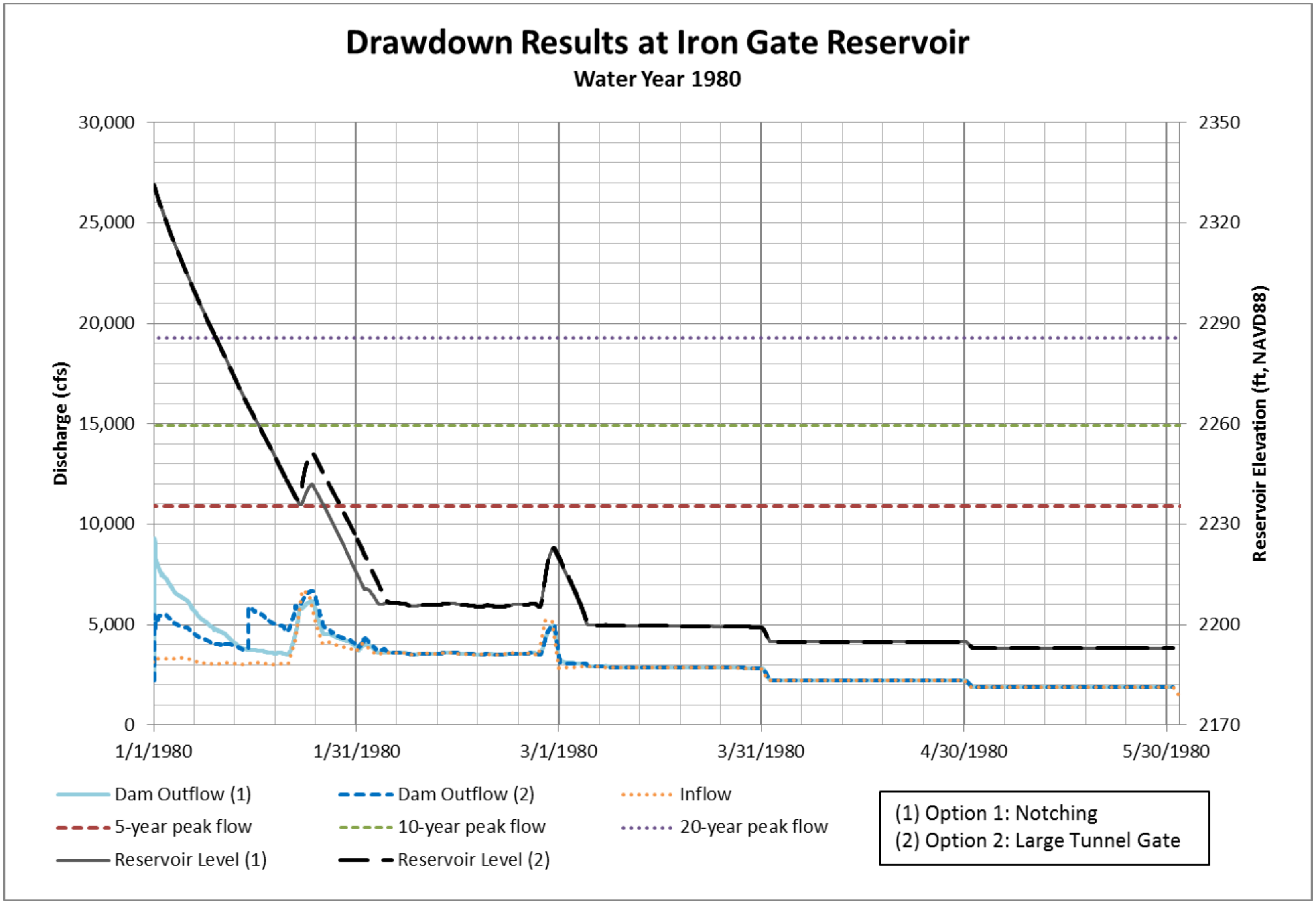

Figure 4-20 Iron Gate Reservoir Drawdown, Water Year 1980

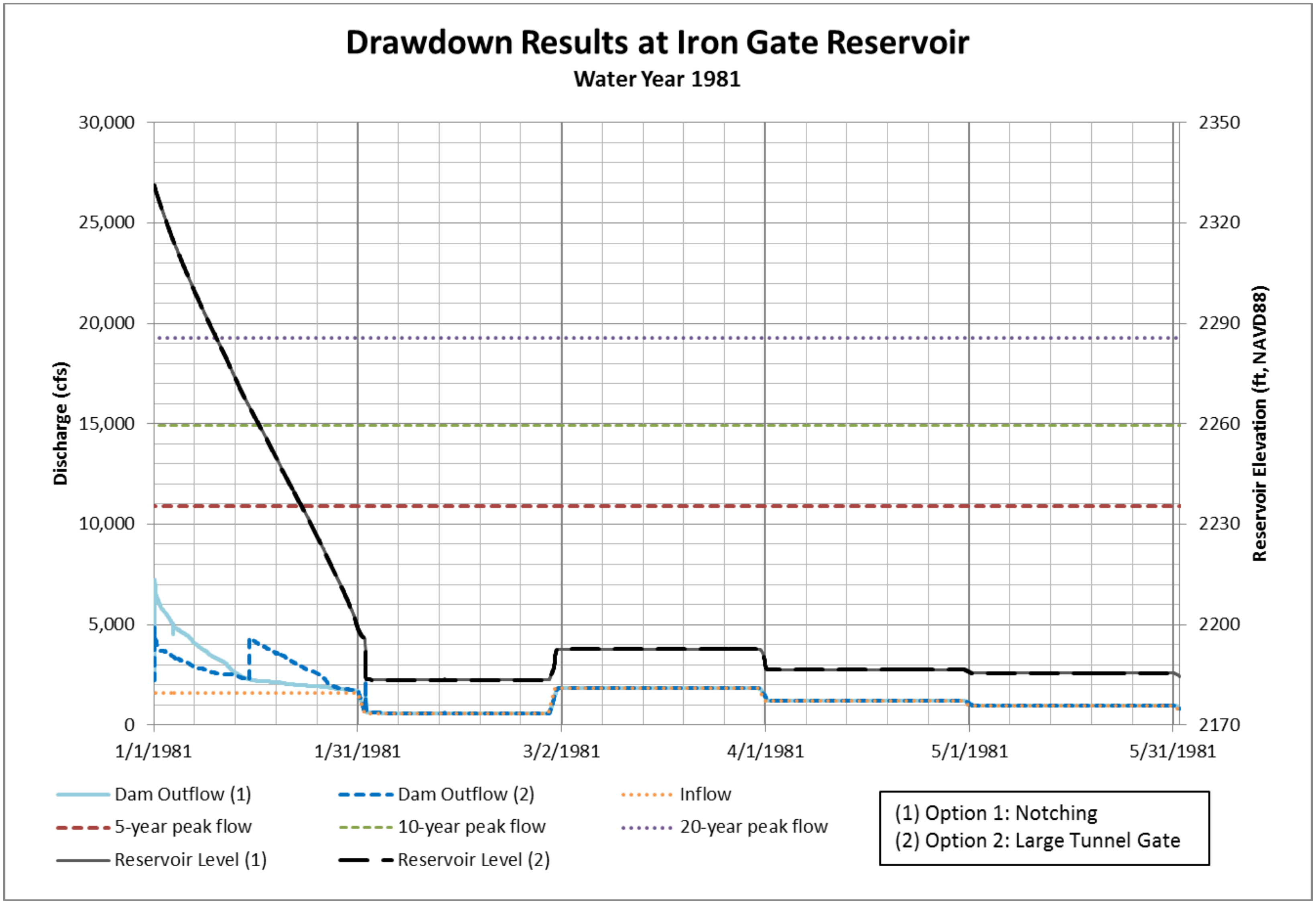

Figure 4-21 Iron Gate Reservoir Drawdown, Water Year 1981

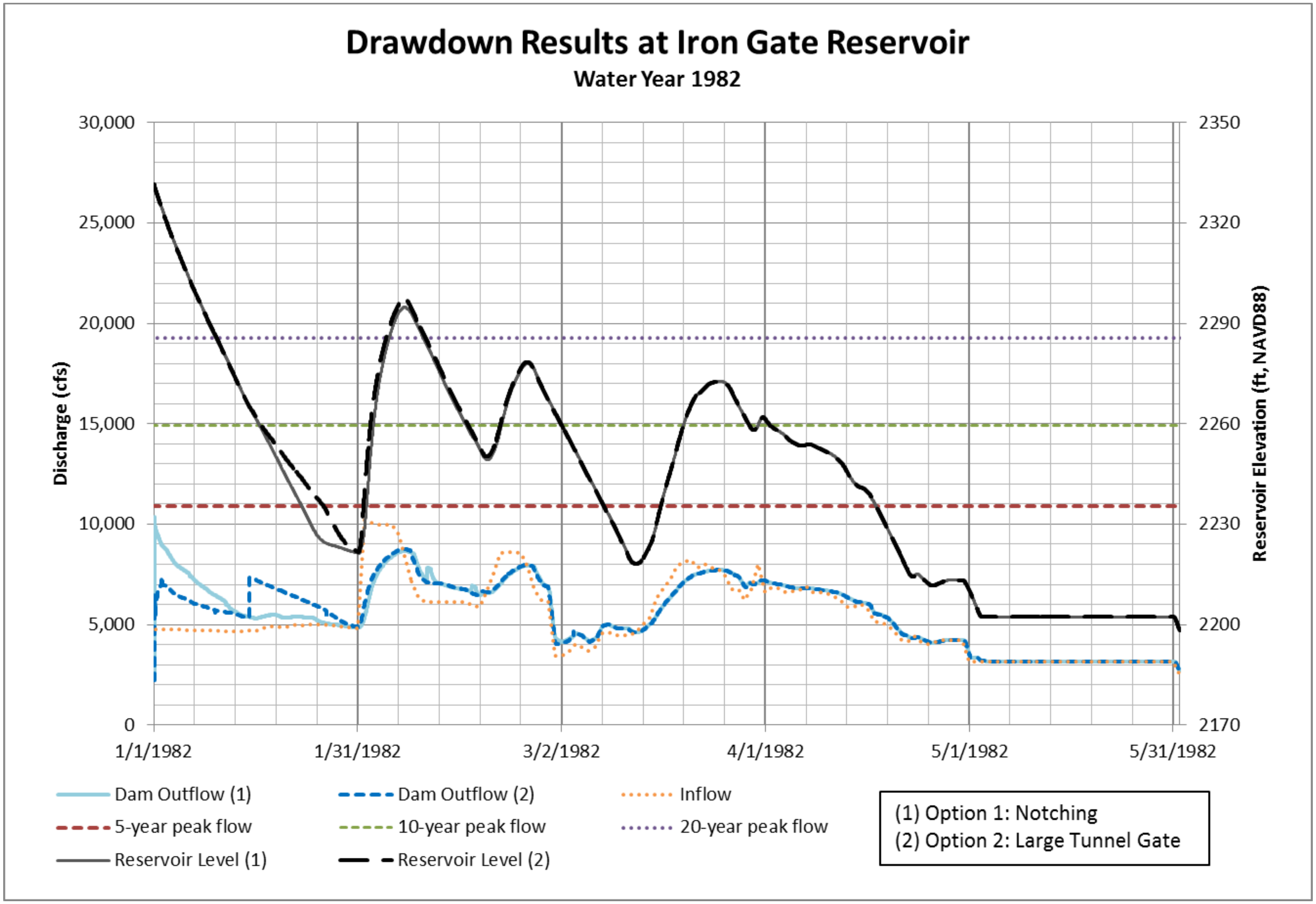

Figure 4-22 Iron Gate Reservoir Drawdown, Water Year 1982

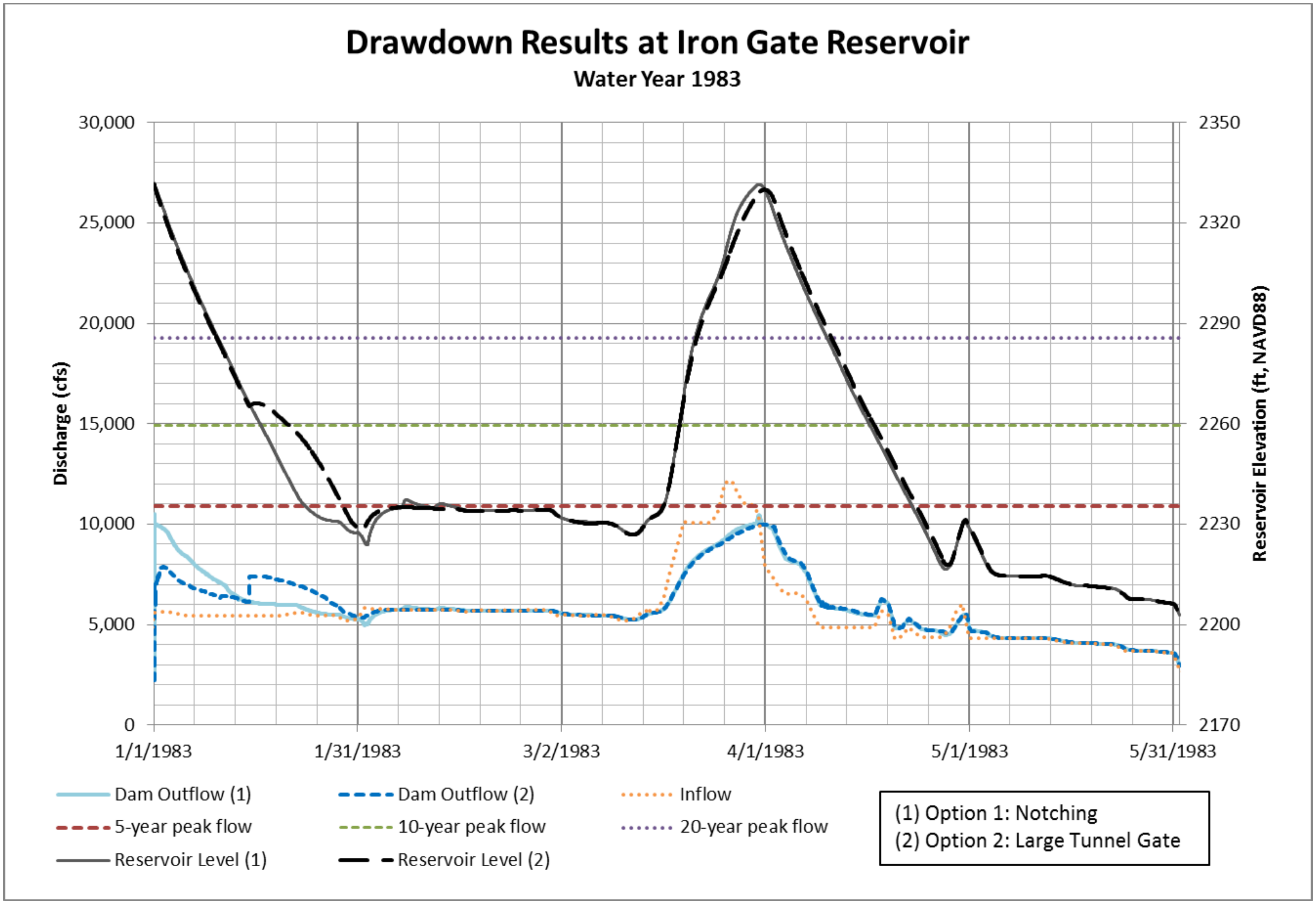

Figure 4-23 **Iron Gate Reservoir Drawdown, Water Year 1983**

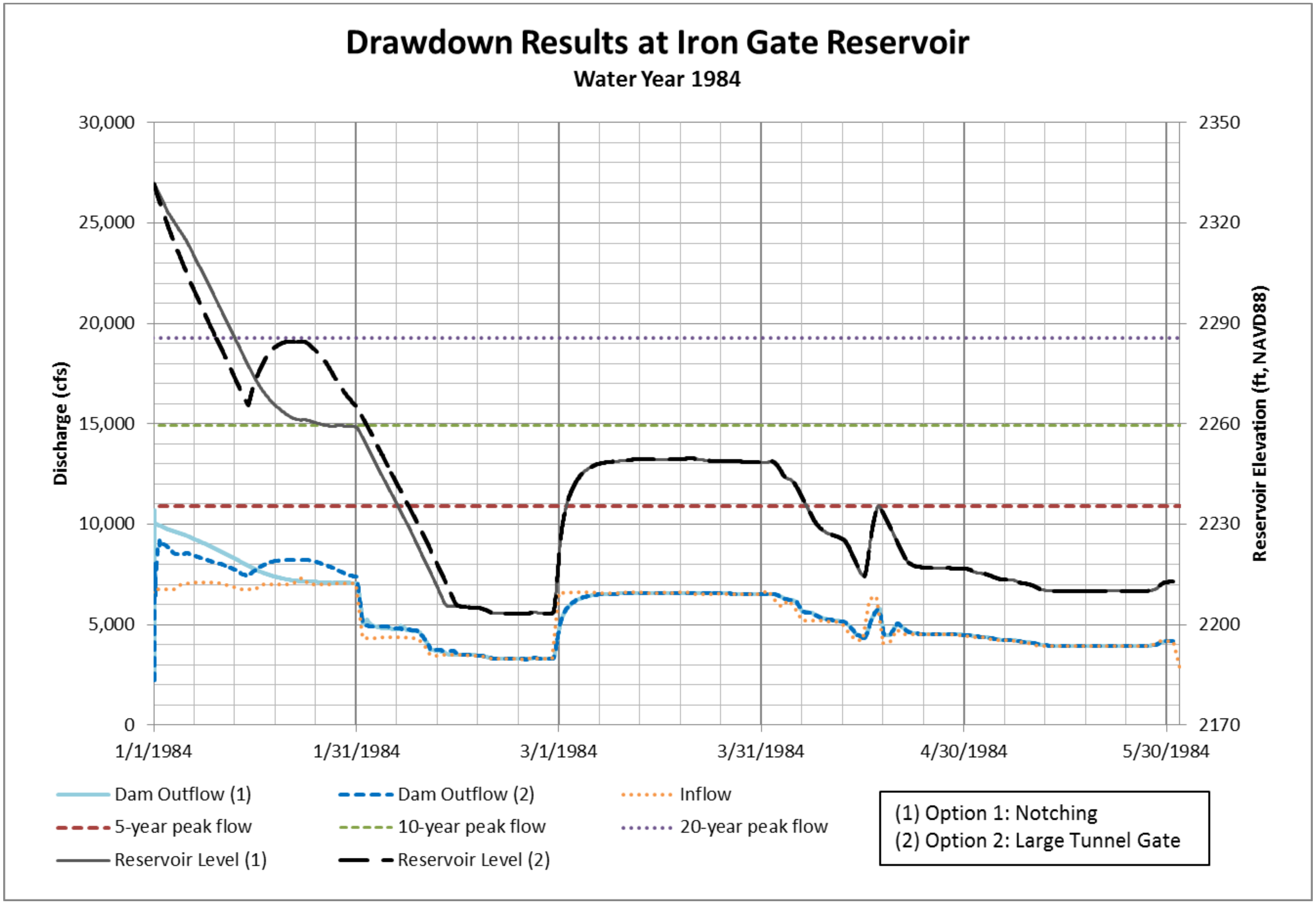

Figure 4-24 Iron Gate Reservoir Drawdown, Water Year 1984

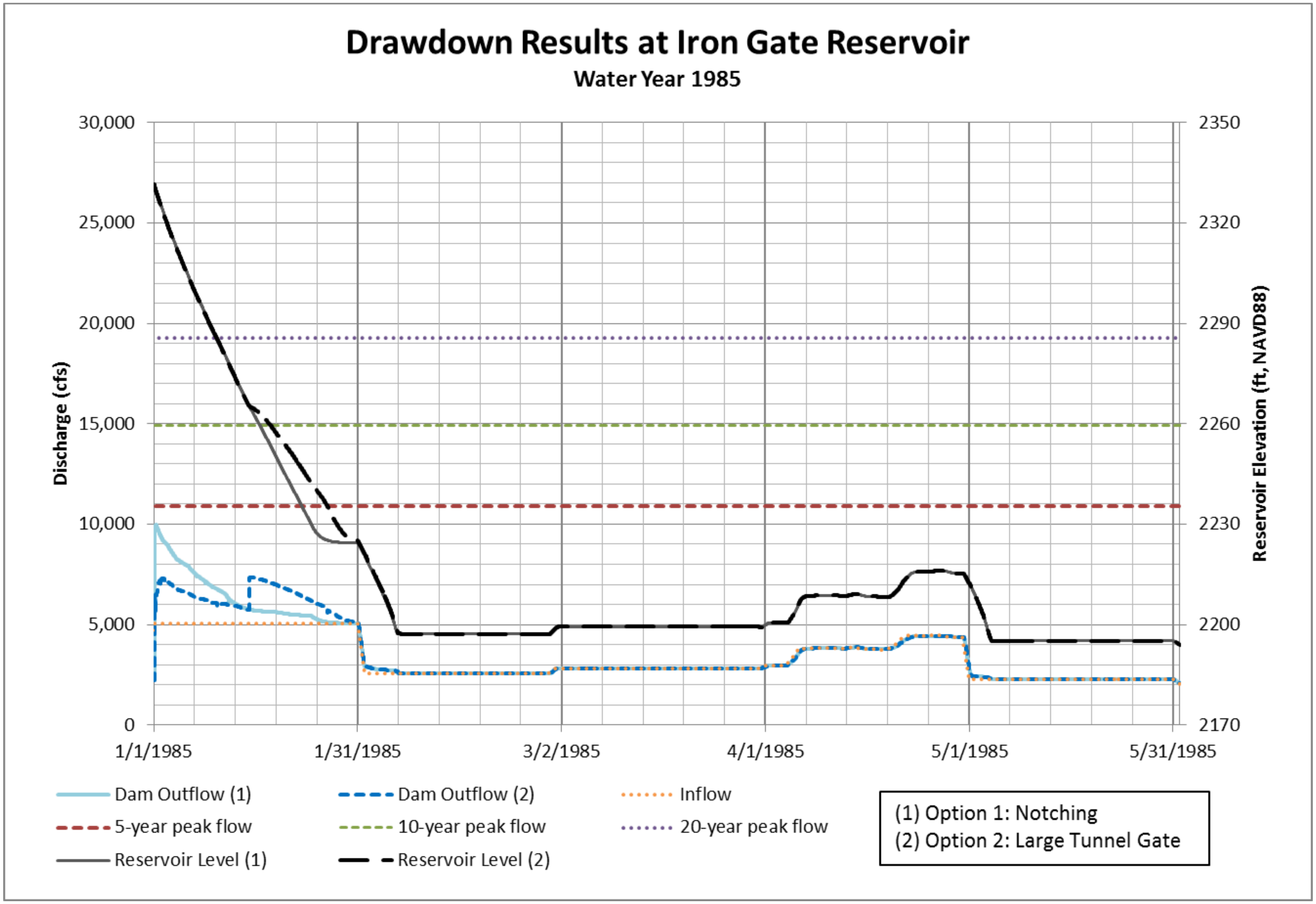

Figure 4-25 Iron Gate Reservoir Drawdown, Water Year 1985

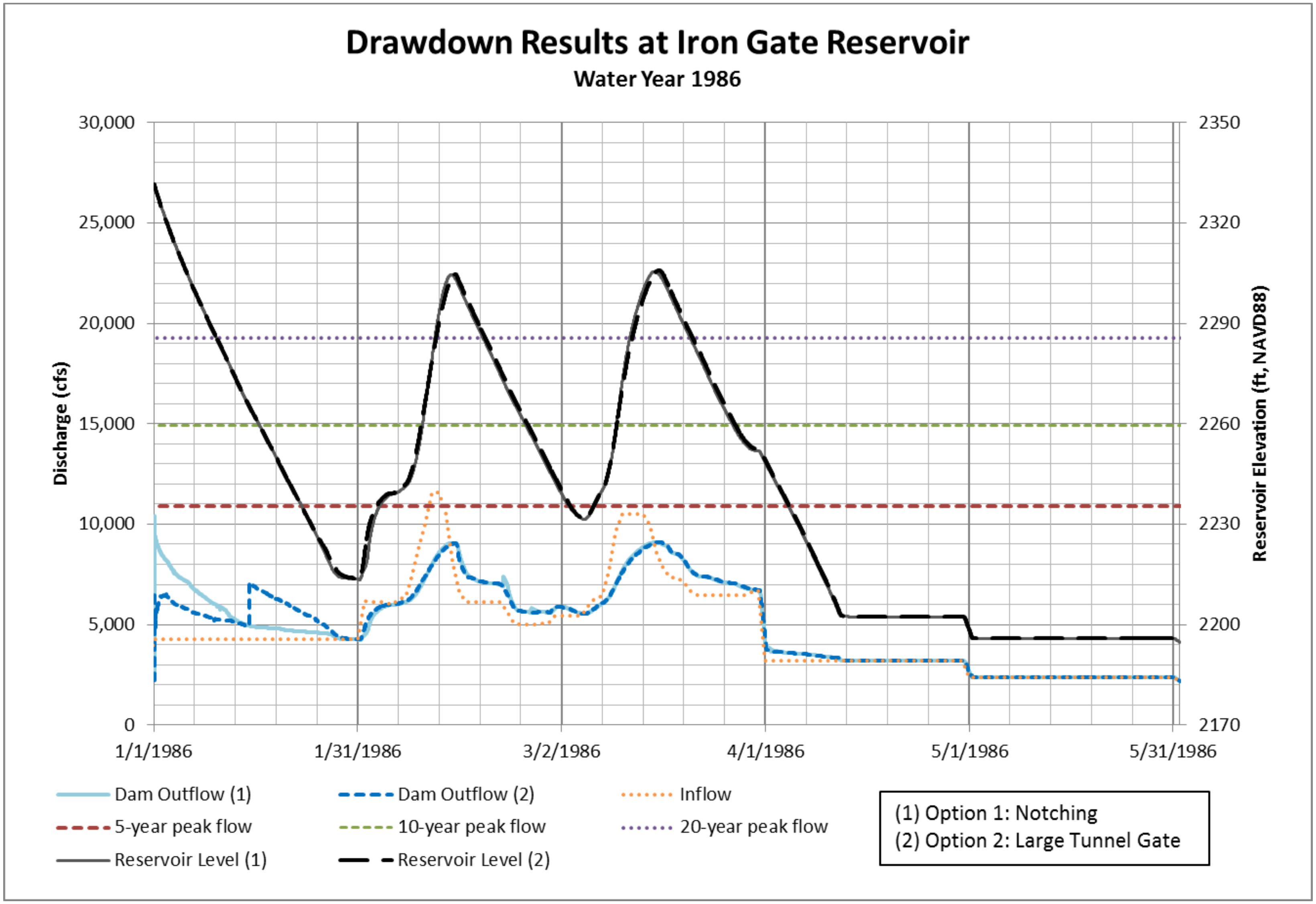

Figure 4-26 **Iron Gate Reservoir Drawdown, Water Year 1986**

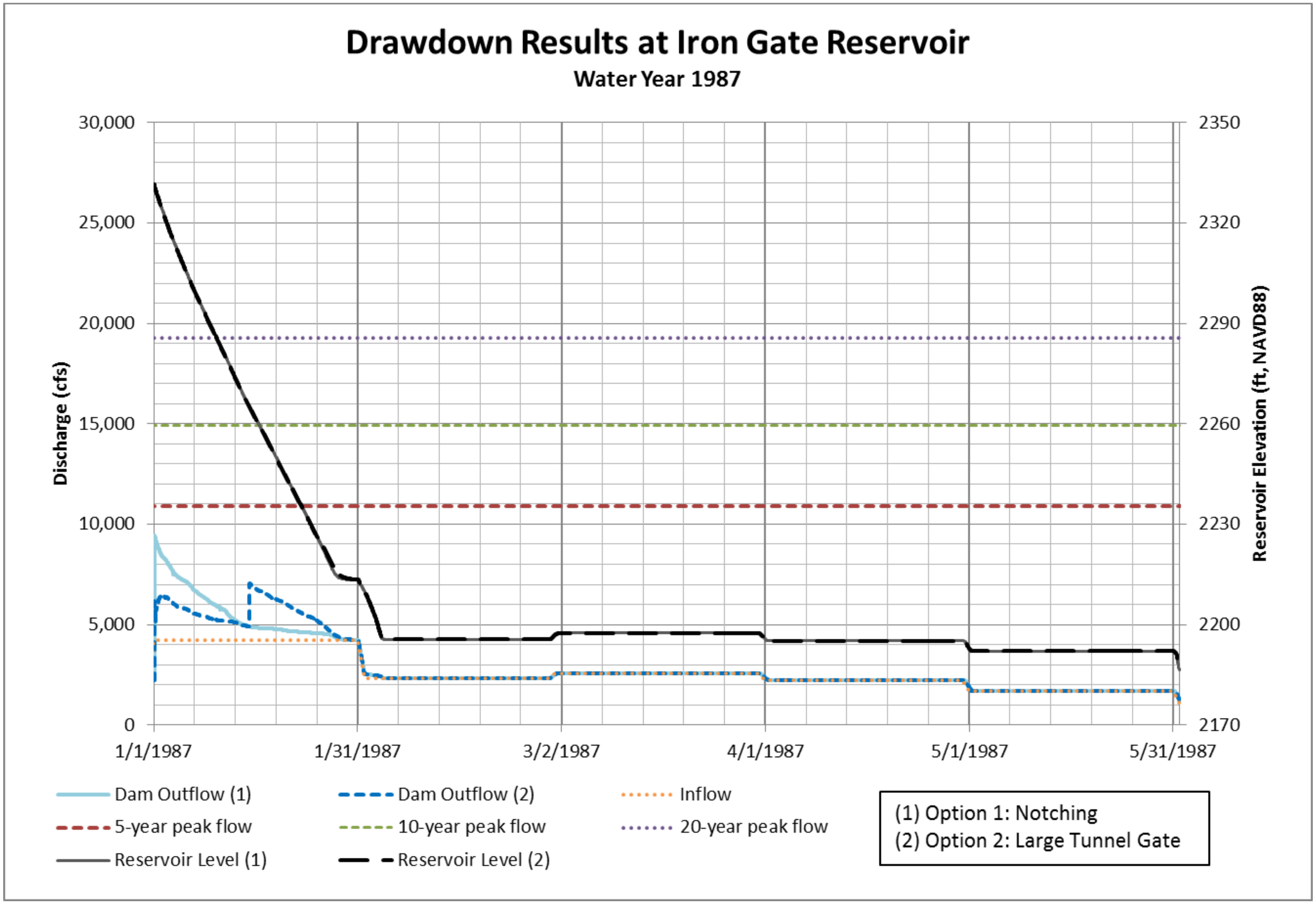

Figure 4-27 Iron Gate Reservoir Drawdown, Water Year 1987

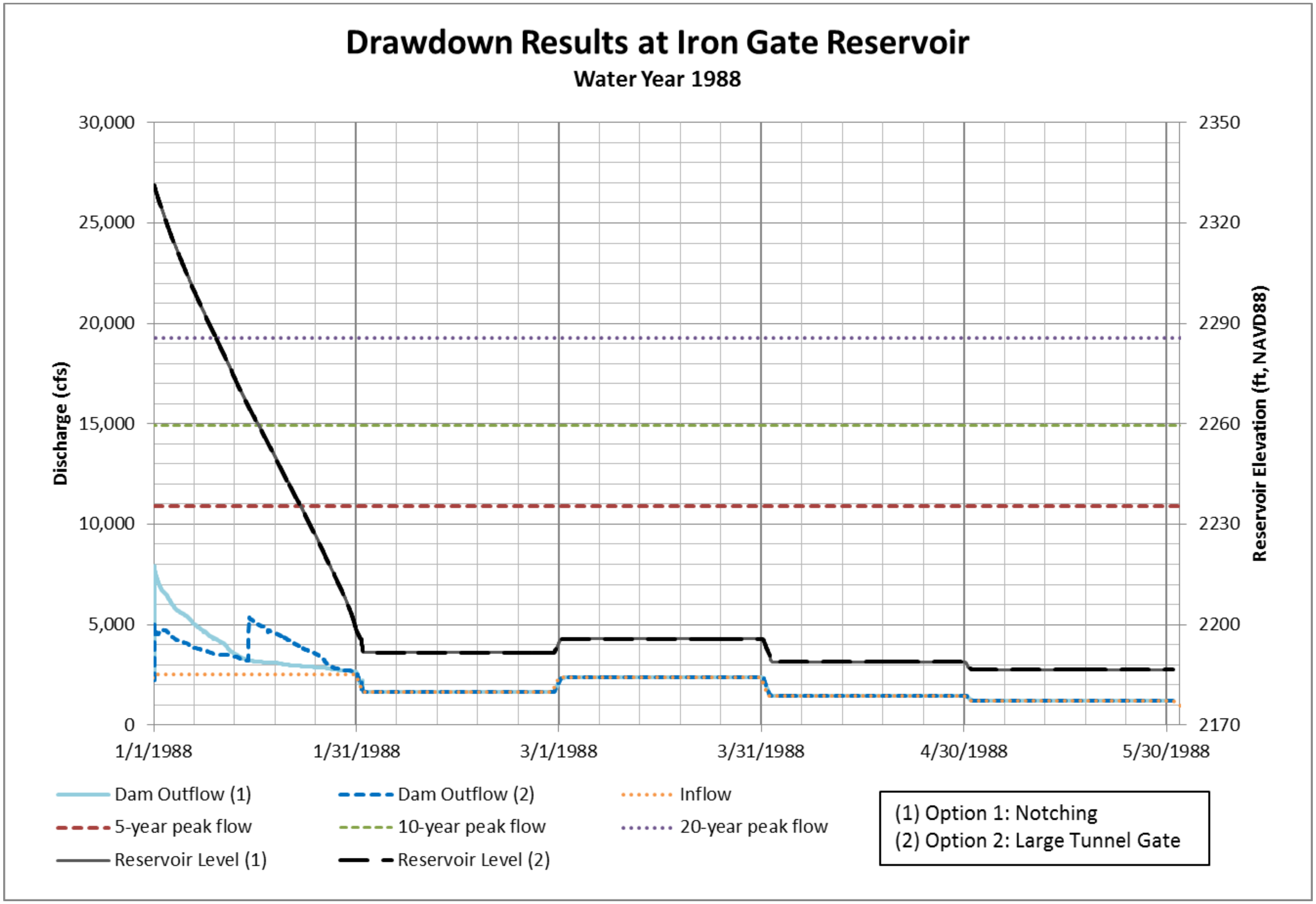

Figure 4-28 Iron Gate Reservoir Drawdown, Water Year 1988

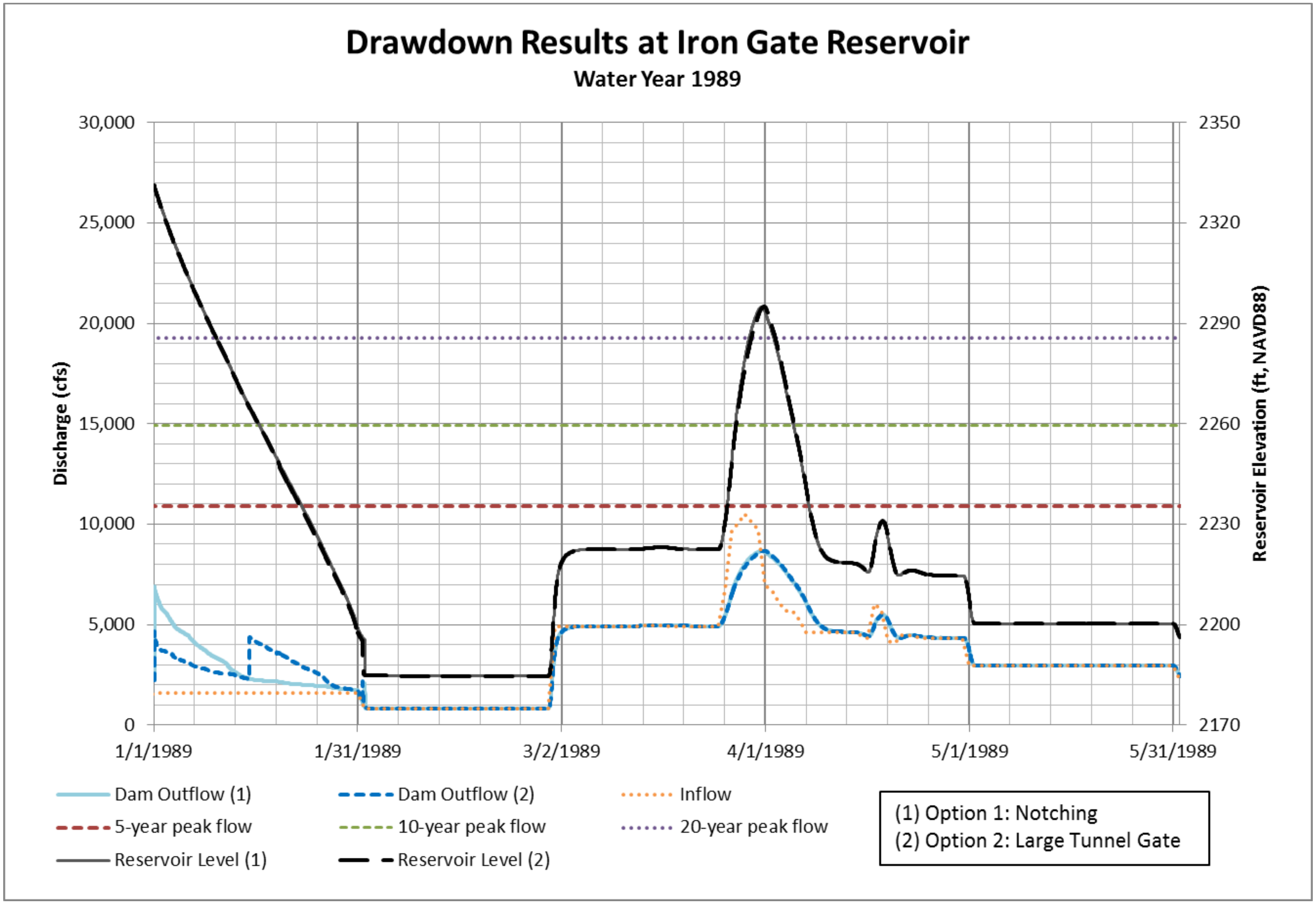

Figure 4-29 Iron Gate Reservoir Drawdown, Water Year 1989

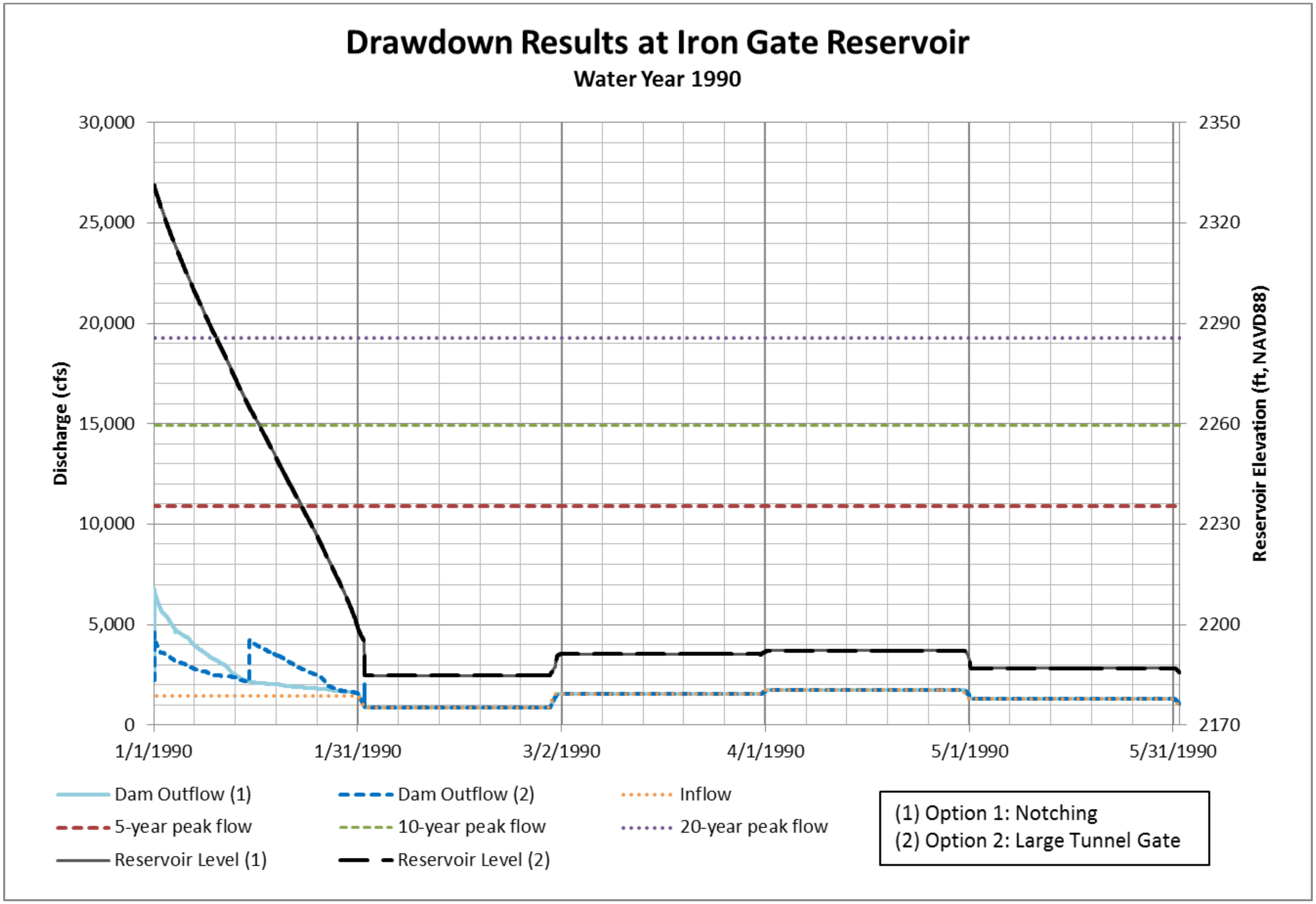

Figure 4-30 Iron Gate Reservoir Drawdown, Water Year 1990

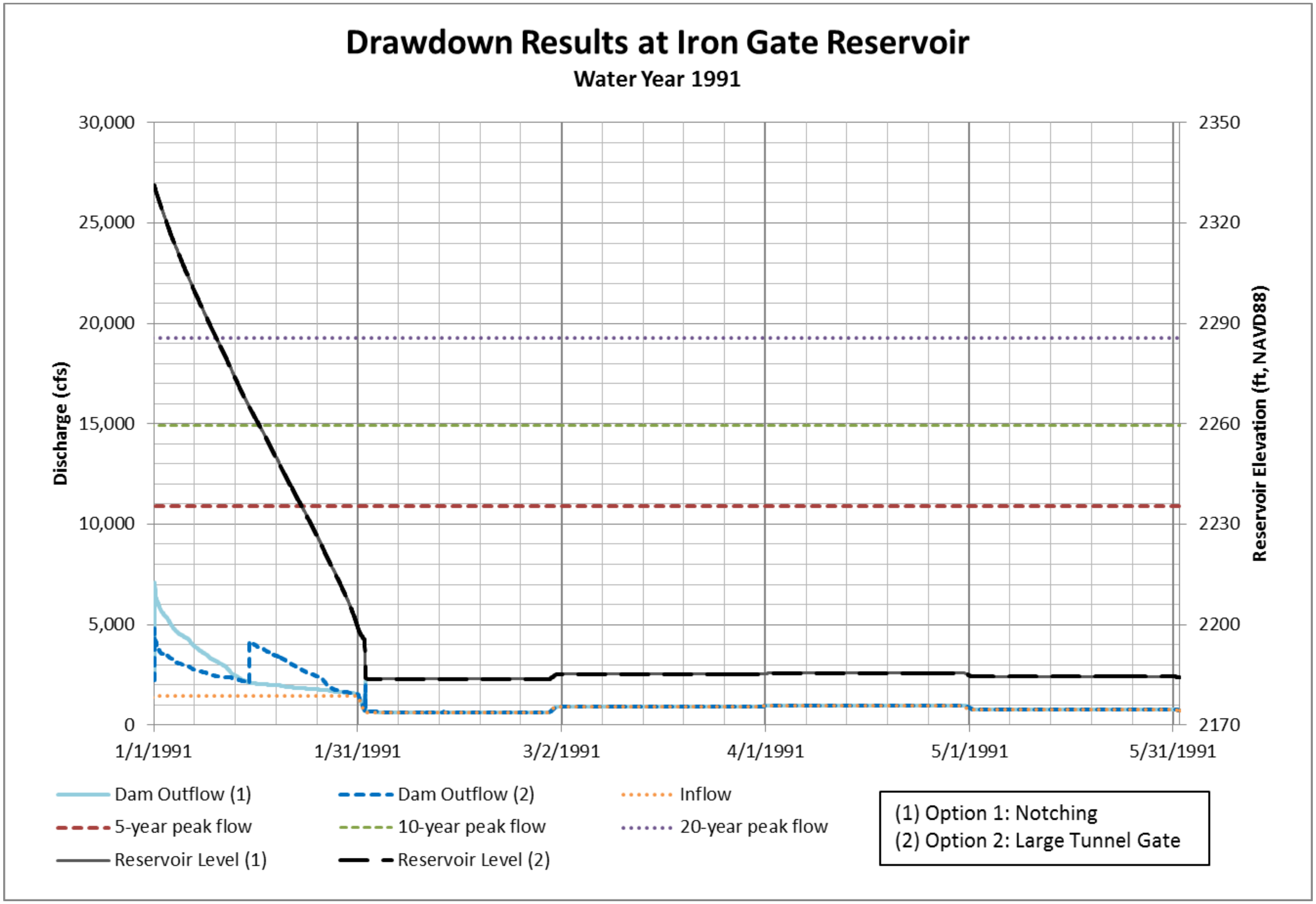

Figure 4-31 Iron Gate Reservoir Drawdown, Water Year 1991

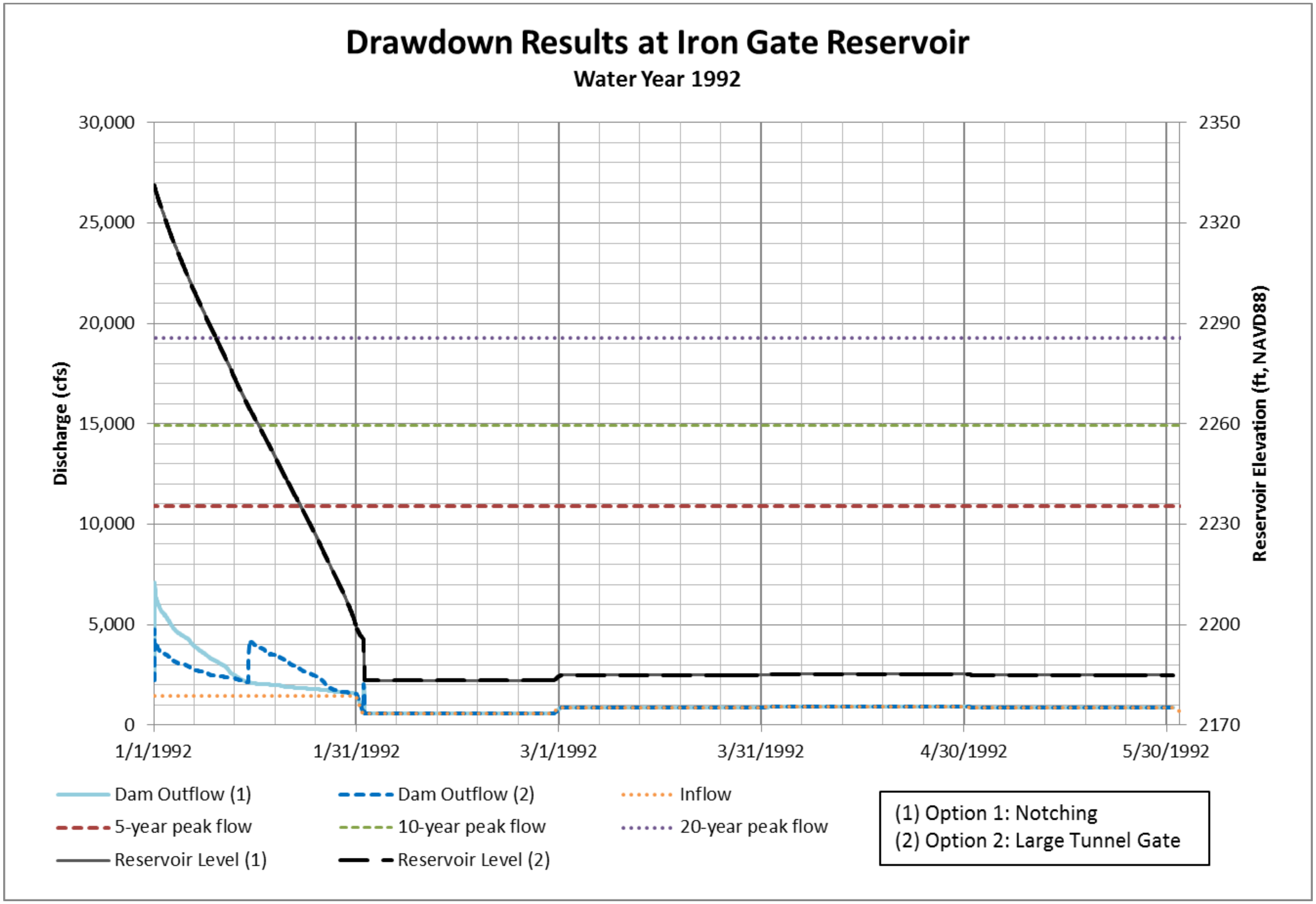

Figure 4-32 Iron Gate Reservoir Drawdown, Water Year 1992

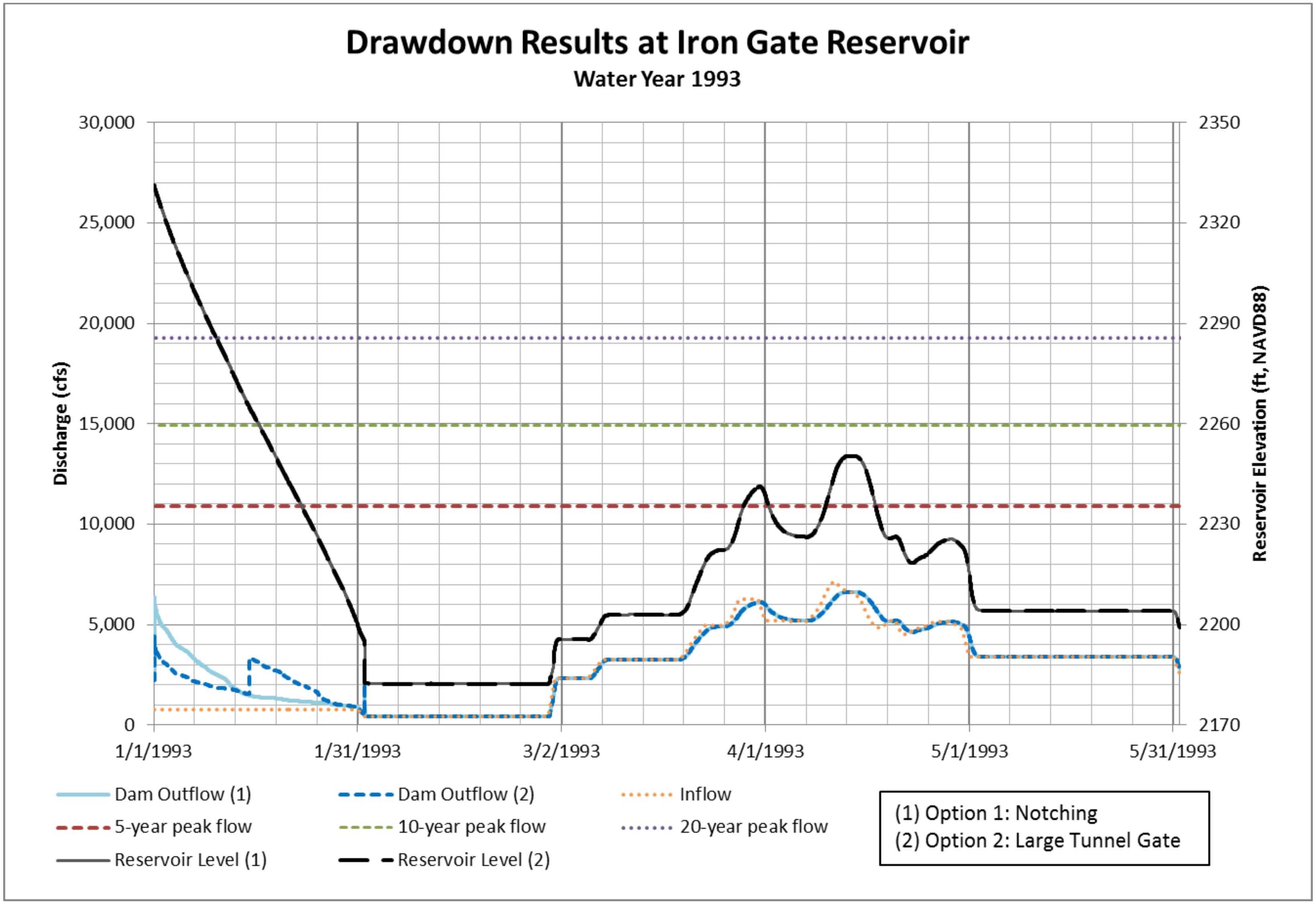

Figure 4-33 Iron Gate Reservoir Drawdown, Water Year 1993

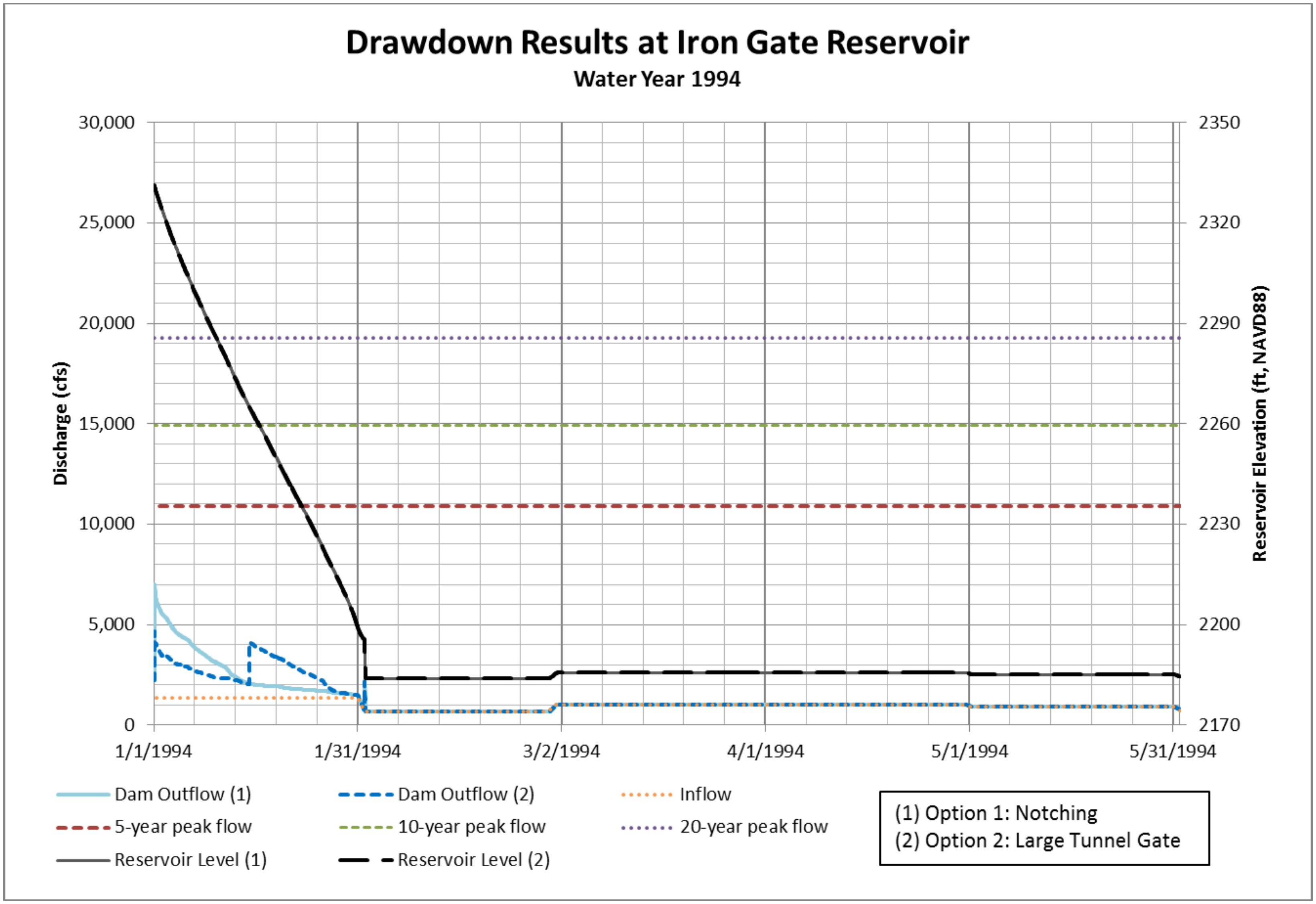

Figure 4-34 Iron Gate Reservoir Drawdown, Water Year 1994

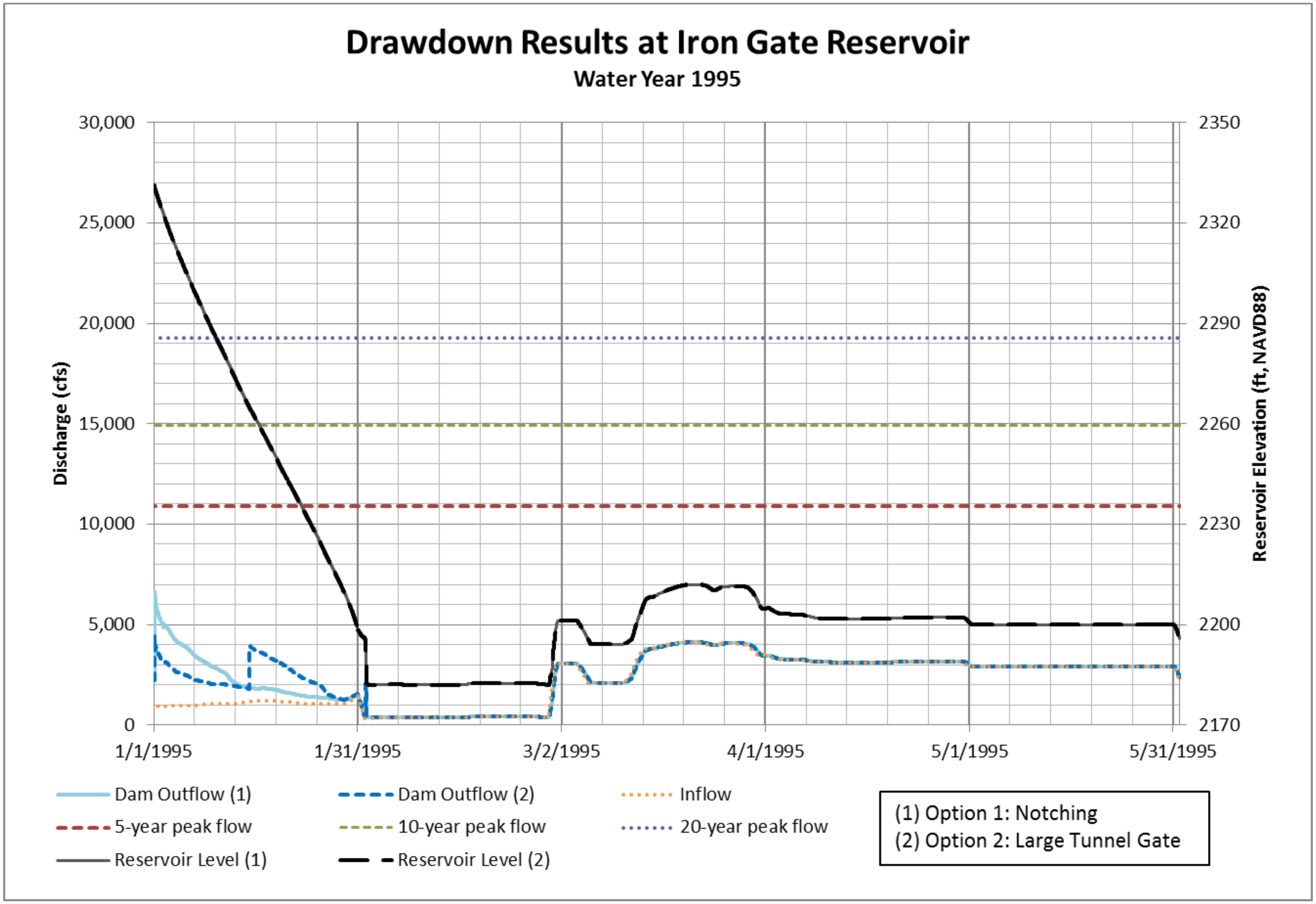

Figure 4-35 Iron Gate Reservoir Drawdown, Water Year 1995

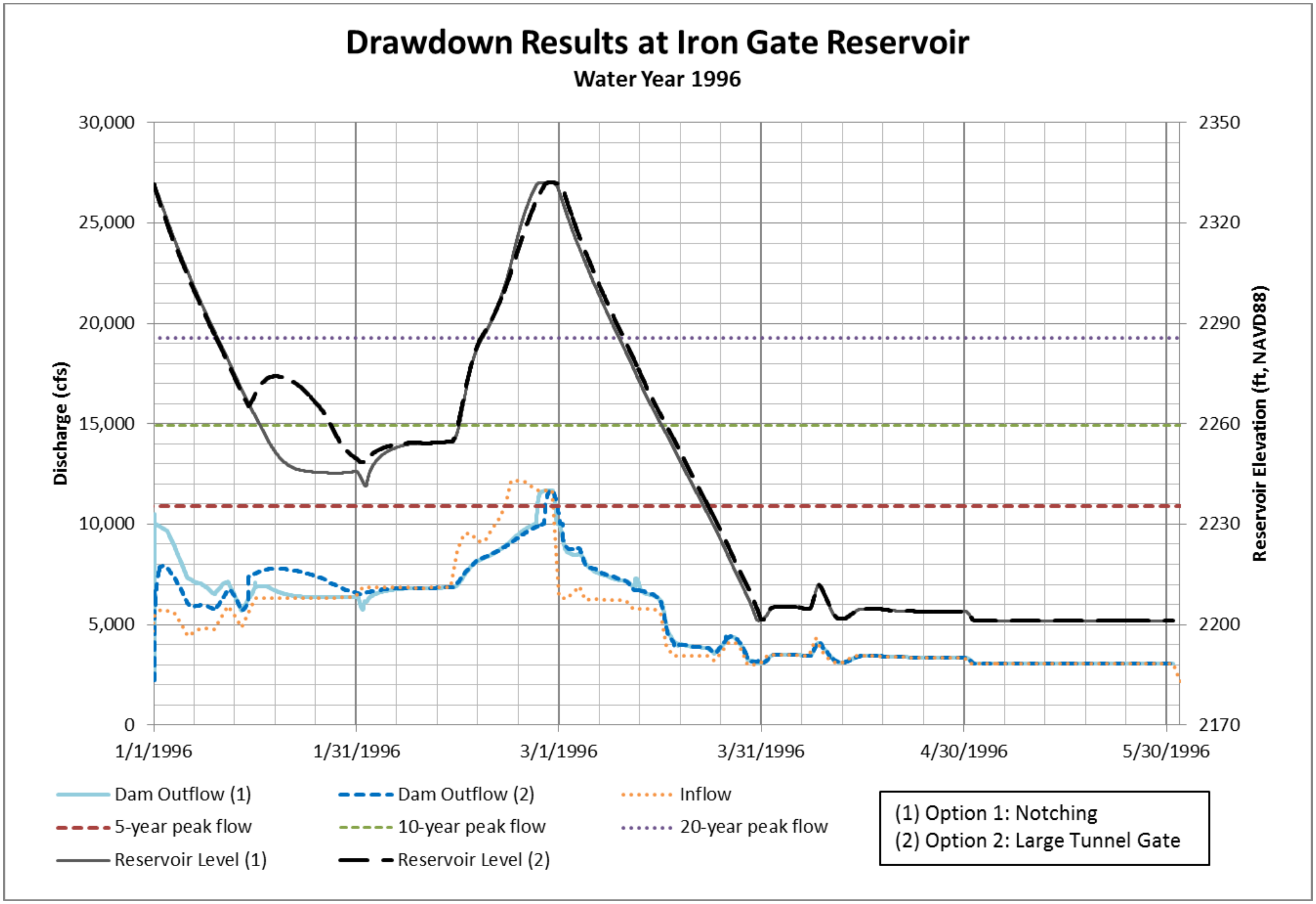

Figure 4-36 Iron Gate Reservoir Drawdown, Water Year 1996

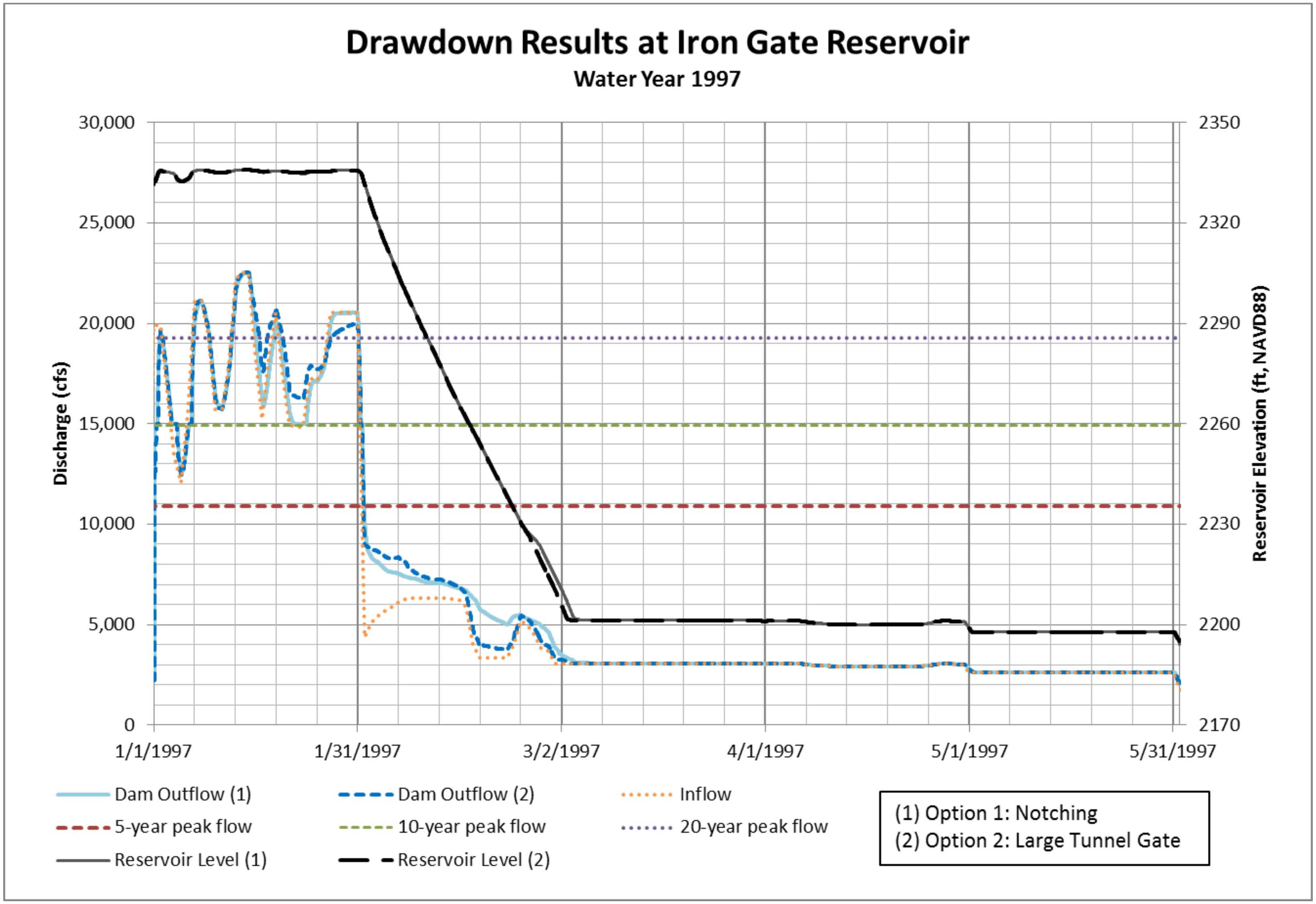

Figure 4-37 Iron Gate Reservoir Drawdown, Water Year 1997

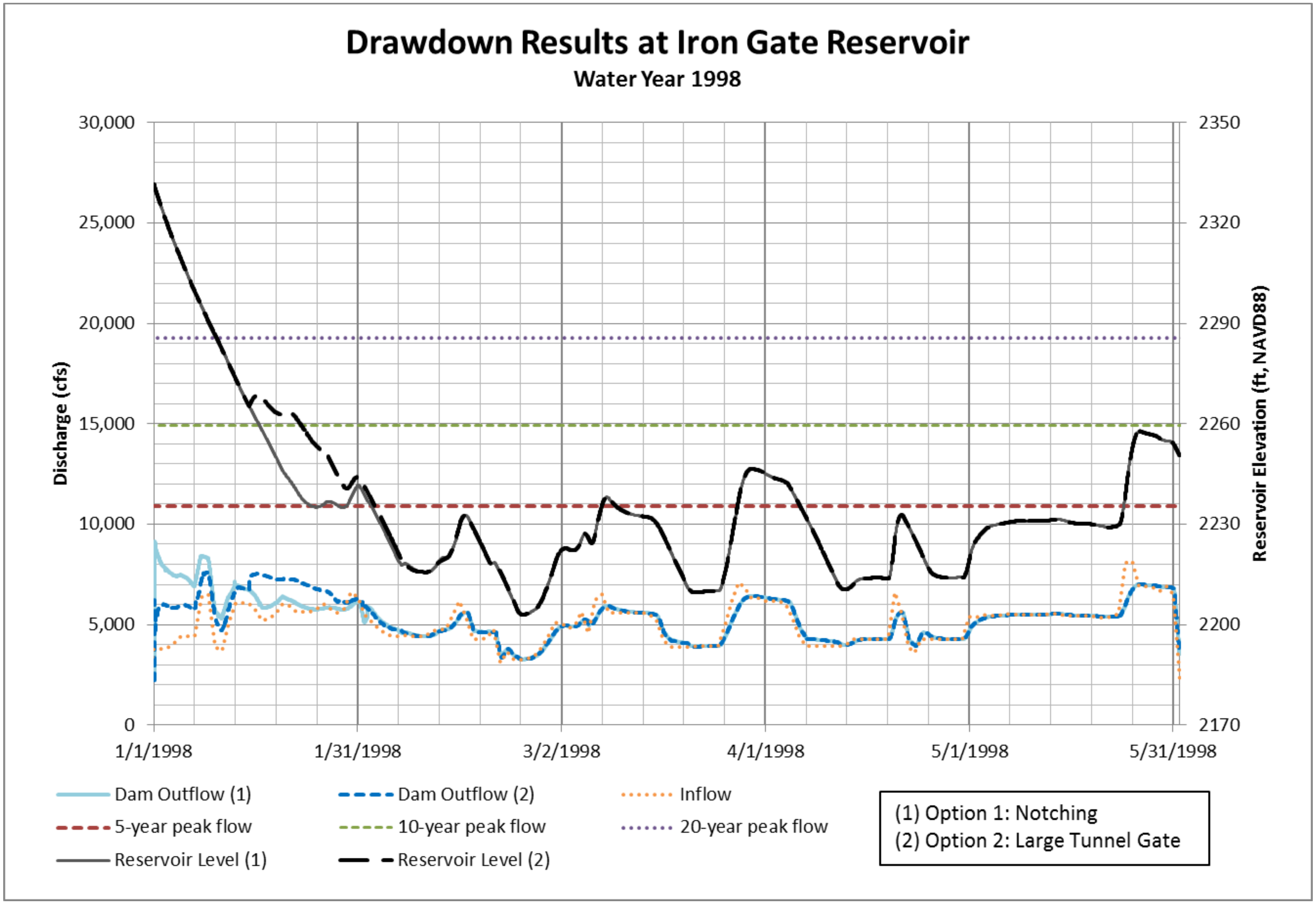

Figure 4-38 Iron Gate Reservoir Drawdown, Water Year 1998

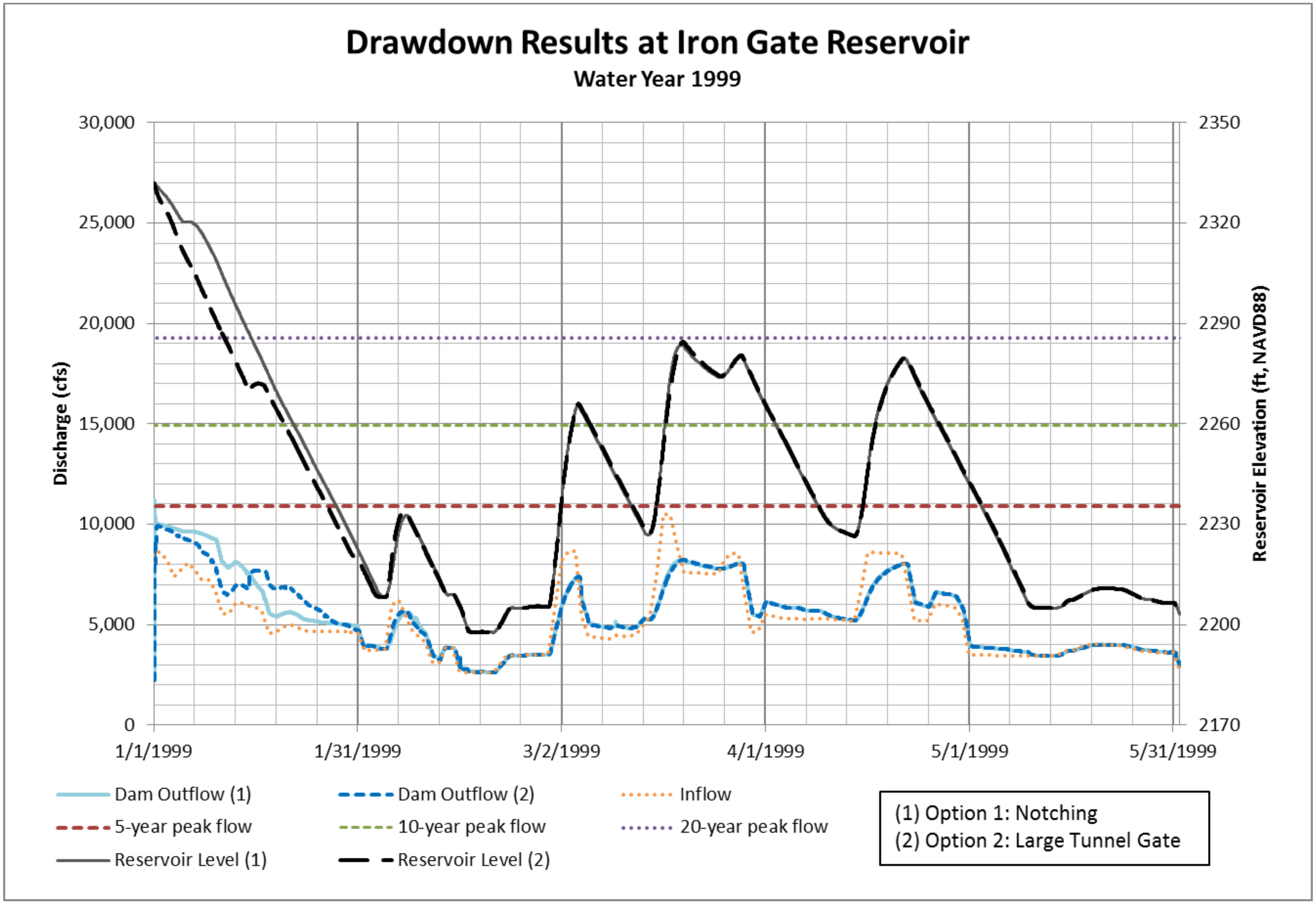

Figure 4-39 Iron Gate Reservoir Drawdown, Water Year 1999

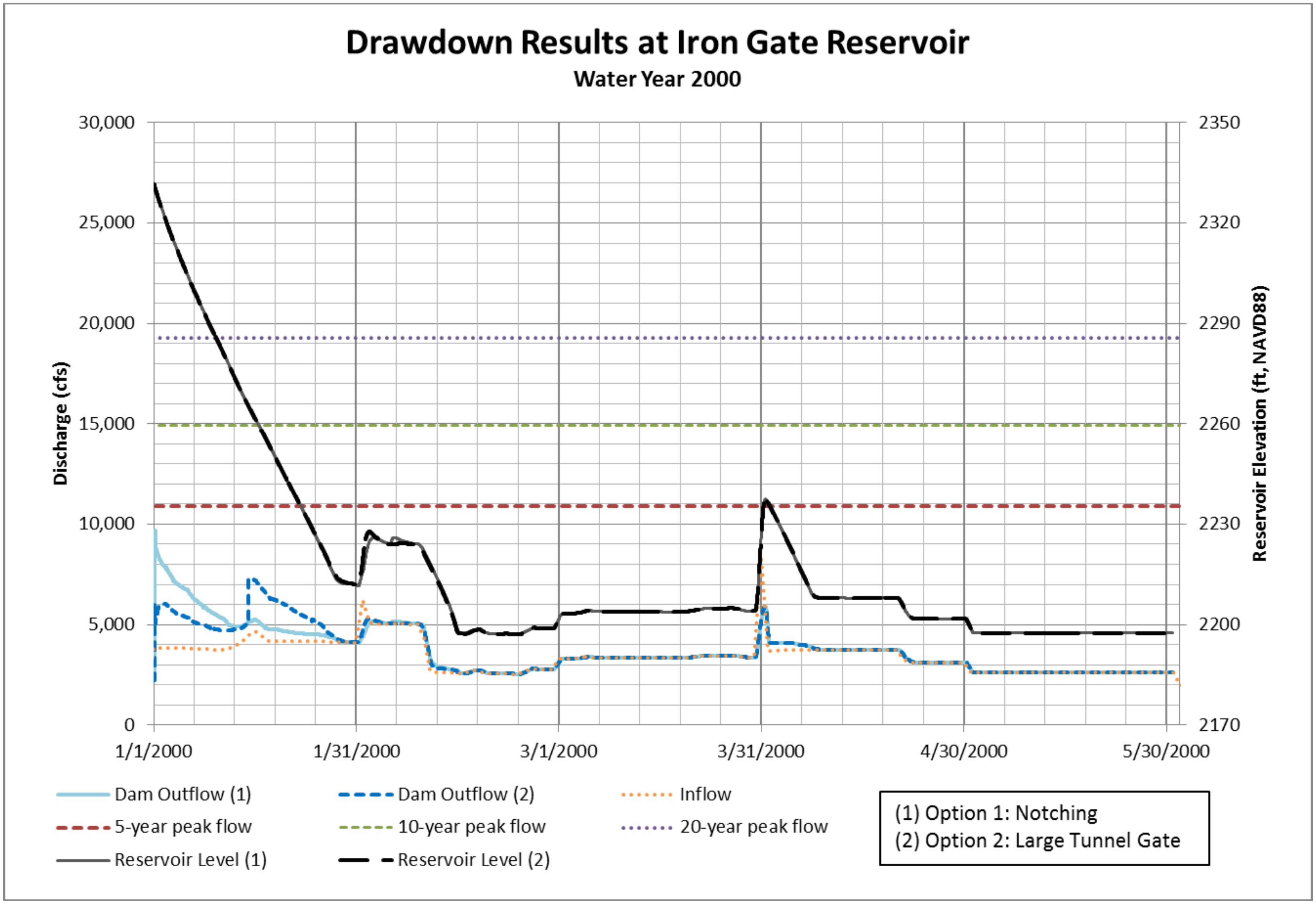

Figure 4-40 Iron Gate Reservoir Drawdown, Water Year 2000

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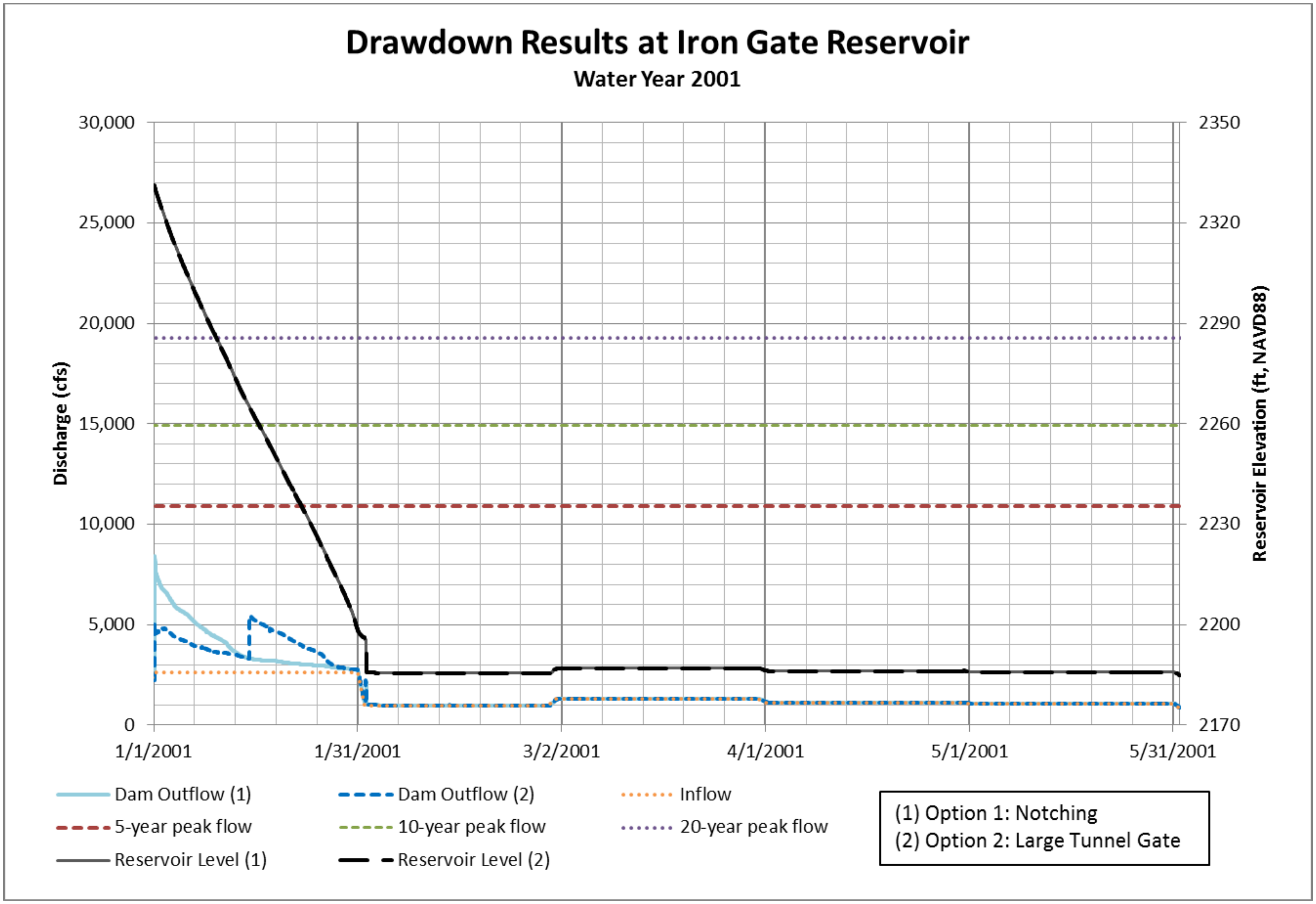

Figure 4-41 Iron Gate Reservoir Drawdown, Water Year 2001

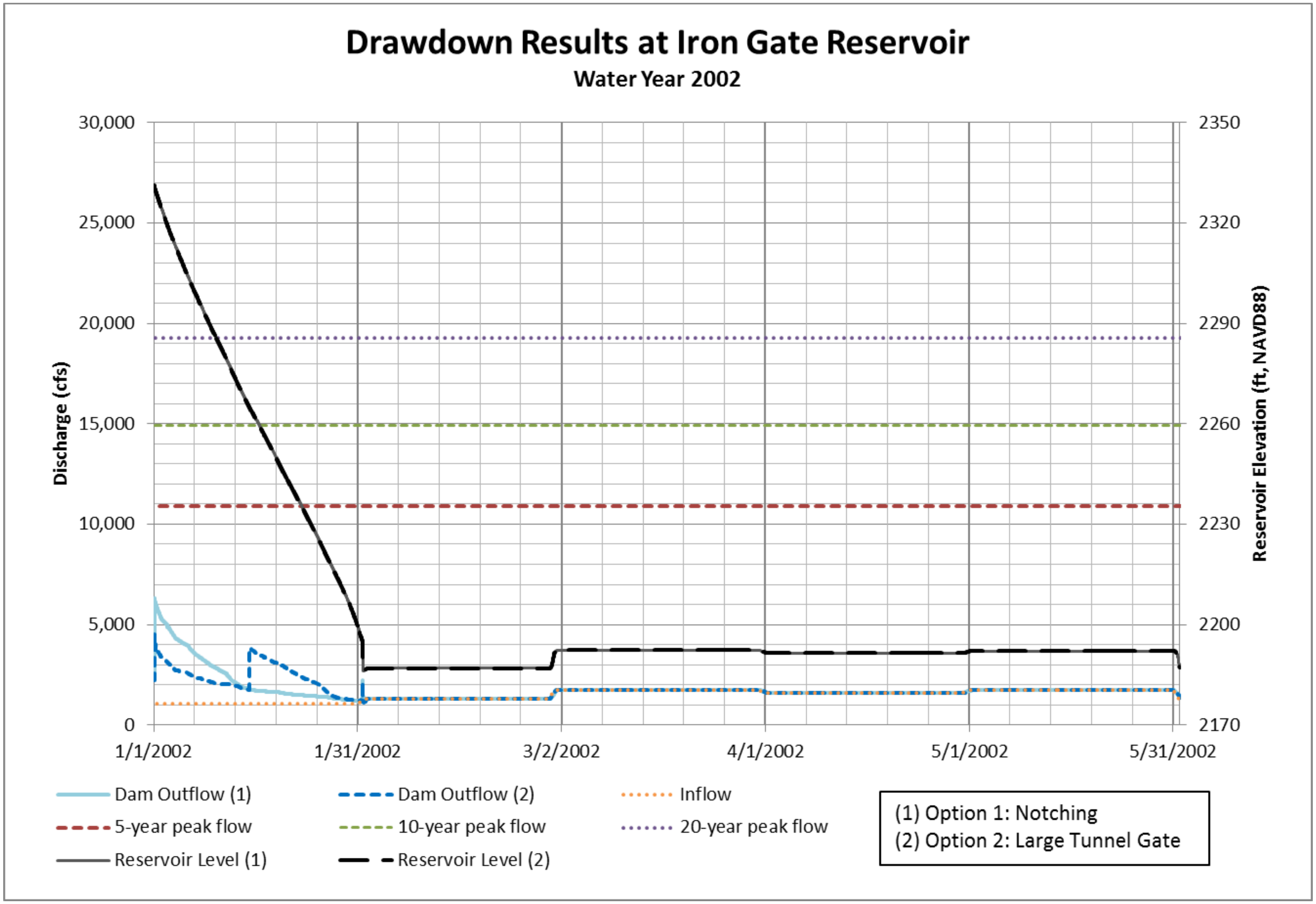

Figure 4-42 Iron Gate Reservoir Drawdown, Water Year 2002

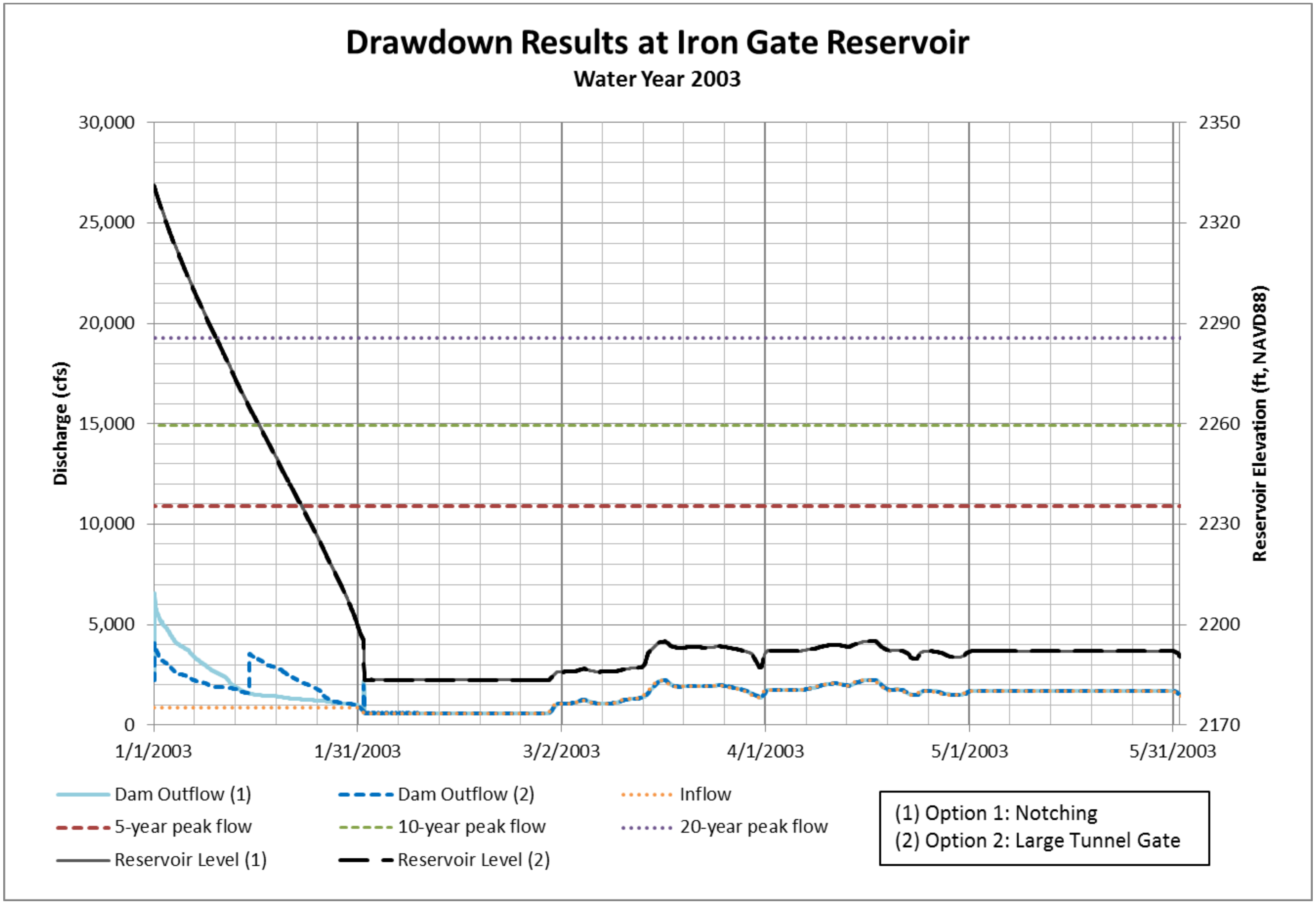

Figure 4-43 Iron Gate Reservoir Drawdown, Water Year 2003

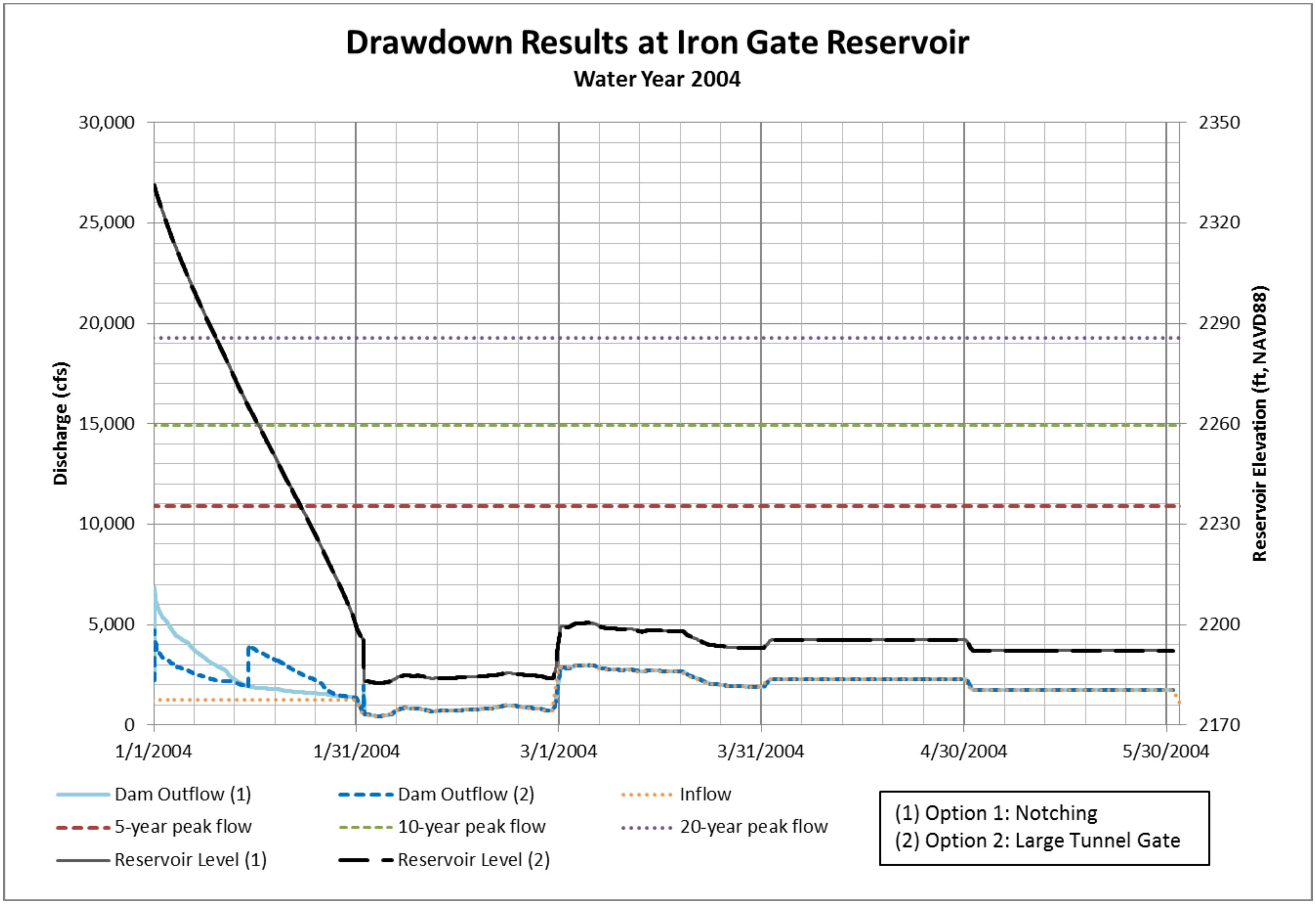

Figure 4-44 Iron Gate Reservoir Drawdown, Water Year 2004

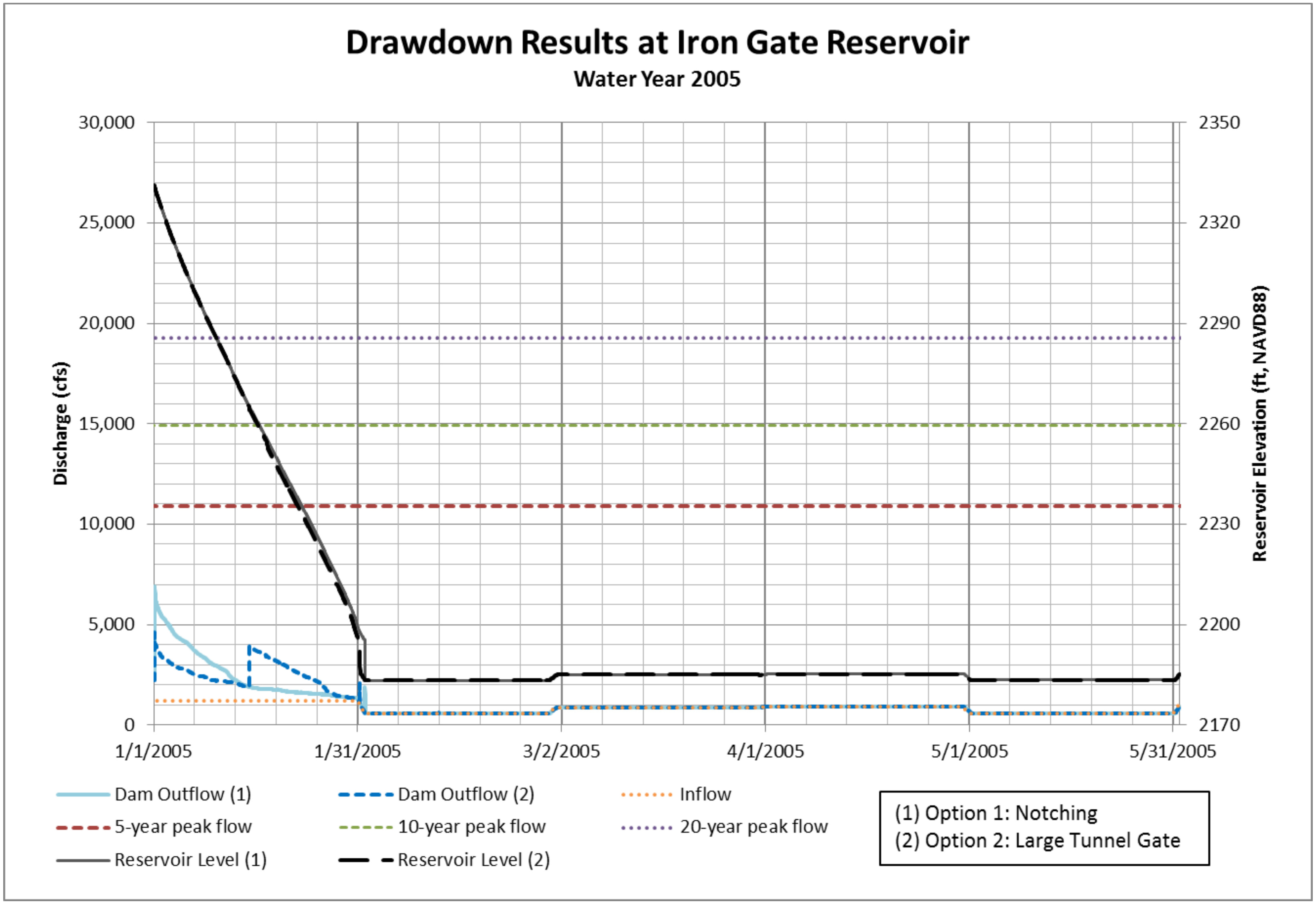

Figure 4-45 Iron Gate Reservoir Drawdown, Water Year 2005

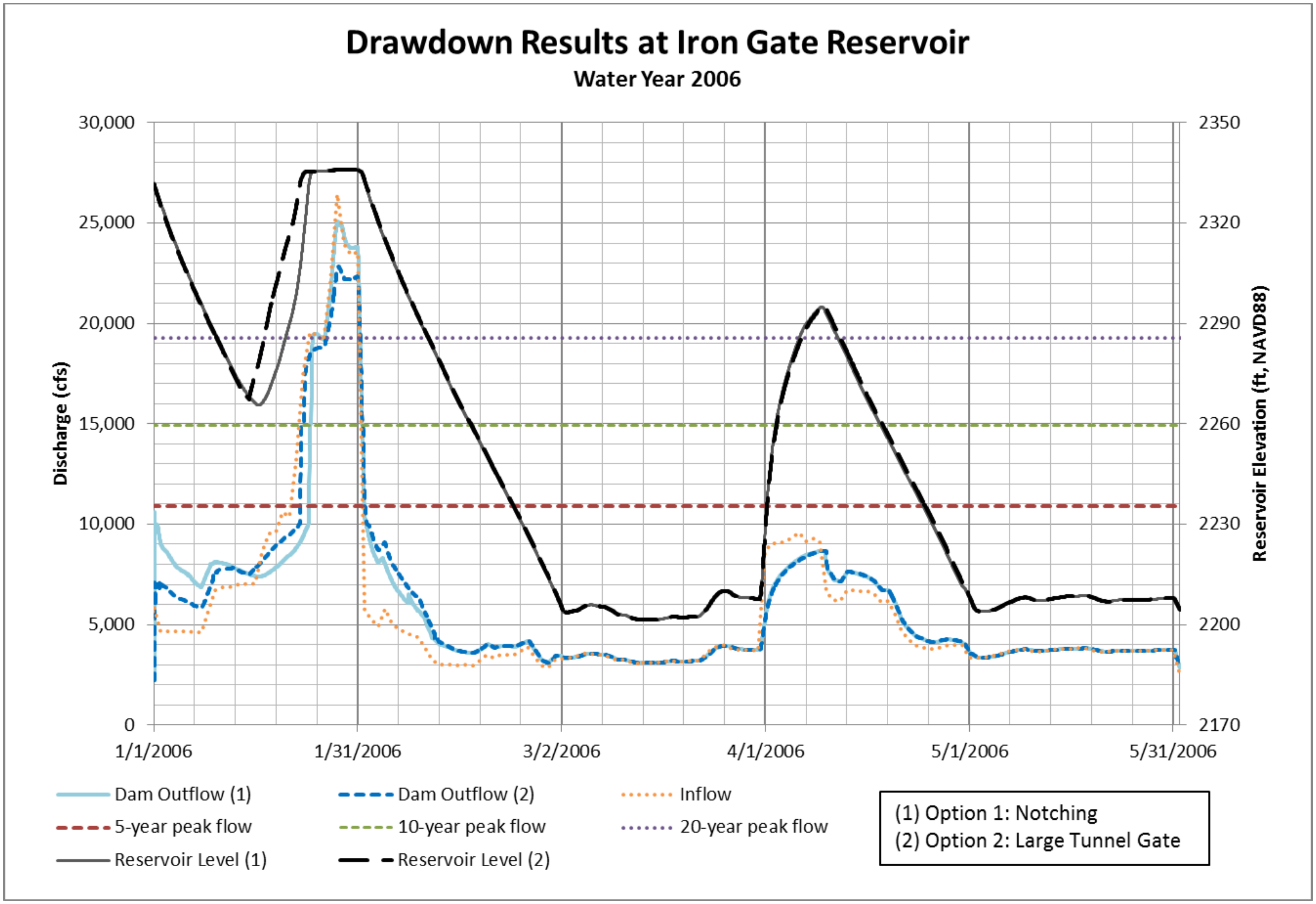

Figure 4-46 Iron Gate Reservoir Drawdown, Water Year 2006

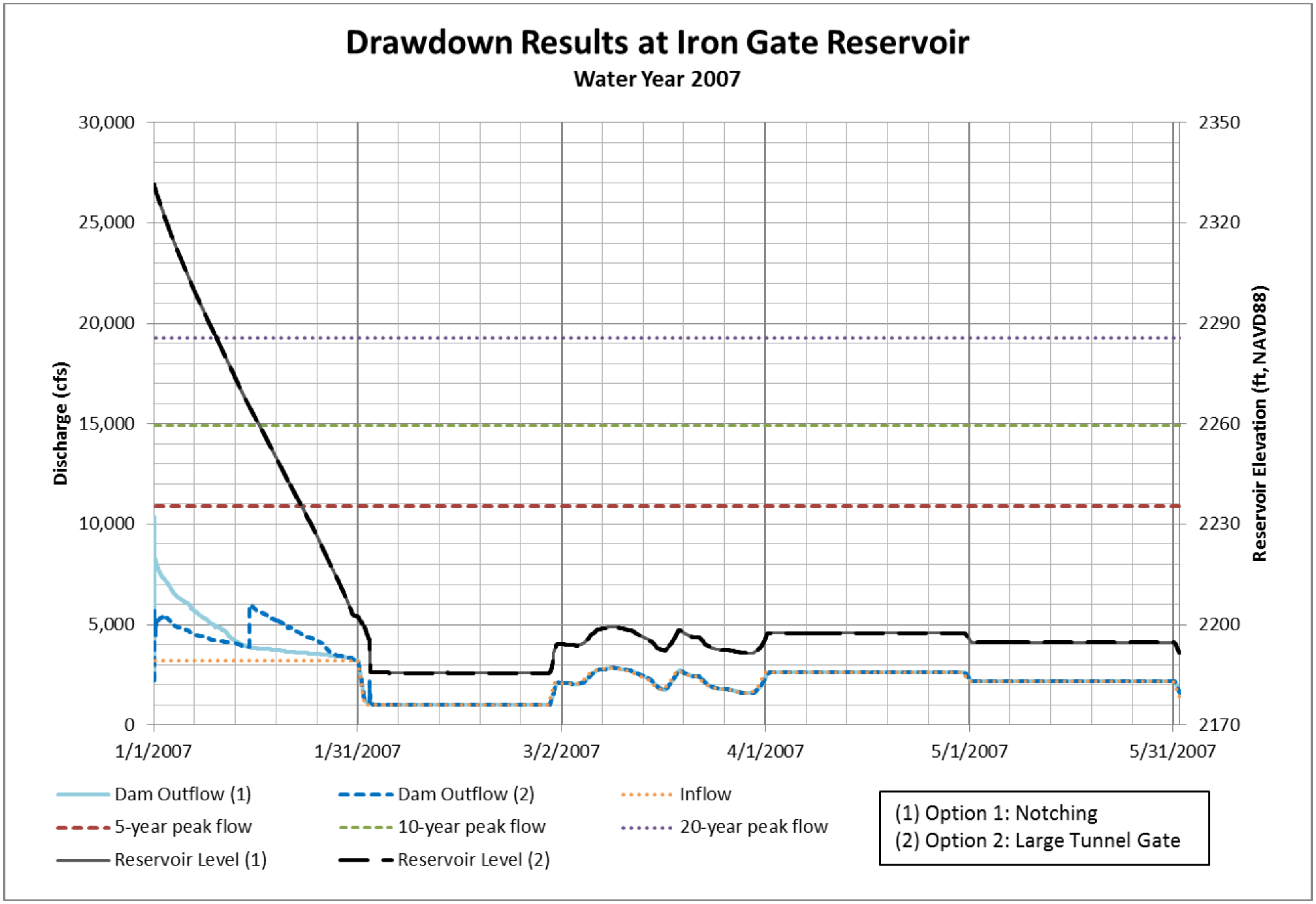

Figure 4-47 Iron Gate Reservoir Drawdown, Water Year 2007

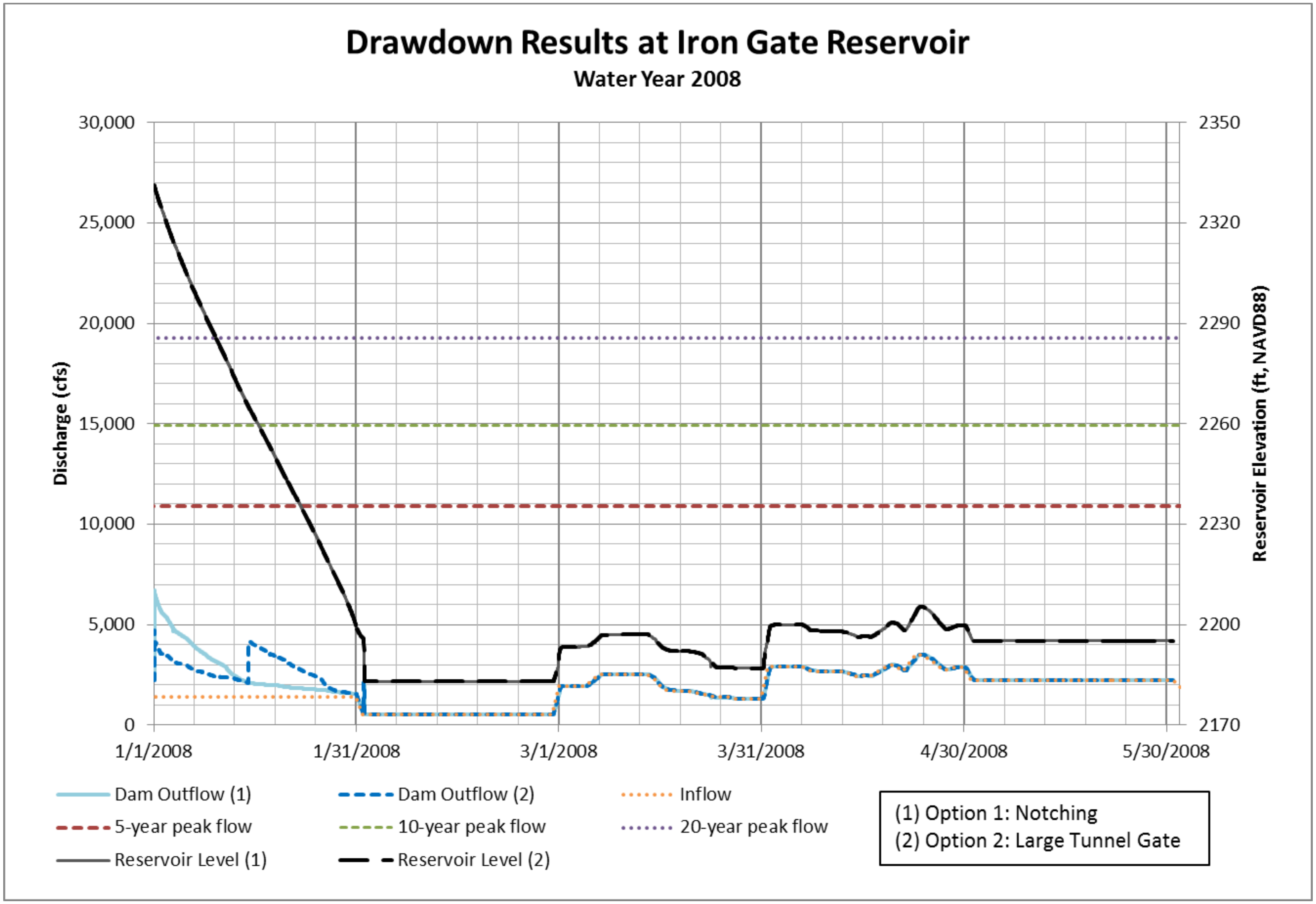

Figure 4-48 Iron Gate Reservoir Drawdown, Water Year 2008

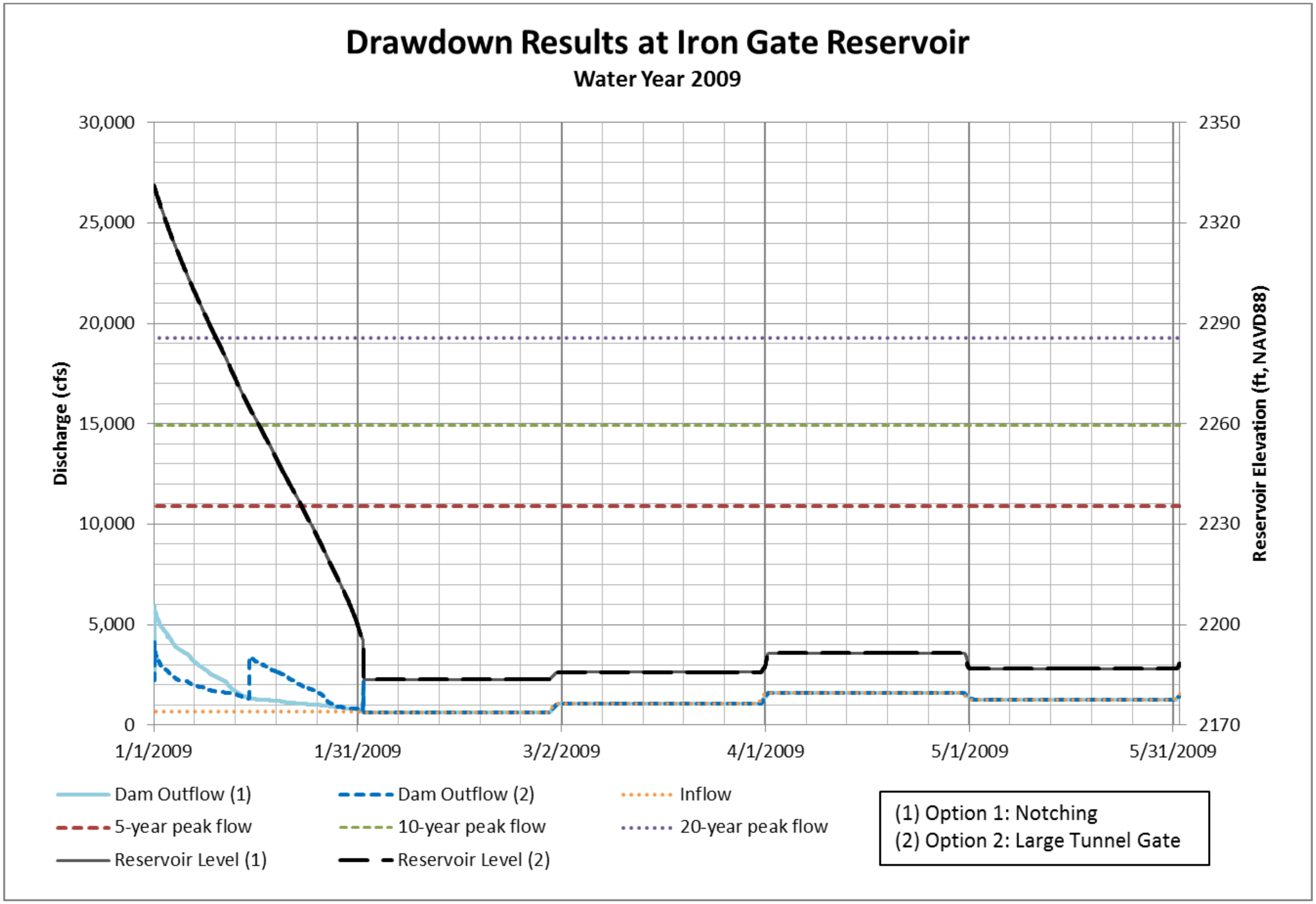

Figure 4-49 Iron Gate Reservoir Drawdown, Water Year 2009

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Chapter 5: Flood Frequency Analysis

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5. FLOOD FREQUENCY ANALYSIS

Figures 5-1 and 5-2 show the linear correlation between flows measured at the USGS gauges at J.C. Boyle and Copco as compared to the measured flows at Keno. KRRC used these relationships to extend the historical record of flows at J.C. Boyle and Copco prior to performing the flood frequency analysis. Figures 5-3, 5-4, and 5-5 show the results of the flood frequency analysis at J.C. Boyle, Copco, and Iron Gate, respectively.

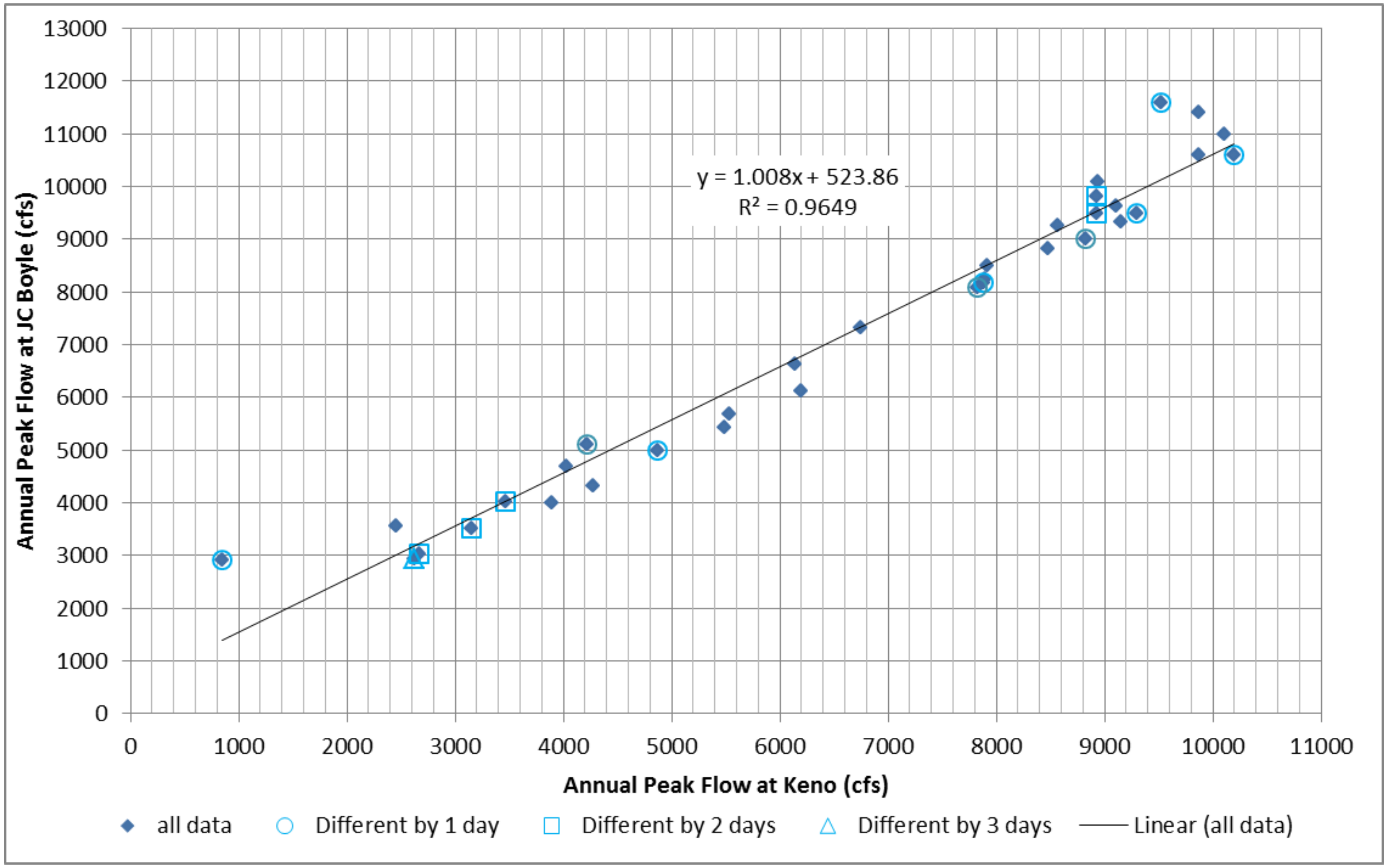

Figure 5-1 Linear Correlation between Flows at J.C. Boyle versus Flows at Keno

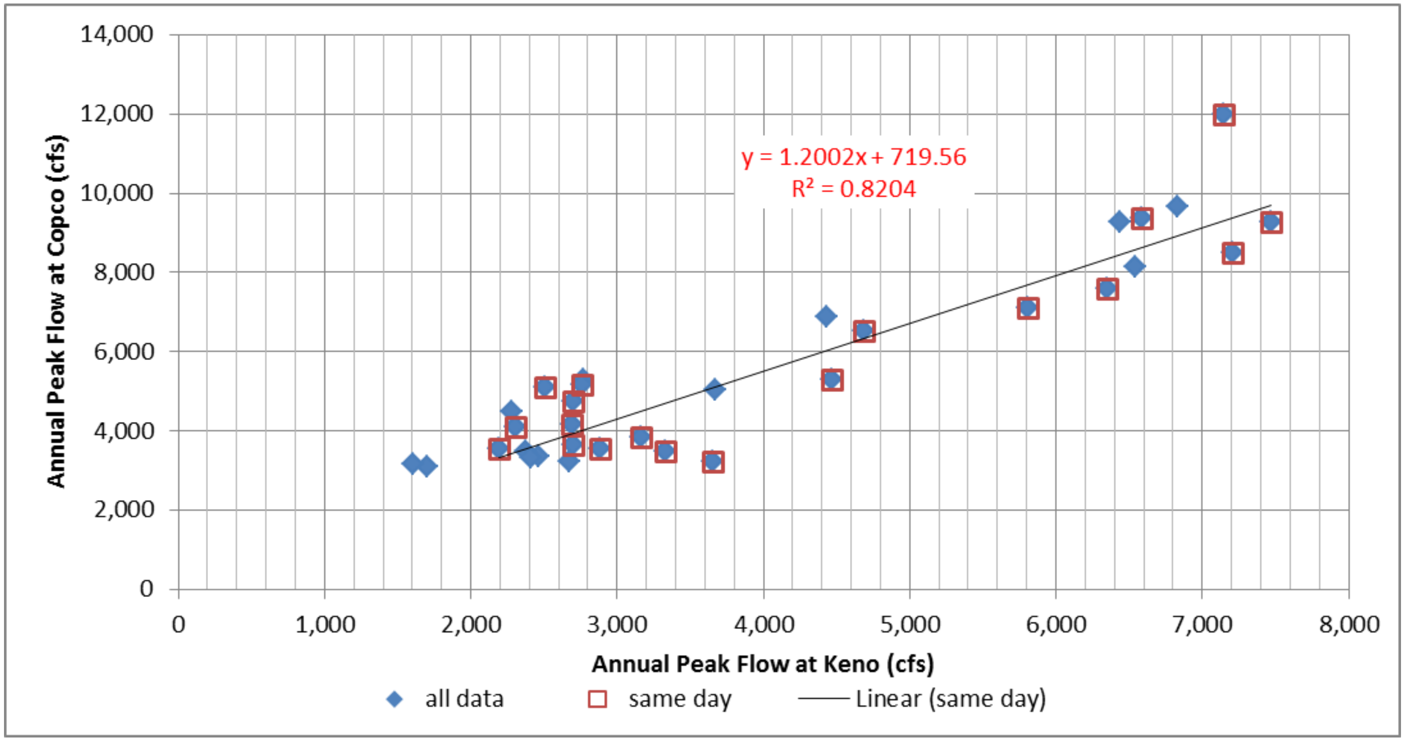

Figure 5-2 Linear Correlation between Flows at Copco versus Flows at Keno

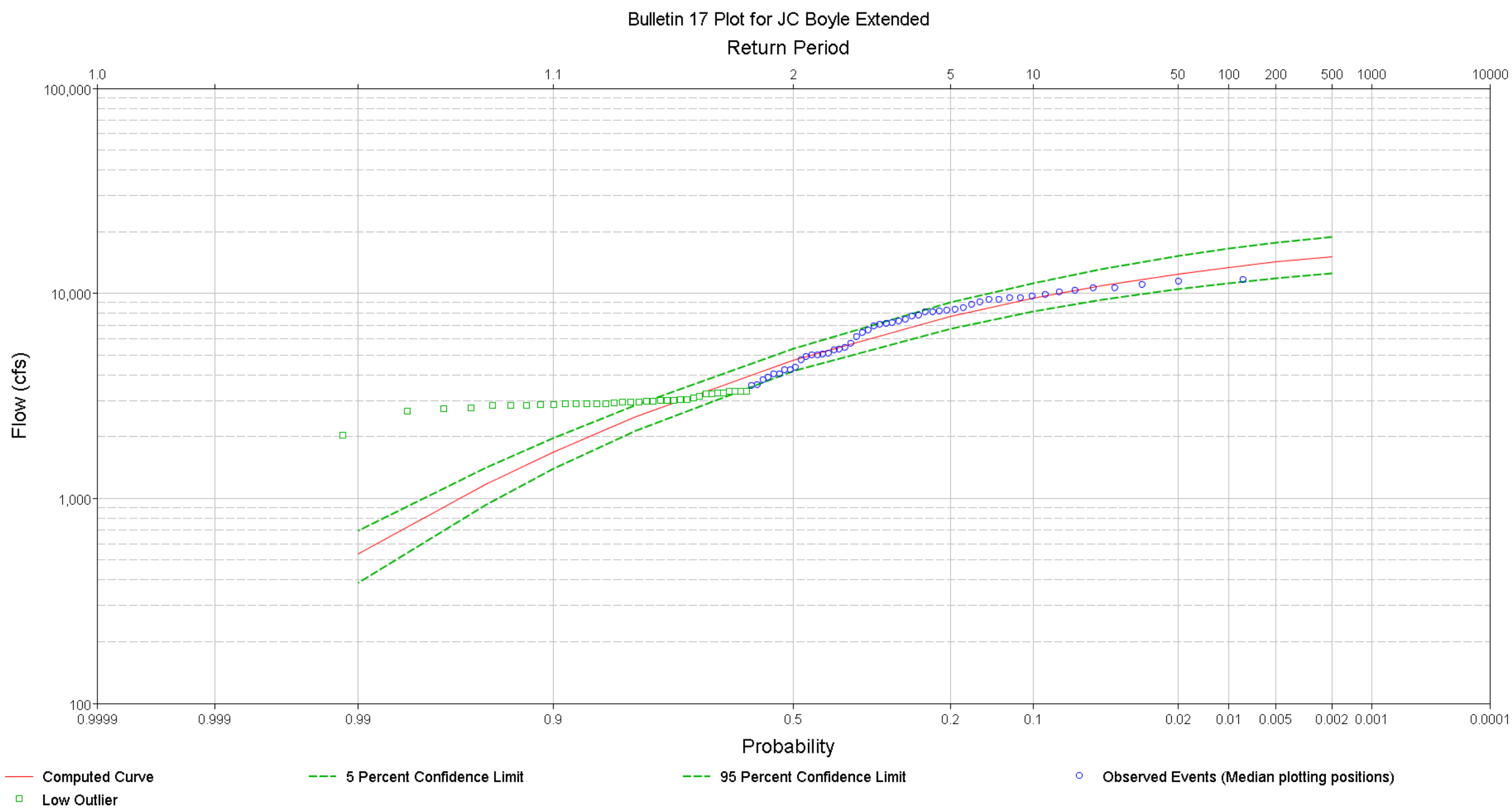

Figure 5-3 Flood Frequency Curve, J.C. Boyle

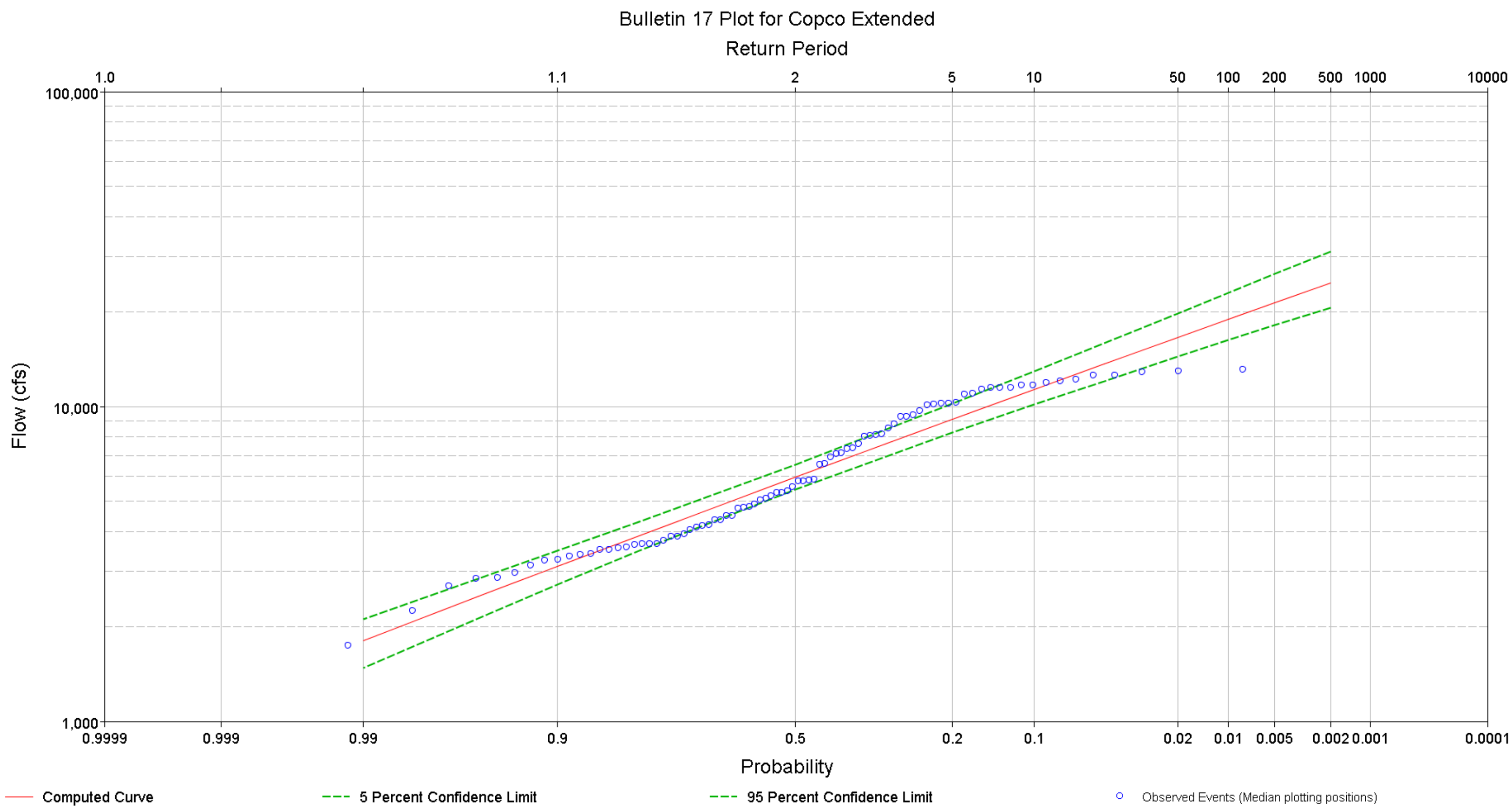

Figure 5-4 Flood Frequency Curve, Copco 1

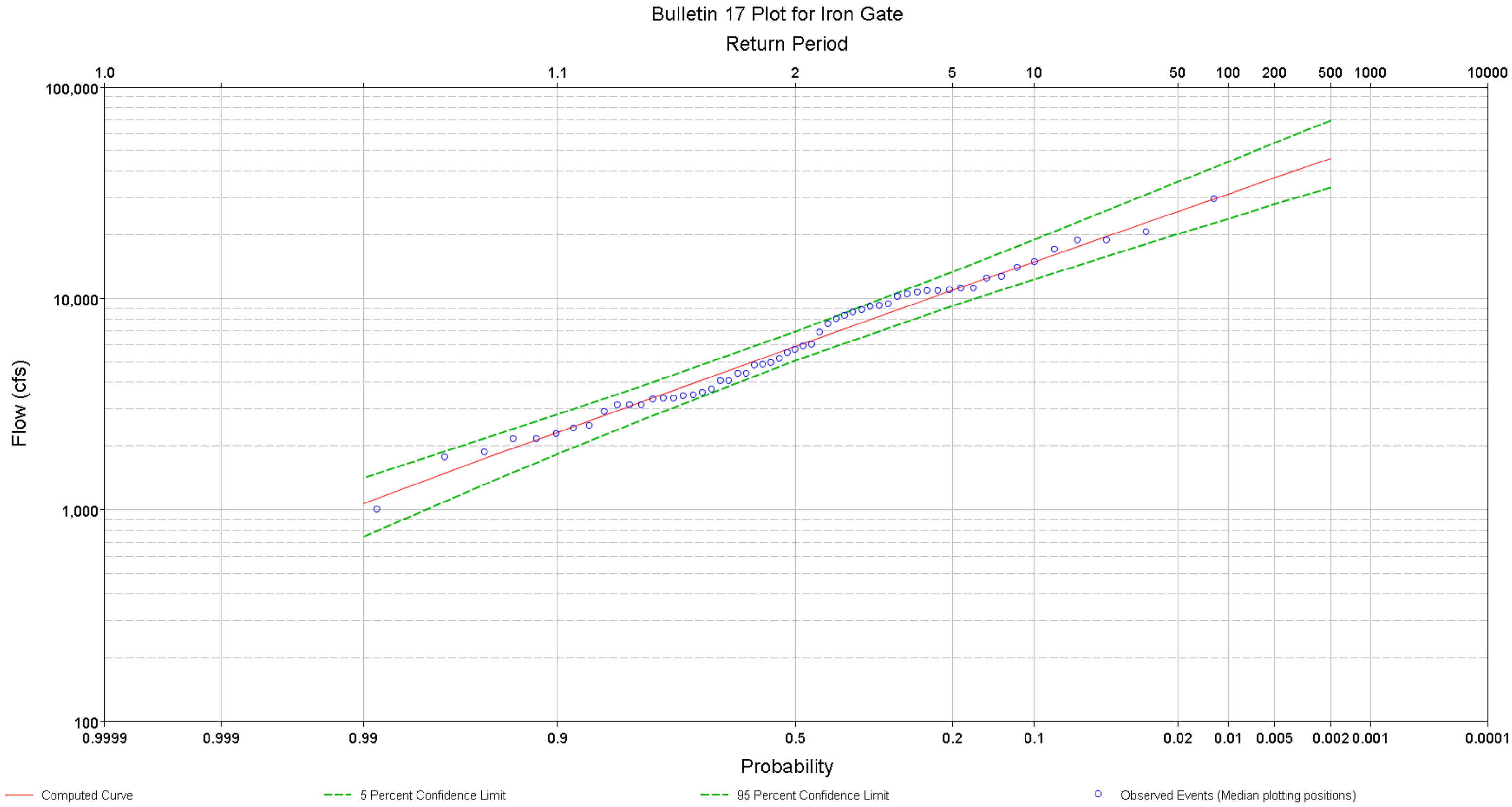

Figure 5-5 Flood Frequency Curve, Iron Gate

Appendix G Copco Foundation Removal

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Klamath River Renewal Project

Project ref:
60537920

From:
Phillip Mineart, Shannon Leonard

Date:
June 20, 2018

To: Klamath River Renewal Coporation

CC:

Technical Memorandum

Subject: Definite Plan for the Lower Klamath Project
Analysis of Copco No. 1 Foundation Removal

1.0 Introduction

During construction of Copco No. 1 Dam, approximately 100 feet of alluvium was removed below channel grade and backfilled with concrete. When the dam is demolished, the depth of the foundation removal needs to be sufficient so that river bed sediment mobilization through natural channel processes does not expose the concrete and create a fish passage barrier or prevent bedload movement in the active bed layer. The KRRC performed a scour analysis to determine a conservative depth of bed material mobilized by the restored river to recommend a depth of foundation removal for the Project.

Copco No. 1 dam has captured most of the coarse sediment that either entered the river or was mobilized between J.C. Boyle Dam and Copco No. 1 Dam. Any sediment downstream of Copco No. 2 Dam that was mobilized by storm flows, therefore, was not replaced by the inflowing upstream of sediment. This has likely resulted in the removal of sediment downstream of Copco No. 2, especially the finer sediment, and possibly a steepening of the slope. The removal of Copco No. 1 and Copco No.2 will release any sediment that has been retained in the reservoirs and more importantly will allow any bedload sediment mobilized upstream of Copco No. 1 to move through the Copco reach. Over time the slope of the stream should return to the pre-project condition. This may result in a slope that is different than the existing slope downstream of the dams.

The concrete needs to be removed to a depth below pre-dam channel grade sufficient to allow the passage of bedload during storm events. This requires an estimate of the future grade at Copco No. 1and the depth or thickness of the bedload transport layer below grade. The equilibrium slope is used to estimate the future stream bed elevation at the dam based on extending that grade from the bedrock controls in the channel downstream of Copco No. 2 Dam. Presumably the stream slope will return to its pre-project slope; however, if the particle size distribution in the future contains more fines and less coarse material, than pre-dam bed material (e.g., Lake Ewauna continues to retain coarse material) the slope could be shallower than pre-dam slope resulting in a somewhat lower post-project bed elevation at the dam. The “active layer thickness” was calculated to estimate the depth required to allow bedload transport.

2.0 Future Stream Grade at Copco No. 1 (Equilibrium Slope)

The equilibrium slope is the slope at which the shear stress on the bed during the design condition just equals the critical shear stress needed to initiate sediment motion. The calculation of critical shear stress typically requires the selection of a representative particle size of the stream bed material. The median particle size (i.e., d50) is often used though larger sizes such as the d75 or higher have been used. An alternative approach is to use a probabilistic approach.

The representative particle size approach assumes that when the shear stress exceeds the critical shear stress of the representative particles size 100% of the sediment smaller than the representative size is in motion and 0% of the larger particles are. In streams with relatively uniform particle sizes this is usually sufficient (e.g., sand bed stream); however, in streams such as the Klamath River with widely varying particles sizes it does not represent actual conditions very well.

The equilibrium slope was calculated using the method developed by Gessler (1967) as descried in Ferro and Porto (2011) and Porto and Gessler (1999). Rather than using a representative particle size, a representative particle size distribution is used. An assumption behind the method is that an armored layer will form, and the method calculates a probability that a given size particle in the distribution remains in the armored layer. A representative particle size is then calculated that results in the same bed stability as the particles that are likely to make up the armor layer. That is, instead of picking a representative particle size a priori, a value is calculated that is representative of the particles likely to make up the armor layer based on the particle distribution and their corresponding critical shear stresses.

Input data needed for the analysis include: stream characteristics (flow, depth, and slope) and particle size distribution. A 2-year flow was assumed for the design flow event. This is assumed to be representative the long term average flow for movement of sediment. Based on the frequency analysis discussed in Section 4.3 of the main body of the Definite Plan, a flow of 6,000 cfs was used. There is no bathymetry data between the Copco No. 1 and Copco No. 2 dams, so stream characteristics from the HEC-RAS model (discussed in Section 4 of the Definite Plan) for the reach downstream of Copco No. 2 Dam were used. The depth of flow downstream of the Copco No. 1 Dam was between 6 and 7 feet for the 2-year event.

Particle Size Distribution

Particle size distribution data for sediments downstream of Copco No. 1 and Copco No. 2 dams were not available. However, the USBR sediment transport study (USBR 2012) provides a figure (Figure 5-18 in USBR 2012) showing values for the d16, d50 and d84 particle sizes for a station near the Copco Dams (RM 198 in that report) and above Copco Lake (RM 206-208 in that report). Table 1 below lists the values estimated from that figure.

Table 1. Particle Size Data near Copco Dams

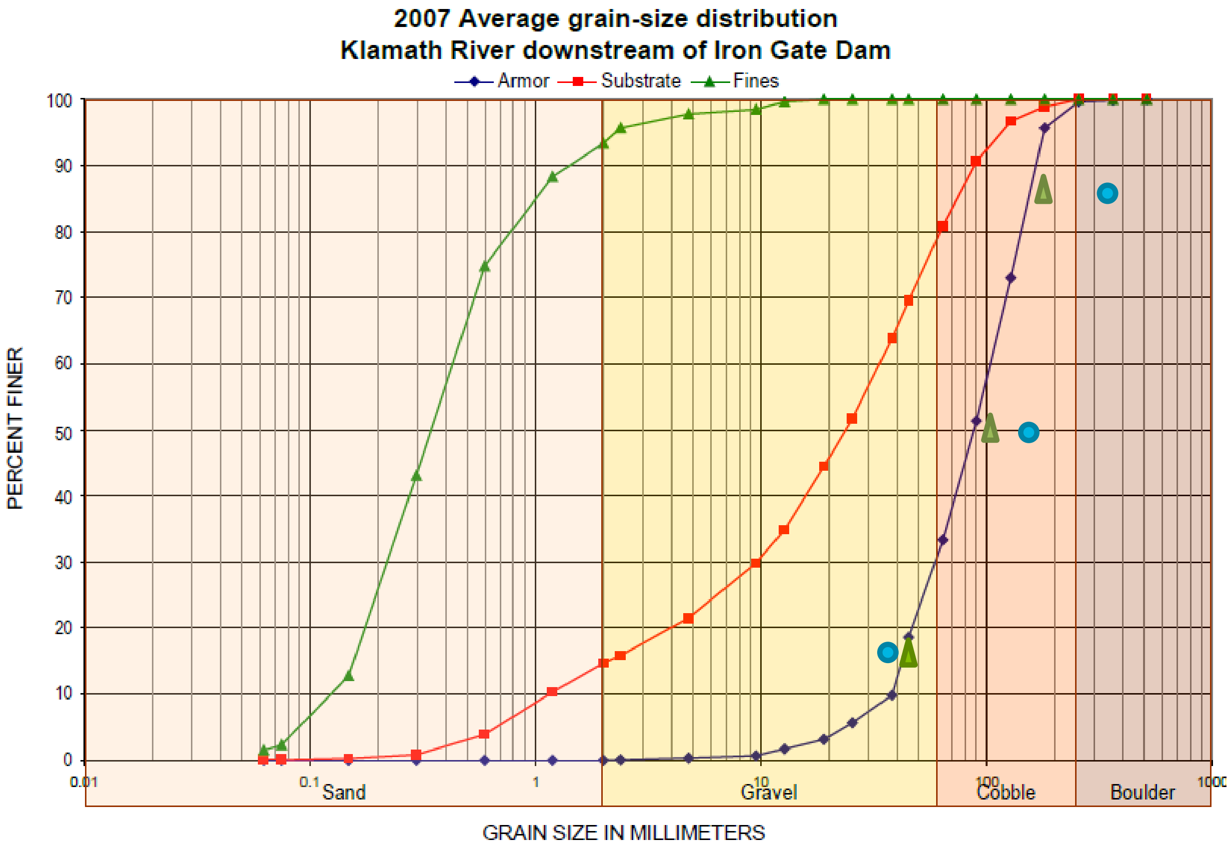
Site[1]	D16	D50	D84
RM 198	22	80	130
	28	120	320
	31	160	400
	62	220	520
Average	35.75	145	342.5
RM 206-208	7	42	81
	26	51	98
	27	60	105
	40	100	200
	42	105	200
	61	110	205
	63	120	220
	64	130	310
	91	190	
Average	46.8	100.9	177.4

Source: Figure 5-18 USBR Sediment Study (USBR 2012); Note: Adjacent values may not be from the same sample

[1] Site river miles are as reported in USBR 2012c. Corresponding revised river miles in this report are 201.8 and 210.3-212.3, respectively.

Note that since the values were plotted by river mile versus particle diameter, it is not possible to group the data by sample; that is, it is not known which d16 value goes with which d50 and which d84. Therefore, the average values for each particle size were used.

To use a probabilistic method for calculating equilibrium slope, a particle size distribution is needed. Several distributions are presented in Holmquist-Johnson and Milhous (2010), the closest located below Iron Gate Dam at RM 187[1]. The USBR data and the Holmquist-Johnson and Milhous distributions are plotted together in Figure 1. The USBR data generally follows the same distribution as the armor layer reported in Holmquist-Johnson and Milhous. The particle size distribution for the armor layer was used in the analysis below except for sizes greater than d75 which were approximated by a curve going through the USBR data.



RM198 (blue circles), RM206-208 (green triangles). River miles are as reported in USBR 2012c. Corresponding revised river miles in this report are 201.8 and 210.3-212.3, respectively.

Figure 1. Particle Size Distribution Data from Holmquist-Johnson and Milhous (2010) Compared to USBR data collected near Copco Dams

[1] As reported in that paper. Corresponding revised river mile is about 190.1.

Methods

The calculation of equilibrium slope proceeded using the following steps (see Ferro and Porto 2011 for details on the calculations):

1. The bed shear stress was calculated for the 2-year event as:

$$\tau_0 = \gamma h S \qquad \text{Equation 1}$$

Where:

τ_0 = boundary (bed) shear stress
γ = specific weight of water
h = depth of flow
S = bed slope

2. The particle distribution was divided into 20 increments of 5% each
3. For each increment the critical shear stress was calculated using Shields relationship
4. The probability of a particle not be removed (i.e., remaining in the armor layer) is calculated using the relationship:

$$q_i = \left\{1 - exp\left[-a\left(\frac{\tau_{ci}}{\tau_0}\right)^b\right]\right\}^n \qquad \text{Equation 2}$$

Where:

q_i = probability particle i will remain in the armor layer (i.e., will not be removed)
a, b, n = empirical coefficients equal to: 0.5641, 2.0386, and 0.7612, respectively.
τ_{ci} = critical shear stress for particle i

τ_0 = bed shear stress

5. Calculate the average stability of the armor layer. The most stable layer is when q_{bar} = 0.5:

$$q_{bar} = \frac{\int_{D_{min}}^{D_{max}} q^2 p_0 dD}{\int_{D_{min}}^{D_{max}} q p_0 dD} \qquad \text{Equation 3}$$

Where:

q_{bar} = average stability of armor layer
D_{max}, D_{min} = maximum and minimum particle size
q = stability of particle
p_0 = relative weight of particle in original distribution (= 0.05 in these calculation, i.e., distribution divided into 20 equal increments)
D = particle diameter

6. Calculate the average particle size in the armor layer the corresponds to an average stability of 0.5 (which is the most stable layer), = 0.27m for stream below Copco based on particle size distribution in Figure 1
7. Calculate the critical shear stress of the armor layer based on particle size in step 6.
8. Find the slope that corresponds to a bed shear stress equal to the critical shear stress from step 7.

Results

Based on the armor particle size distribution and the average water depth from the HEC-RAS model developed for the drawdown study (Section 4), the minimum equilibrium slope is 0.0093. Applying this slope starting at a bedrock grade control located about 1200 feet downstream from Copco No. 2 Dam the elevation at the dam is 2474.5 feet. This is about 10 feet below estimated pre-dam channel grade at Copco No. 1 dam.

The original slope and grade was estimated from Copco No. 2 drawings G-3444, D-3722, and F-4261 and drawings 6043-CD-4 and F-1475 for Copco No. 1. Drawing F-1109 for Copco No. 1 also provided information on original grades but was not consistent with the other drawings so was not used. Based on this data, the original slope before construction was 0.013, slightly steeper than estimated above (note, the drawings show a much steeper slope below Copco No.2 than between Copco No.1 and No.2, 0.013 is the average)

The depth of water varies in the HEC-RAS model. If the shallowest water depth is used rather than the average, the equilibrium slope could be as high as 0.012. In this case the projected grade at Copco No. 1 Dam would be about 2 feet below estimated pre-dam channel grade.

3.0 Active Layer Thickness

The thickness of the active layer was estimated using Technical Supplement 14B Scour Calculations of the National Engineering Handbook (NRCS 2007). The active layer thickness is:

$$T = \frac{D_x}{(1-e)P_x}$$

Equation 4

Where:

D_x	= the size of the smallest non-transportable particle present in the streambed
P_x	= the fraction of bed material of a size equal to or coarser than D_x
e	= the porosity of the bed material, assumed equal to 0.43

The smallest non-transportable particle in the bed was calculated using the relationship below:

$$D_x = K\left(\frac{yS_e}{\Delta s_g}\right)^a \left(\frac{u_*}{\nu}\right)^b$$

Equation 5

Where:

y	= flow depth
S_e	= energy slope
Δs_g	= relative submerged density of bed-material sediment □ 1.65
U_*	= shear velocity
ν	= kinematic viscosity of water
a, b, K	= 0,1,17 (from Table TS14B-4 in NRCS 2007)

The values for flow depth and shear velocity were taken from the equilibrium slope calculations. The energy slope was assumed equal to the equilibrium slope.

With the above assumptions the minimum transportable particle size varied from 0.0189 to 0.219 m (0.621 to 0.719 feet) for storm events from 2-year to 100-year. The depth of the active layer varied from 5.8 to 7.5 feet.

The above analysis did not account for the presence of immobile boulders in the river. The presence of boulders will decrease the bed load transport in the river relative to what is estimated from sediment transport relationships. The over-estimation could be by several times. Neglecting the impacts of boulders on the sediment transport will result in an over estimation on the thickness of the active layer. The amount of overestimation is dependent upon the size and spatial density of boulders in the river. Therefore, the estimation of active later thickness should be considered conservative and the actual thickness could be much less.

4.0 Depth of Removal for Cutoff Wall and Foundation

Based on the equilibrium slope and active layer thickness results, the cutoff wall should be removed to a minimum of 8 feet below grade (for the active layer thickness) and up to 18 feet below grade (for the equilibrium slope and the active layer thickness). The recommended removal depth is 20 feet below the pre-dam stream bed to elevation 2463.5 feet.

5.0 References

Ferro and Porto 2011. Ferro, V, and P. Porto. Predicting the equilibrium bed slope in natural streams using a stochastic model for incipient sediment motion. Earth Surface Processes and Landforms. Vol 36., pp.1007-1022.

Holmquist-Johnson and Milhous 2010. Holmquist-Johnson, C.L. and Milhous, R.T. Channel maintenance and flushing flows for the Klamath River, California. U.S. Geological Survey Open File Report 2010-1086, 31 p.

NRCS 2007. Natural Resources Conservation Service. National Engineering Handbook, Part 654. 2007. Stream Restoration Design. Technical Supplement 14B Scour Calculations.

Porto and Gessler 1999. Porto, P. and J. Gessler. Ultimate Bed Slope in Calabrian Streams upstream of Check Dams: Field Study. American Society of Civil Engineers, Journal of Hydraulic Engineering. December.

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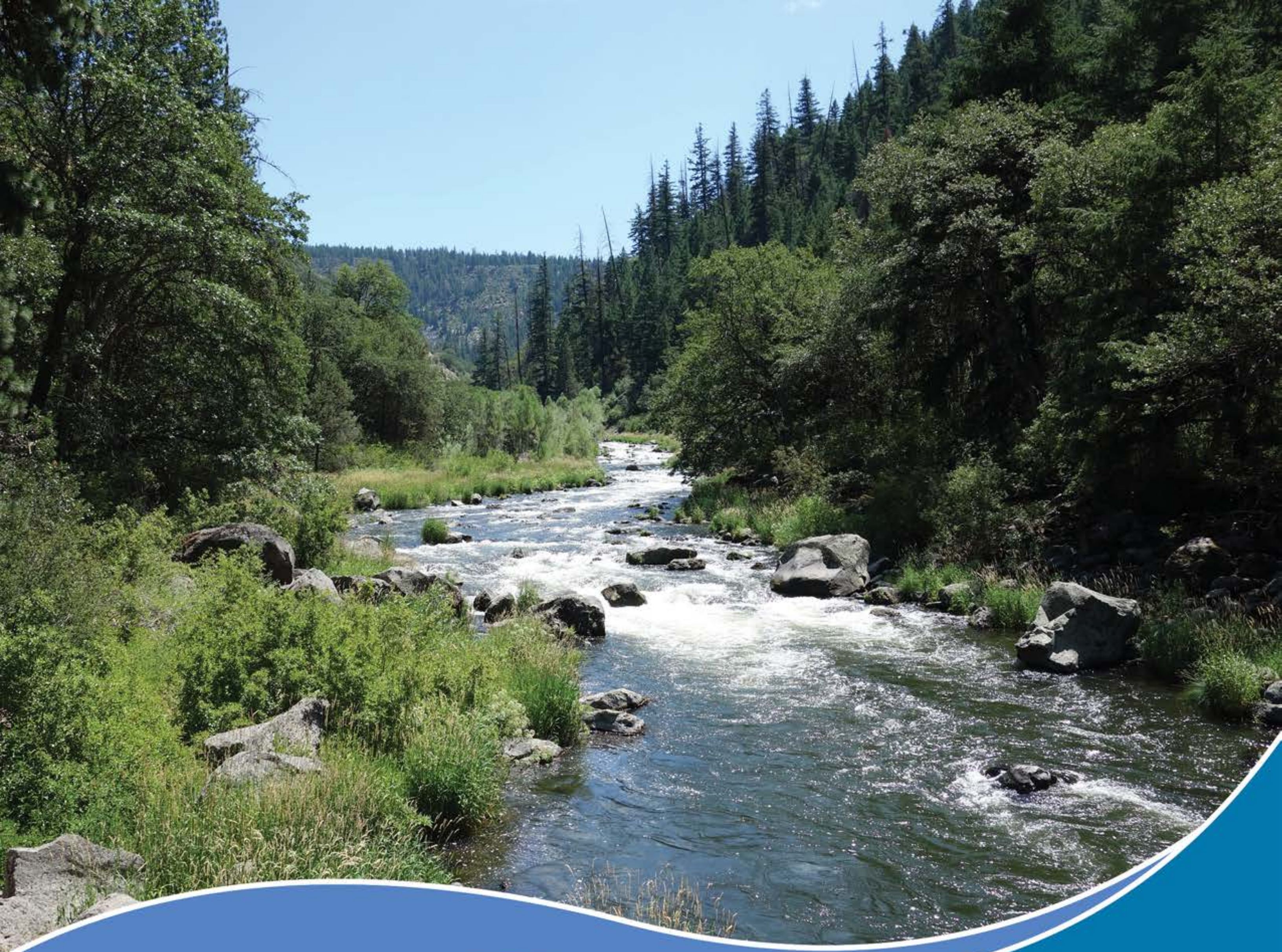

Definite Plan for the Lower Klamath Project

Appendix H – Reservoir Area Management Plan

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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KLAMATH RIVER RENEWAL CORPORATION

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Acronyms and Abbreviations

1D	one-dimensional
2D	two-dimensional
BLM	Bureau of Land Management
Cal IPC	California Invasive Plant Council
CDFW	California Department of Fish and Wildlife
cm	centimeters
CY	cubic yards

EIS/R	Environmental Impact Statement/Report
FERC	Federal Energy Regulatory Commission
ft	foot/feet
ft^3	cubic foot
GIS	geographic information system
GPS	global positioning system
H:V	horizontal to vertical ratio
IEV	invasive exotic vegetation
IPM	Integrated Pest Management
KBMP	Klamath Basin Monitoring Program
KHSA	Klamath Hydroelectric Settlement Agreement
kPa	kilopascals
KRRC	Klamath River Renewal Corporation
KRWG	Klamath Restoration Work Group
lbf/ft^2	pound-force/square foot
lbf/in^2	pound-force/square Inch
lbs	pounds
LW	large wood
NMFS	National Marine Fisheries Services
ODFW	Oregon Department of Fish and Wildlife
O.C.	On center
Pa	Pascals
PLS	pure live seed
PNA	plant nutrient availability
Q100	100-year
Q2	2-year
RM	river miles
RWQCB	Regional Water Quality Control Board
RWZ	Rocky wake zone
SDOR	Secretarial Determination of Record
USBR	US Bureau of Reclamation
USDA	US Department of Agriculture
USGS	U.S. Geological Survey

Chapter 1: Introduction and Purpose

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1. INTRODUCTION AND PURPOSE

The Klamath Hydroelectric Settlement Agreement (KHSA) signed in 2010 and updated in 2016 establishes the framework to decommission and remove four dams (Iron Gate, Copco No. 1, Copco No. 2, and J.C. Boyle) on the Klamath River as shown on Figure 1-1. Upon approval by the Federal Energy Regulatory Commission (FERC) of a license transfer application filed by PacifiCorp and the Klamath River Renewal Corporation (KRRC), and further approval by the FERC of a surrender application filed by KRRC, the dams, power generation facilities, water intake structures, canals, pipelines, and ancillary building will be removed (the Project) by the KRRC as licensee. As the Project is implemented, the reservoir areas will become exposed and require restoration and stabilization of bare sediment deposits for long-term water quality and ecological benefits, and restoration of natural river functions and processes.

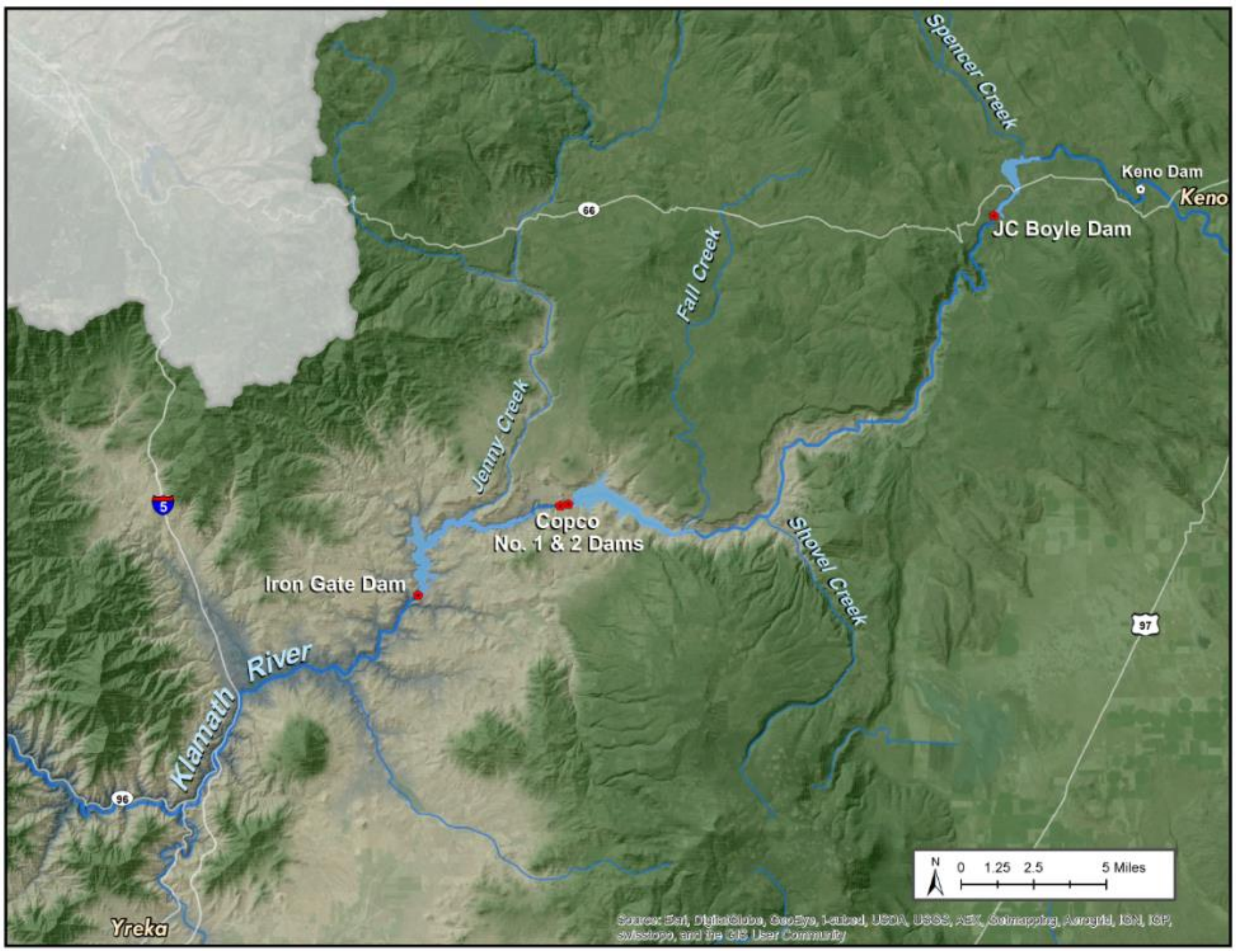

Figure 1-1 Vicinity map showing locations of Klamath River dams

As part of the 2012 Environmental Impact Statement/Report (EIS/R) and 2013 Secretarial Determination of Record (SDOR), a Reservoir Area Management Plan (USBR, 2011c) (the 2011 Plan) was developed by the Bureau of Reclamation (USBR) with assistance from the National Marine Fisheries Services (NMFS), Bureau of Land Management (BLM) and the EIS/R project team. The 2011 Plan describes anticipated conditions in the reservoir areas after removal of the four dams based on hydraulic modeling, sediment characteristics, and reservoir drawdown scenarios.

The 2011 Plan was developed primarily with the intent to minimize invasive vegetation and stabilize remaining reservoir sediments to reduce the likelihood of future sediment releases. Numerous dam removals and reservoir restoration projects have been completed since the 2011 Plan with valuable lessons learned. Likewise, additional testing has been performed with the reservoir sediments and current restoration techniques that can be incorporated into the Project to improve reservoir restoration success. Hence, this Reservoir Area Management Plan (RAMP) incorporates current restoration practices and techniques. The primary purposes of updating the 2011 Plan through this RAMP is threefold:

1. Update the goals and objectives to better match current stakeholder and regulatory requirements;
2. Include current knowledge base and lessons learned from other dam removal and restoration projects; and
3. Include details and information that were not fully developed in the 2011 Plan.

The remainder of this report follows the outline below:

1. Project goals and objectives;
2. Historical and existing conditions in the reservoir areas;
3. Anticipated reservoir conditions after dam removal;
4. Reservoir area restoration; and
5. Monitoring and adaptive management.

Chapter 2: Reservoir Area Management Goals and Objectives

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2. RESERVOIR AREA MANAGEMENT GOALS AND OBJECTIVES

KRRC convened a working group of, regulatory, tribal, and consulting professionals, the Klamath Restoration Work Group (KRWG) to provide expert knowledge and recommendations for updating the 2011 Plan. The KRRC Technical Representative led the KRWG. KRRC held two workshops in 2017 and a consensus recommendation was to update the goals and objectives based on current knowledge of restoration and experience from recent dam removal and restoration plans. Table 2-1 provides a summary of goals and objectives of this RMAP.

Table 2-1 Updated goals, objectives, and restoration activities for reservoir restoration

Period	Goal	Objective	Restoration Activity
Pre-construction Period	Prepare native plant materials for revegetation.	Collect and propagate native plant seed and grow container plants.	Identify potential seed collection, seed propagation, pole harvest cutting areas, and container plant grow contractors.
			Perform surveys to identify and map seed collection and pole harvest areas.
			Prepare seed collection, seed propagation, container plant growing, and pole harvest contract documents.
			Award and monitor native plant and seed contracts.
			Develop revegetation contract documents.
	Reduce invasive exotic vegetation (IEV).	Reduce and minimize the local sources of IEV.	Gather existing IEV data and perform IEV surveys.
			Review potential herbicides and potential impact on fish and water quality.
		Implement an IEV management program	Create management plan and review with stakeholders.
			Procure local contractor to perform IEV removal.
			Inspect and monitor IEV removal execution.
	Understand likely evolution of reservoirs post-removal and responses to restoration and reservoir management.	Conduct studies to fill in data gaps from 2011 Reservoir Area Management Plan	Sample sediment and perform tests to investigate wetting and drying characteristics, plant nutrient availability, and natural revegetation potential.
			Perform revegetation pilot tests for native seed mixes.
			Identify reference physical and ecological conditions in tributaries.

Period	Goal	Objective	Restoration Activity
	Maximize reservoir area restoration for ecological uplift.	Develop comprehensive restoration plan for post-removal reservoir conditions.	Actively promote erosion of reservoir deposits during drawdown, use available techniques such as barge mounted hydraulic monitors or boats.
			Modify and enhance site specific restoration actions based on site conditions after drawdown.
			Identify culturally significant areas that are off limits to disturbance.
			Develop final engineering plans for implementation.
Dam removal period (0 to 1 year)	Allow natural erosion and transport of reservoir deposits and dispersal in the ocean.	Maximize erosion of reservoir deposits during drawdown.	Prepare and amend sediment based on pilot test plot results.
	Evaluate active restoration options (post-removal) for habitat development.	Determine locations amenable to site specific restoration actions.	Install irrigation system.
			Hydroseed sediment by planting zones.
			Install pole cuttings, acorns, and container plants.
	Stabilize remaining reservoir sediments.	Initiate native plant revegetation.	Conduct field monitoring of mainstem/tributaries, fix non-natural barriers.
			Include criteria for IEV removal during revegetation implementation.
			Bi-weekly inspections of revegetation areas to verify IEV compliance.
			Actively promote erosion of reservoir deposits during drawdown, use available techniques such as barge mounted hydraulic monitors or boats.
	Restore volitional fish passage in mainstem and tributaries.	Monitor and rectify any non-natural fish passage barriers.	Conduct field monitoring of mainstem/tributaries, fix non-natural barriers.
	Minimize IEV.	Implement and monitor IEV removal during revegetation.	Include criteria for IEV removal during revegetation implementation.
			Bi-weekly inspections of revegetation areas to verify IEV compliance.
Short-term (1 to 5 years after removal)	Restore natural ecosystem processes.	Continue native plant revegetation, maintenance and monitoring	Monitor establishment and adaptively replace failed pole cuttings, acorns, and container plants.
			Maintain irrigation system.
			Re-seed poorly established areas.
	Implement process-based river and tributary restoration actions where applicable.	Increase quantity and quality of in-stream and off-channel habitat for aquatic species.	Construct in-stream habitat features based on engineered designs that are appropriate for the system.
			Construct off-channel wetlands, side channels, and alcoves where appropriate.
			Enhance mid-channel gravel bars.

Period	Goal	Objective	Restoration Activity
	Minimize IEV	Continue IEV monitoring and removal.	Include criteria for IEV removal during establishment.
			Perform monthly inspections to verify IEV removal compliance.
	Restore volitional fish passage in mainstem and tributaries.	Monitor and rectify any non-natural fish passage barriers.	Conduct field monitoring of mainstem/tributaries, fix non-natural barriers.
Long-term (5 to 10 years)	Restore natural ecosystem processes.	Continue revegetation monitoring and adaptive management.	Monitor establishment and adaptively replace failed pole cuttings, acorns, and container plants.
	Monitor and maintain restoration features.	Ensure habitat restoration features are functioning as planned.	Field based monitoring throughout reservoir areas where restoration features were installed.
	Minimize IEV.	Continue IEV monitoring and removal.	Perform quarterly site inspections and verify compliance.
	Restore volitional fish passage in mainstem and tributaries.	Continue monitoring for non-natural fish passage barriers.	Remove all non-natural fish passage barriers.

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Chapter 3: Historical and Existing Conditions

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3. HISTORICAL AND CURRENT CONDITIONS

Conditions at the J.C. Boyle, Copco No. 1, and Iron Gate reservoirs were well documented prior to construction of the dams. Topographic surveys were conducted prior to dam construction and there are photos of pre-dam conditions and the construction of each dam. The following sections describe the physical and ecological conditions of each reservoir area prior to dam construction and the current reservoir conditions. The Copco No. 2 reservoir area is relatively small and is not discussed in this updated plan as it will readily transition back to pre-dam conditions without active restoration.

3.1 J.C. Boyle

KRRC subdivides discussion of the J.C. Boyle Reservoir into two reaches based on valley morphology and geomorphic features mapped prior to dam construction in 1958. The Canyon Reach extends from J.C. Boyle Dam to Highway 66 bridge (U.S. Geological Survey [USGS] river miles [RM] 230 to 231) and the Upstream Reach runs from the Highway 66 bridge to the upstream extent of the J.C. Boyle Reservoir (RM 231 to 233) (Figure 3-1).

3.1.1 Historical Conditions

In the Canyon Reach, the Klamath River was historically incised several tens to hundreds of feet into the surrounding volcanic bedrock to form a deep, narrow valley (Figure 3-1). The narrow valley contained limited space for sediment storage, and accordingly there are no mapped historical geomorphic features (USBR, 2011c). The Klamath River was single threaded with significant exposures of bedrock on the river bed and banks that limited channel adjustment. There is little evidence of bedform development, and most in-channel sediment visible in photos is boulder- or cobble-sized (e.g., Figure 3-2 and Figure 3-3). Rapids that were likely bedrock-controlled are visible upstream of RM 230 and downstream of the Highway 66 bridge (Figure 3-2). At RM 230, an unnamed tributary enters from river left, and the historical valley widens (Figure 3-1). The narrow width of the 2-year and 100-year flood extents demonstrates the confined nature of the Canyon Reach (Figure 3-1). Ponderosa pines occupied upland hillsides adjacent to the river, but the bedrock banks of the riparian corridor were sparsely vegetated primarily with shrubs and grasses. There is little photographic evidence of large wood (LW) accumulations in the channel, which is consistent with low tree recruitment and the high velocities and lack of accommodation space that restricted sediment accumulation and created exposed bedrock in the reach.

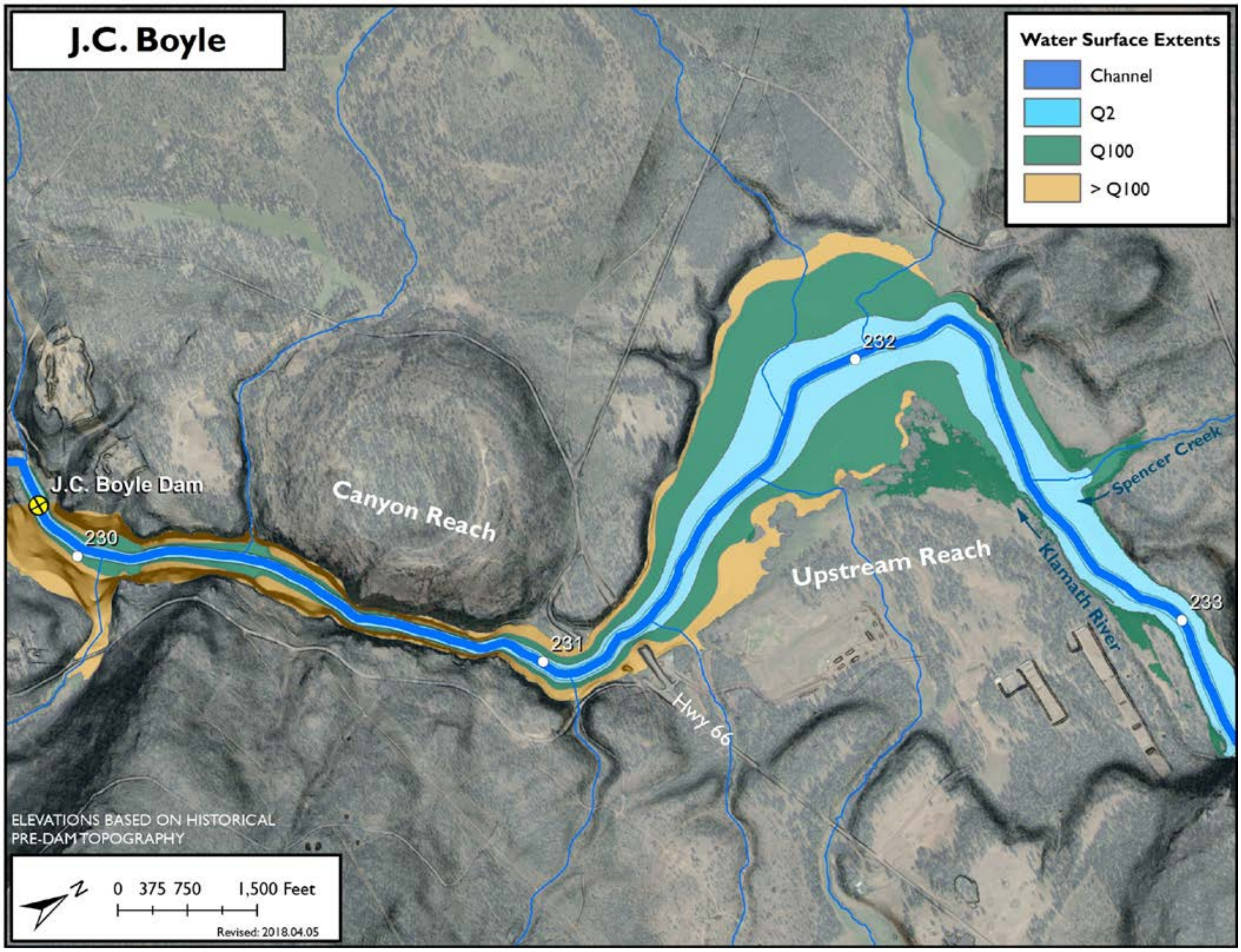


Figure 3-1 Slopeshades of bare earth LiDAR overlaid with aerial imagery and historical topography of J.C. Boyle Reservoir area with flood inundation boundaries for the 2-year (Q2) and 100-year (Q100) floods. Reach designations and river miles are noted.

The Upstream Reach occupies a wide, low relief area as the river abruptly exits the steep, narrow bedrock canyon upstream of RM 233 (Figure 3-1). Bedrock control is visible on river right approximately 1,000 feet (ft) upstream of RM 232 where the Klamath River abruptly turns south, but otherwise the pre-dam channel was primarily alluvial. The valley geometry promoted sediment accumulation and there were alluvial fans and terraces mapped on both sides of the Klamath River (USBR, 2011c). A nearly 1 mile wide alluvial fan and terrace was mapped on river-right around RM 232 and was likely formed by distributary deposition from several unnamed tributaries that would have migrated across the deposit surface. The primary tributary, Spencer Creek, enters the reservoir from the north 0.5 miles downstream of RM 233 and was associated with a mapped floodplain and alluvial fan (USBR, 2011c). The Klamath River actively modified its channel as suggested by the extensive mapped floodplains and the vegetated and unvegetated bars, including a large semi-vegetated, mid-channel bar upstream of the Highway 66 Bridge (Figure 3-2). Most of the current reservoir was shallowly inundated during high flows (Figure 3-1) as a result of the low floodplain gradient and the small bank heights of the historical river. Ponderosa pine forest dominated upland areas in the Upstream Reach, but woody vegetation was sparse to non-existent in the areas of the mapped geomorphic features. These areas were cleared of trees for agricultural use and wood production. No LW was visible in the active channel. Wetland conditions were likely supported in Spencer Creek, which had a multi-threaded distributary character in its lower sections.

Highway 66 bridge crosses the Klamath River in current location. Flow is top to bottom. Dam location is out of frame to the bottom left.

Figure 3-2 Aerial photo of J.C. Boyle Reservoir area (1952) prior to dam construction

3.1.2 Current Conditions

Current conditions in the J.C. Boyle Reservoir vary considerably between the two reaches. The reservoir is narrow with low sinuosity in the Canyon Reach with reservoir water depths increasing from approximately 10 ft at the Highway 66 bridge to maximum values around 35 ft at the unnamed tributary junction 1,000 ft upstream from the dam. In the Upstream Reach, water depths are near zero for all but the historical channel footprint where depths are typically 10 to 15 ft with maximum values of 20 ft within the deep pool at the river right bedrock control.

J.C. Boyle Dam impounds an estimated 990,000 ± 300,000 cubic yards (CY) of fine-grained sediment, a large fraction of which is dead algae and other organic material (USBR, 2011c). Most of the sediment volume is stored in the Canyon Reach, where sediment thicknesses increase from 0 to 2 ft at the Highway 66 Bridge to maximum values of 20 ft near the dam (USBR, 2011c). The sediment in this reach is, on average, 50% silt, clay 40%, and 10% sand. The accumulated reservoir sediment deposit in the Upstream

Reach is primarily confined to the historical channel where it is typically less than 4 ft thick except for a 1,000 ft section around RM 231.75 where thicknesses of 8 to 10 ft filled the local low topography. Little to no reservoir sediment is stored outside of the historical channel in the Upstream Reach. As expected, the Upstream Reach sediment is coarser than downstream and is approximately 55% sand, 25% silt, and 20% clay on average (USBR, 2011c). In the Upstream Reach, the reservoir sediments are underlain by a 0 to 2 ft thick layer of coarser Quaternary alluvial gravel and sand, which is in turn underlain by fine-grained, but resistant, weathered Tertiary volcanics (USBR, 2010). Intact organic fragments (e.g., roots, twigs, bark, and wood) were only found at the pre-reservoir contact in three of the cores (USBR, 2010). The accumulated in-situ reservoir sediment in both reaches has high moisture content over 100% with low cohesion, low strength, and high erodibility (USBR, 2011c). The measured friction angle for the reservoir sediments from a sediment core near the dam site is approximately 30 degrees.

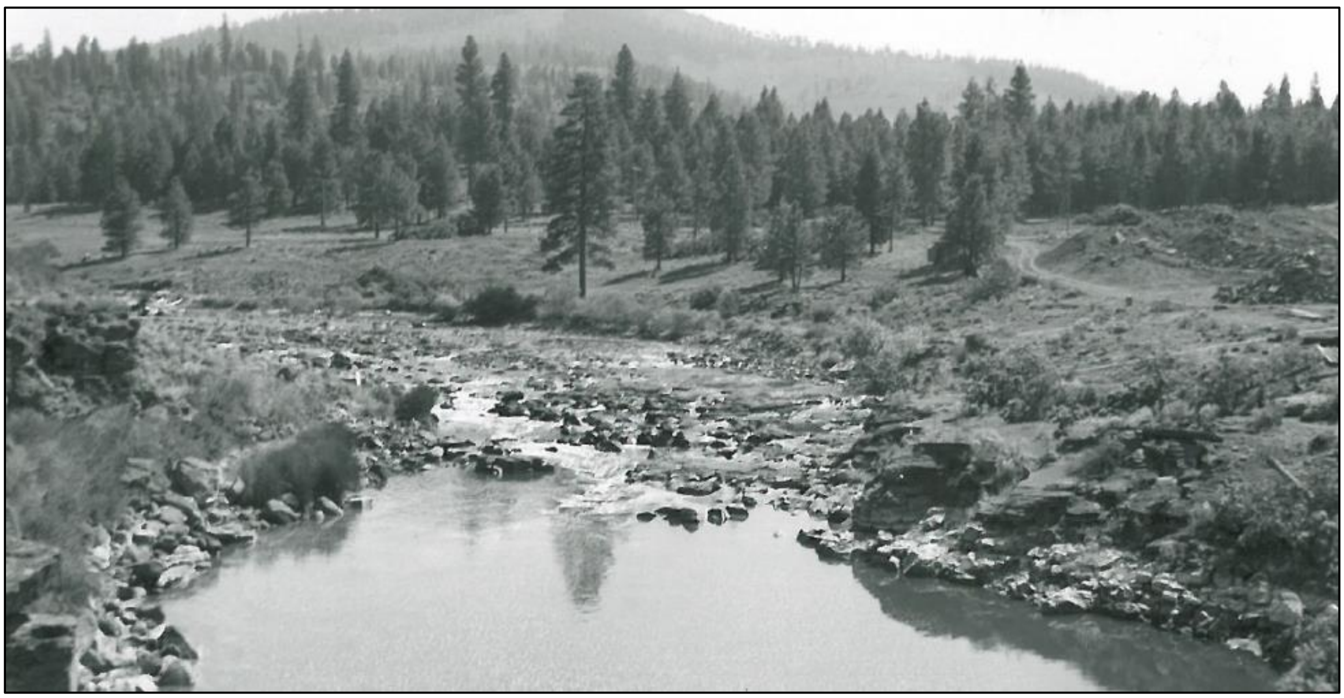


Figure 3-3 View looking upstream at location where J.C. Boyle Dam was constructed in 1957 with view of historical vegetation and geomorphology

Upland vegetation type and distribution around both reaches of the J.C. Boyle Reservoir is similar to pre-dam conditions and is dominated by ponderosa pine. Wetland conditions exist at the mouths of the Upstream Reach tributaries, notably Spencer Creek. The wide, shallow reservoir margins of the Upstream Reach experience seasonal fluctuations in water level. Assorted native grasses were observed, primarily along the river right bank of the Upstream Reach reservoir (USBR, 2011c). Conifers were mapped along the full margin of the reservoir, with the highest concentrations along the west bank of the Upstream Reach. Rushes and reed canary grass were mapped primarily along the river left/east bank of the Upstream Reach. Willow species were largely absent except for a few places near Highway 66.

At J.C. Boyle, average daily minimum temperatures are below freezing from November until May, and average daily maximum temperatures are over 80 deg. F. in July and August (Figure 3-4). Ice often forms on the reservoir during winter. Extreme warm temperatures do not typically exceed 100 deg. F. Precipitation is greatest during the winter months. Average monthly precipitation amounts in July and August, when temperatures are hottest, are 0.34 and 0.45, respectively.

3.2 Copco No. 1

KRRC subdivides discussion of the Copco No. 1 Reservoir into two reaches based on valley morphology and geomorphic features mapped prior to dam construction in 1918. The Downstream Reach extends from Copco No. 1 Dam to the historical Deer Creek confluence at RM 205, and the Upstream Reach extends from RM 205 to the upstream extent of the reservoir near RM 208 (Figure 3-5).

3.2.1 Historical Conditions

Historically, the Klamath River within the Copco No. 1 was a sinuous, bedrock meandering river inset within lithified fluvio-lacustrine bedrock. The channel was single-threaded except where flow was split by bedrock islands at RM 202, 203, and 204 (Figure 3-5). The historical valley bottom was relatively wide compared to reaches of the Klamath River downstream of the dam (e.g., historical Iron Gate reservoir valley) and upstream of the reservoir. The wide and flat valley morphology was the result of aggradation caused by the damming of the ancestral Klamath River by the Copco basalt, a 140,000 year old lava flow (Hammond, 1983). The dam was built into this volcanic unit, which continues to constrict the Klamath River and form the canyon walls downstream of RM 202. These lava flows created an ancestral lake approximately 130 ft deep at its maximum (35 to 40 ft above modern lake level) that occupied approximately 5 miles of the Copco valley upstream of RM 202. Tens of feet of diatomite, which is a porous and friable biochemical sedimentary rock formed from the lithification of silica diatom shell accumulations, was deposited while the lava dam was intact to create a relatively flat ancestral lake bed in a similar footprint to the current reservoir. Diatomite is similar to chalk, but is formed from silica, rather than carbonate, and is typically coarser grained in the silt to sand size class (0.01 to 0.2 mm).

The Klamath River incised into the ancestral lake bed after the lava dam was breached and formed the bedrock meandering valley visible in the historical pre-dam topography. This pre-dam topography was characterized by the flat ancestral lake bed, which is perched up to 50 ft above the historical channel, and asymmetric channel-valley cross-sections, which comprise steep to vertical diatomite banks on the outsides of bend and more gradual alluvium-draped slip-off slopes on the insides of the meanders, morphology which is indicative of vertical and lateral erosion proceeding in tandem (e.g., RM 202.5 in Figure 3-5). The diatomite, which is fine-grained but resistant to erosion and capable of supporting vertical slopes where it is exposed on the outsides of bends, likely underlies much of the historical valley floor with maximum thicknesses (measured from tops of bluffs to ancestral valley floor) on the order of 10–100 ft in the downstream-most reaches. Diatomite bluffs ten or more feet in height were present on the outsides of meander bends upstream until at least RM 205 (Figure 3-5, Figure 3-6). The grade of the historical Klamath River in the reservoir area appeared to be controlled by bedrock outcrops, likely the Copco basalt, at the narrow entrance to Ward's Canyon, several hundred feet upstream of the Copco No. 1 Dam location (Figure 3-7).

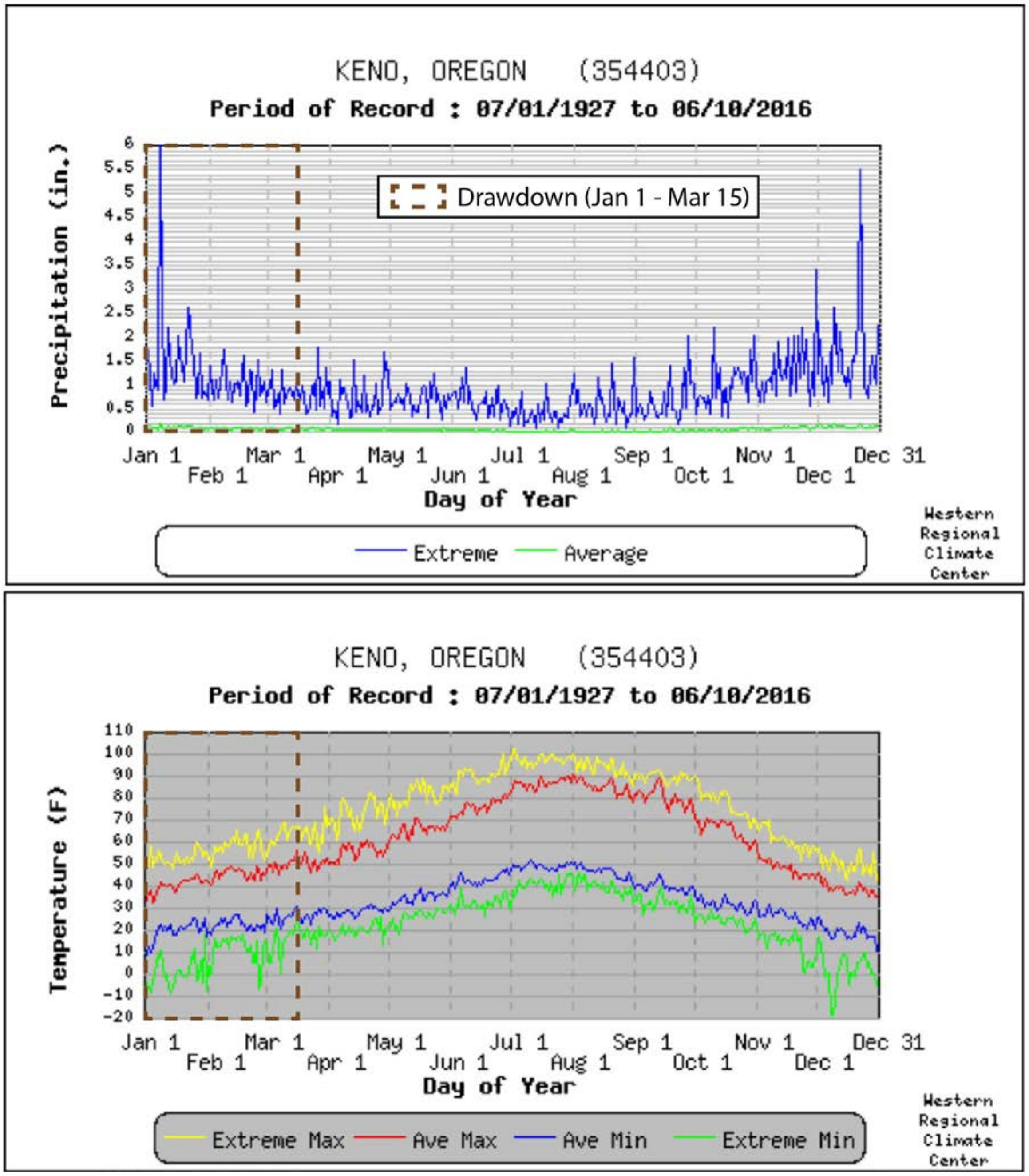


Figure 3-4 Daily temperature (top) and precipitation (bottom) data from nearby Keno, Oregon weather station. Data from Western Regional Climate Center.

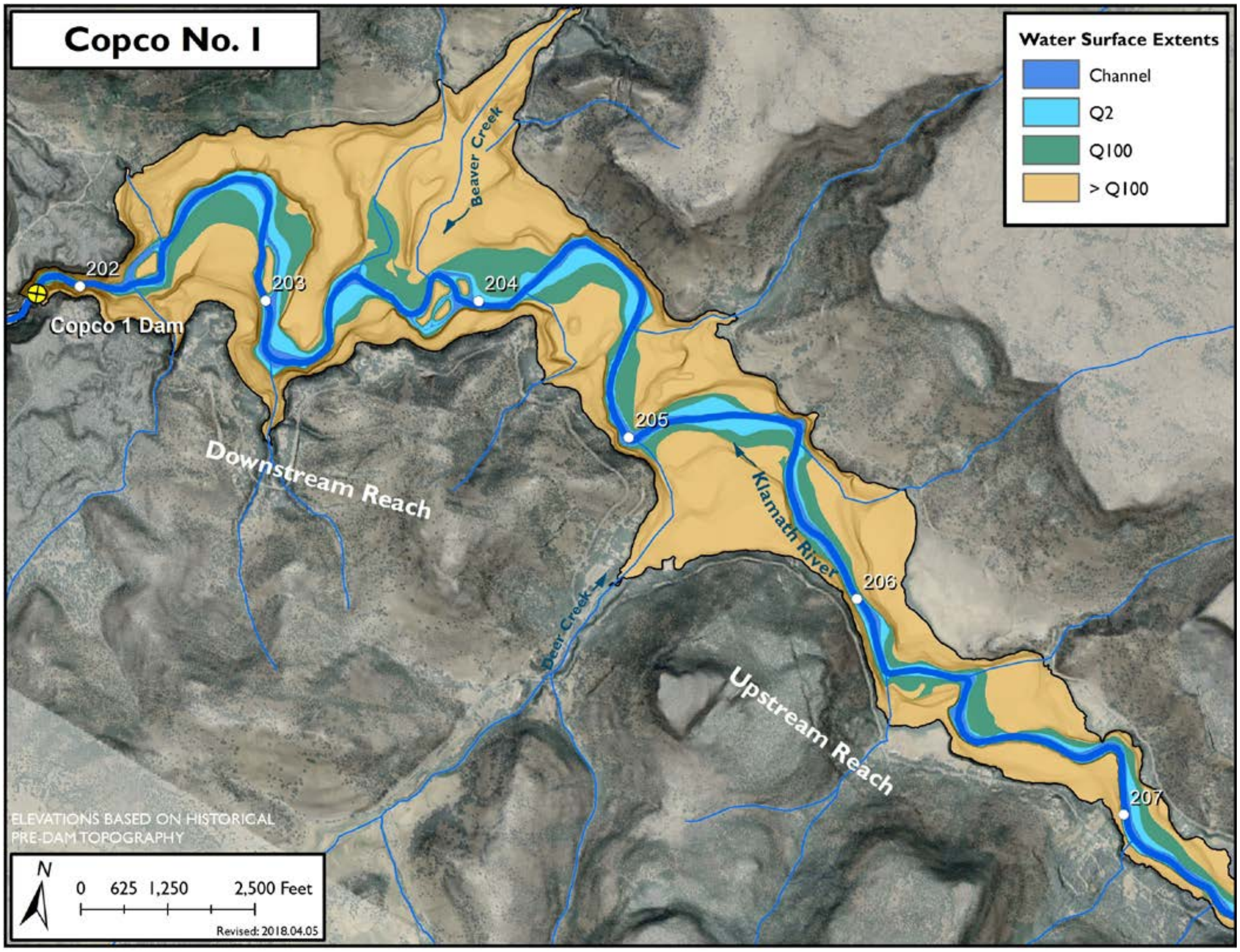
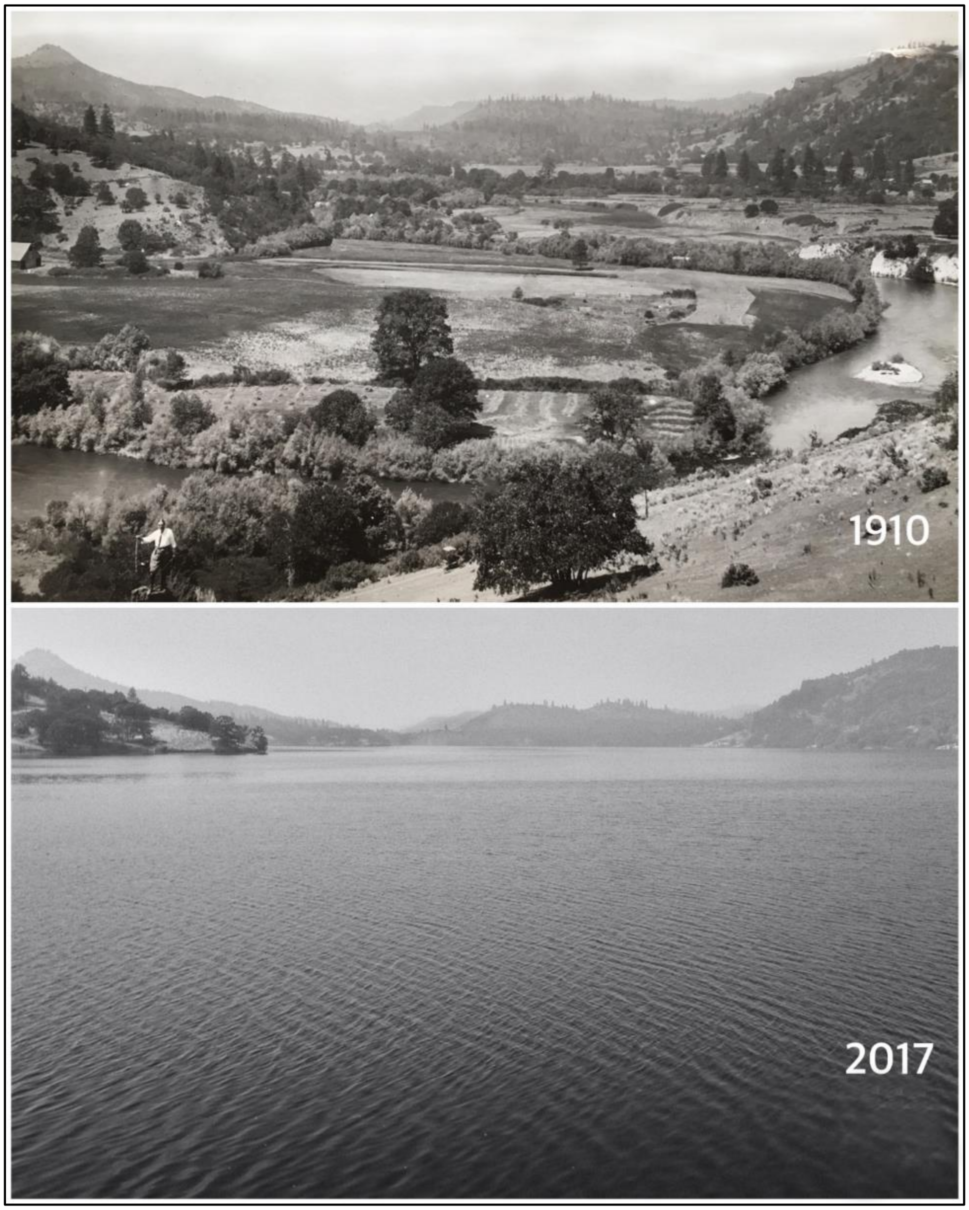


Figure 3-5 Slopeshades of bare earth LiDAR overlaid with aerial imagery and historical topography of Copco Reservoir area with flood inundation boundaries for the 2-year (Q2) and 100-year (Q100) floods.

The historical channel was actively inundating and modifying its narrow floodplain and eroding its diatomite banks as evidenced by the mapped flood inundation boundaries and the presence of a large cut-off meander loop of the mainstem Klamath River occupied by historical Beaver Creek at the time of dam construction (Figure 3-5). Swales, side channels, remnant meanders, and additional floodplain complexity are noted on the 1906 topographic map (Figure 3-8) and visible in the bathymetry (Figure 3-9). However, the large areal extent of the reservoir that is not inundated by the Q100 demonstrates the degree of valley confinement in the reach (Figure 3-5). The degree of alluviation in the historical channel is uncertain. Sand and trace gravel deposits were observed in several of the cores (USBR, 2010), and the channel was eroding diatomite to actively meander, which implies abrasion by sediment tools (Sklar and Dietrich, 2004). Point bars are not noted in historical photos or descriptions, and it is not clear if the vegetated mid-channel island (RM 204.5) visible at the right side of Figure 3-6 is composed of alluvium, diatomite, or a combination.



1910 is prior to dam construction (top photo) showing existing vegetation and land use in the reservoir area. Bedrock/valley fill is exposed in the right bank. A sequence of two mapped alluvial terraces are located on river left in the center of the photograph and bottom photo shows current conditions in 2017.

Figure 3-6 Historical photo of Copco Lake area, 1910 and 2017

The valley bottom was inhabited by humans prior to dam construction and orchards and ranchlands covered much of the land surface with evidence of widespread land clearing. Oak, juniper, and pine groves are visible in photos (Figure 3-6) and marked on the survey maps (Figure 3-8). Riparian vegetation along the mainstem, tributaries, smaller side-channels, and floodplain swales consisted primarily of willows, tule, and brush. Upland vegetation was a mix of oak, pine, juniper, and fir. Prior to dam construction, it appears the valley bottom was cleared of larger trees (e.g., pine) for agricultural purposes.

Figure 3-7 1910 photo looking downstream into Wards Canyon prior to dam construction. Bedrock grade control is visible in the center of the photo.

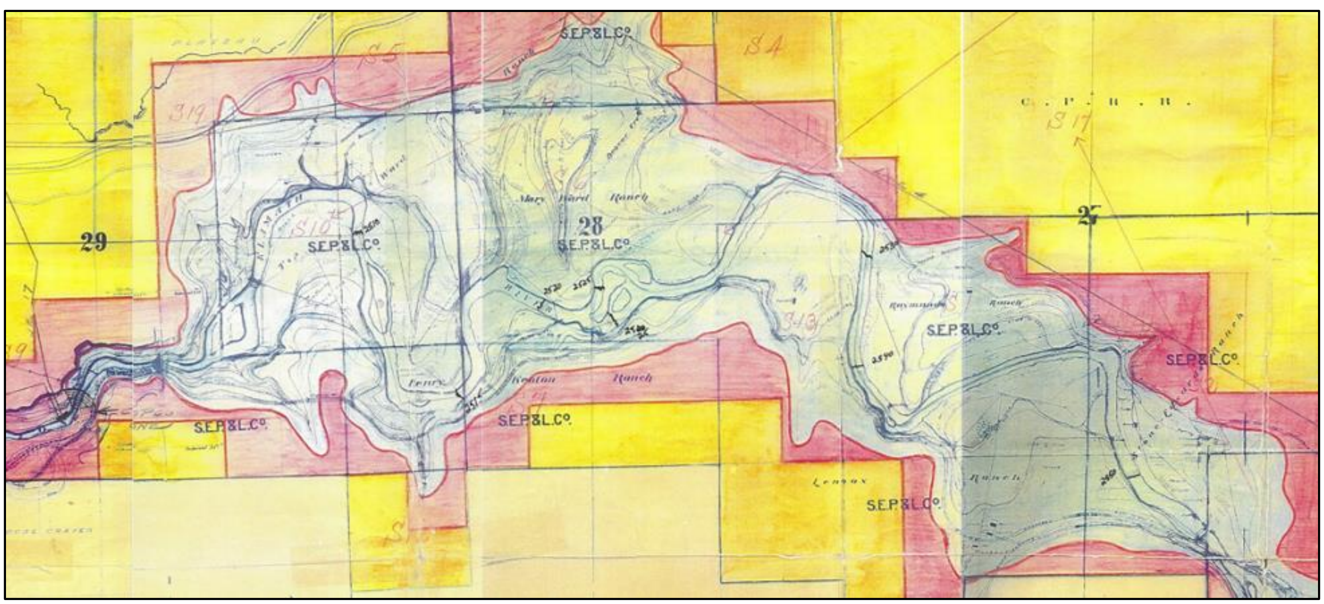


Figure 3-8 Topographic survey and field notes from 1906 survey of Copco Lake area.

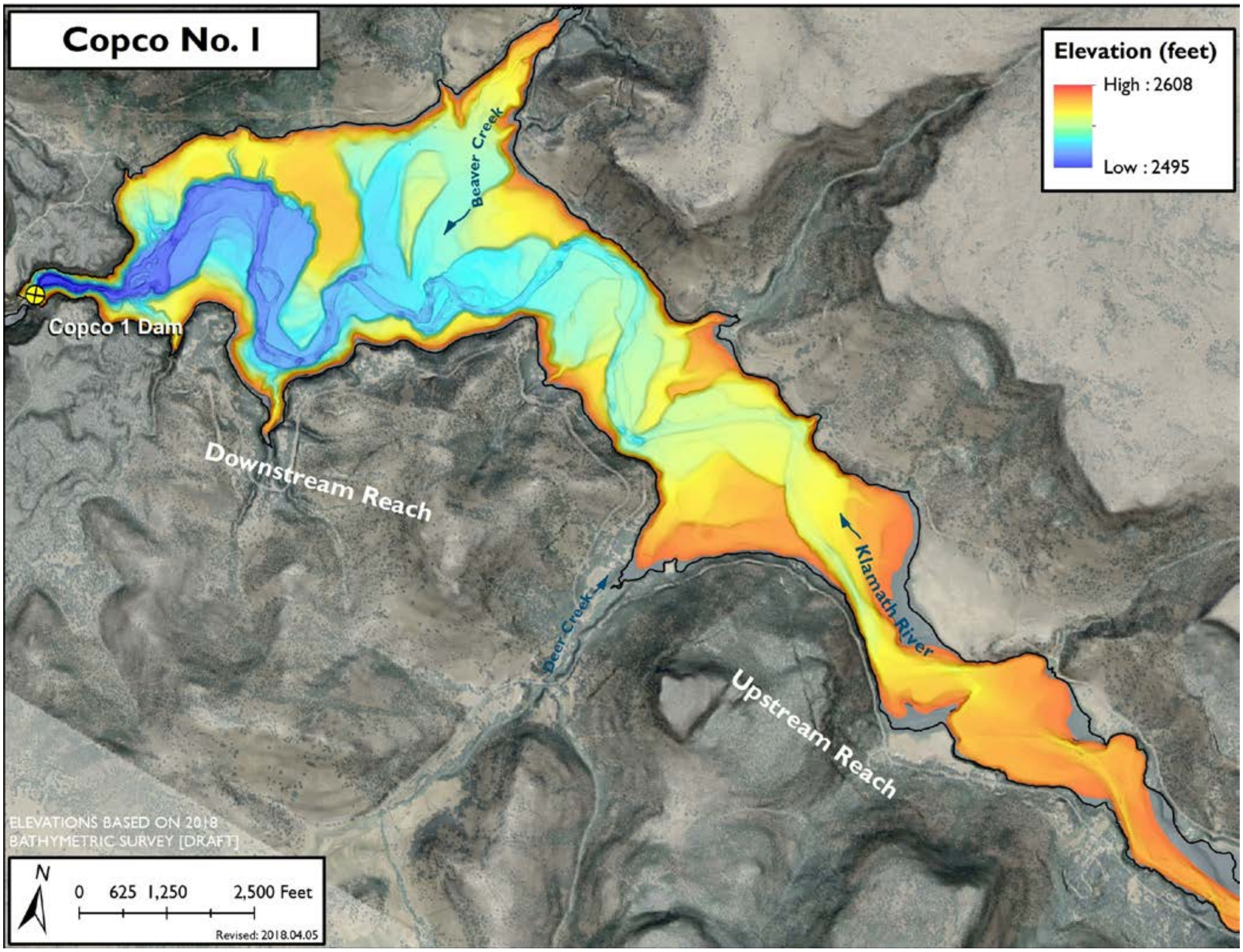


Figure 3-9 Slopeshades of bare earth 1 m LiDAR overlaid with aerial imagery and 2018 1-m bathymetry of Copco Reservoir area.

3.2.2 Current Conditions

Current physical conditions in the Copco No. 1 Reservoir generally vary with distance upstream from the dam and additional cross-sectional variability is due to the historical meandering valley geometry. Reservoir width and maximum depths decrease with distance upstream from the dam with maximum depths located in the historical channel of 100 ft and 60 ft at the dam site and at RM 200, respectively. In the Downstream Reach, shallower depths are present on the ancestral lake bed surfaces. Upstream of RM 201, depths are relatively uniform and are 10 ft or less. Bedrock cliffs, some formed by post-dam erosion of volcaniclastic rocks and diatomite, line portions of the reservoir margin.

Copco No. 1 Dam impounds an estimated 7.44 million ± 1.50 million CY of fine-grained sediment that contains a significant fraction of dead algae and other organic material (USBR, 2011c). Sediment thicknesses decrease longitudinally with distance upstream from the dam and decrease laterally with increasing elevation above the historical channel (USBR, 2011c). Maximum deposit thicknesses are 10 to 12 ft immediately upstream from the dam. Deposit thicknesses are 6 to 10 ft in the historical floodplain (i.e., the Q100 footprint) downstream of RM 206. In the Downstream Reach, the reservoir sediment is, on average 55% clay, 35% silt, and 10% sand (USBR, 2011c), and is underlain at the pre-dam contact by varying concentrations of fluvial sand and trace gravels (USBR, 2010) and a thick layer of fine-grained, but resistant, diatomite. In the Upstream Reach, the coarser reservoir sediment comprises approximately 30% clay, 45% silt, and 25% sand on average (USBR, 2011c) and is similarly underlain by varying concentrations of fluvial sand and trace gravels (USBR, 2010) and a thinner layer of diatomite. Intact organic fragments (e.g., roots, twigs, bark, and wood) were only found at the pre-reservoir contact in a single core (USBR, 2010). The in-situ reservoir sediments in both reaches have high moisture contents of nearly 300% with low cohesion, low strength, and high erodibility (USBR, 2011). The measured friction angle from a sediment core approximately 1 mile upstream from the dam is approximately 27 degrees.

Climate conditions at Copco No. 1 (Figure 3-10) are warmer than J.C. Boyle. Average daily minimum temperature is similarly below freezing from November to May, but temperatures do not reach as low as at J.C. Boyle. The average maximum daily temperature is hotter with temperatures above 90 deg. for July and August. Precipitation is greater in the winter and summers are typically dry. Mean monthly precipitation amounts in July and August, when temperatures are hottest, are 0.88 and 0.36 inches, respectively.

3.3 Iron Gate

KRRC subdivides discussion of the Iron Gate Reservoir into two reaches based on the location of primary tributaries and geomorphic features mapped prior to dam construction in 1962. The Downstream Reach extends from Iron Gate Dam to upstream of the Camp Creek confluence/Mirror Cove arm of the reservoir near RM 195, and the Upstream Reach extends upstream from RM 195 to the upstream extent of the reservoir at RM 199 (Figure 3-11).

3.3.1 Historical Conditions

Prior to dam construction, the Klamath River was a single-thread channel with low to moderate sinuosity that occupied a deep, narrow, and symmetric valley incised into a complex set of intrusive rock, Tertiary volcaniclastic rocks, and younger basaltic and andesitic lava flows that outcrop in many of the ridges adjacent to the channel. Much of the channel bed was composed of coarse sediment that was sourced from adjacent hillslopes and bedrock exposures and formed rapids in the steep and swift reach. Physical conditions (e.g., cross-sectional valley geometry, channel dimensions and characteristics) in the Iron Gate reach were relatively uniform longitudinally, except locally at tributary junctions. Several larger tributaries (Fall Creek, Jenny Creek, and Camp Creek) contributed appreciable sediment to the mainstem and mapped geomorphic features were coincident with the confluences (USBR, 2011c). Figure 3-12 shows construction of the Iron Gate Dam and conditions upstream of the dam.

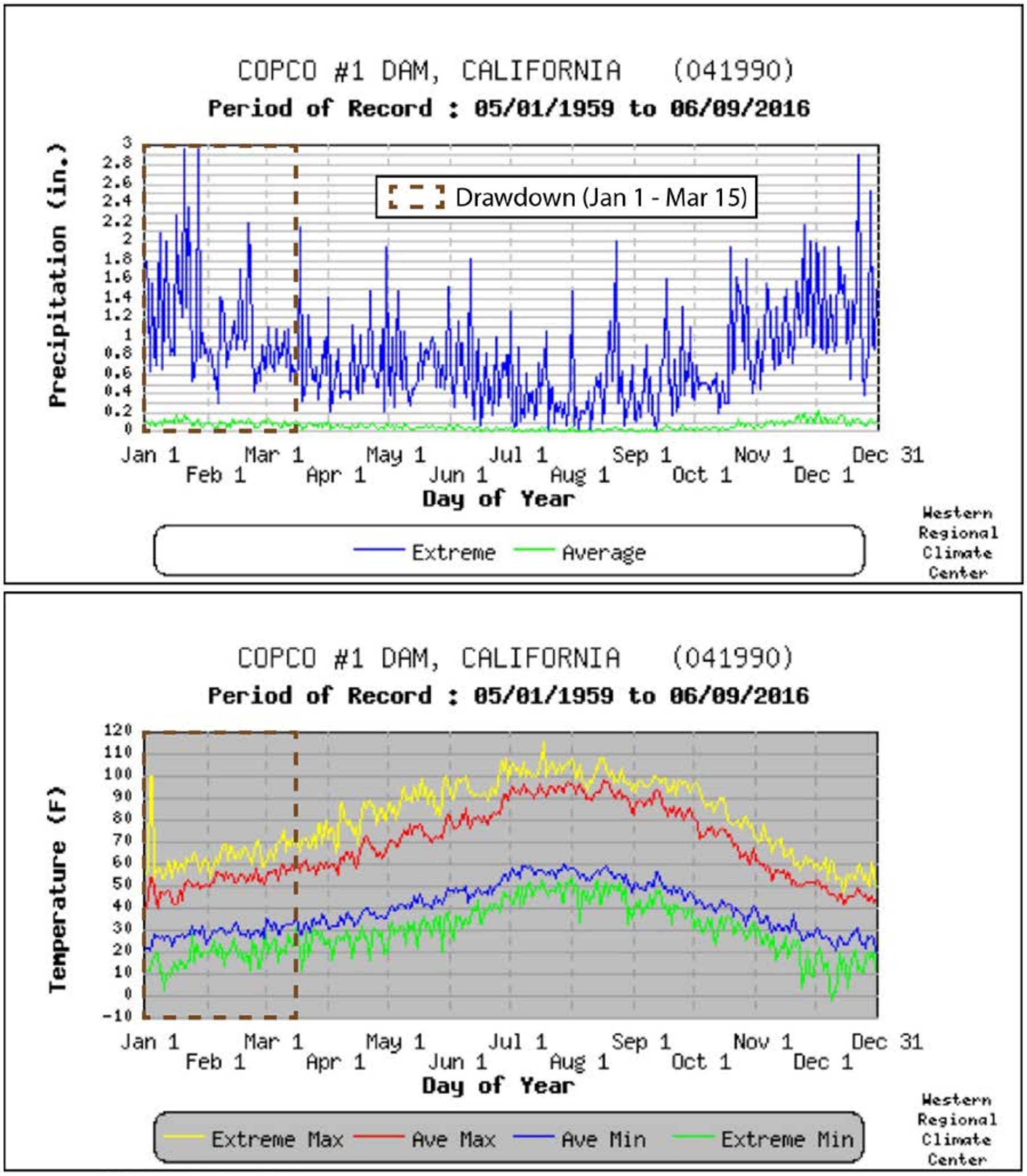


Figure 3-10 Daily temperature (top) and precipitation (bottom) data from Copco #1 Dam, California weather station. Data from Western Regional Climate Center.

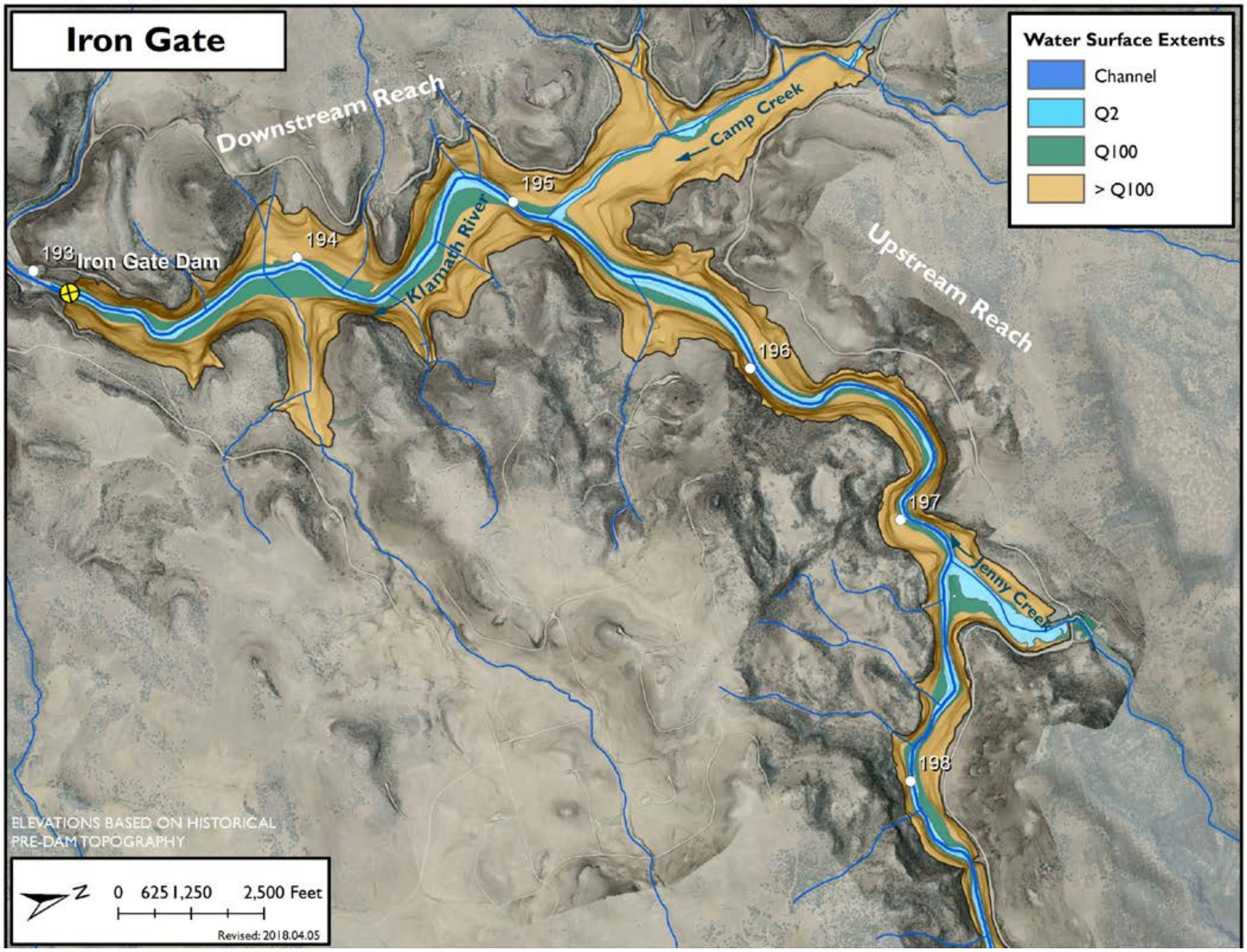


Figure 3-11 Slopeshades of bare earth LiDAR overlaid with aerial imagery and historical topography of Iron Gate Reservoir area with flood inundation boundaries for the 2-year (Q2) and 100-year (Q100) floods.

In the Downstream Reach, Camp Creek, which flows into the present-day Mirror Cove, likely contributed a considerable amount of sediment to the mainstem (USBR, 2010), and there was a large alluvial fan at the historical confluence (Figure 3-13). Camp Creek is vertically incised nearly 10 ft into the fan surface. Downstream of the Camp Creek confluence at RM 195, there was an increased frequency of mapped alluvial terraces, fans, floodplain, and unvegetated bars along the mainstem channel (USBR, 2011c), and the width of the Q100 inundation extent increased accordingly (Figure 3-11). These geomorphic features were longitudinally extensive, but typically limited to 1 to 2 channel widths in lateral extent due to the confined nature of the valley. Rapids were visible in photos at several locations coincident with the wider 100-year floodplains. Anthropogenic disturbance, including mining and road construction, is visible in the bathymetry on the river-left floodplains at RM 194 and RM 195 (Figure 3-13).

Figure 3-12 Photo of Iron Gate Dam during construction and showing reservoir area.

In the Upstream Reach, geomorphic features were largely absent from RM 195 to RM 198, with a notable exception at the confluence with Jenny Creek, which likely contributed a substantial amount of sediment (USBR, 2010), judging by its large contributing area and the volume of sediment it deposited in Iron Gate Reservoir. The channel and floodplain were narrow and topographically confined as indicated by the narrow flood extent widths (Figure 3-11). Near RM 199 and downstream of the Fall Creek confluence, the valley bottom widened, and there was a sequence of mapped alluvial fans and terraces (USBR, 2011c). Prior to dam construction, upland vegetation consisted of grasses with dominant tree species of oak and juniper. Tree concentrations were sparse on southern aspects and considerably thicker on northern aspects and in tributary valleys. A narrow band of willows, tule, and other species lined the riparian zone.

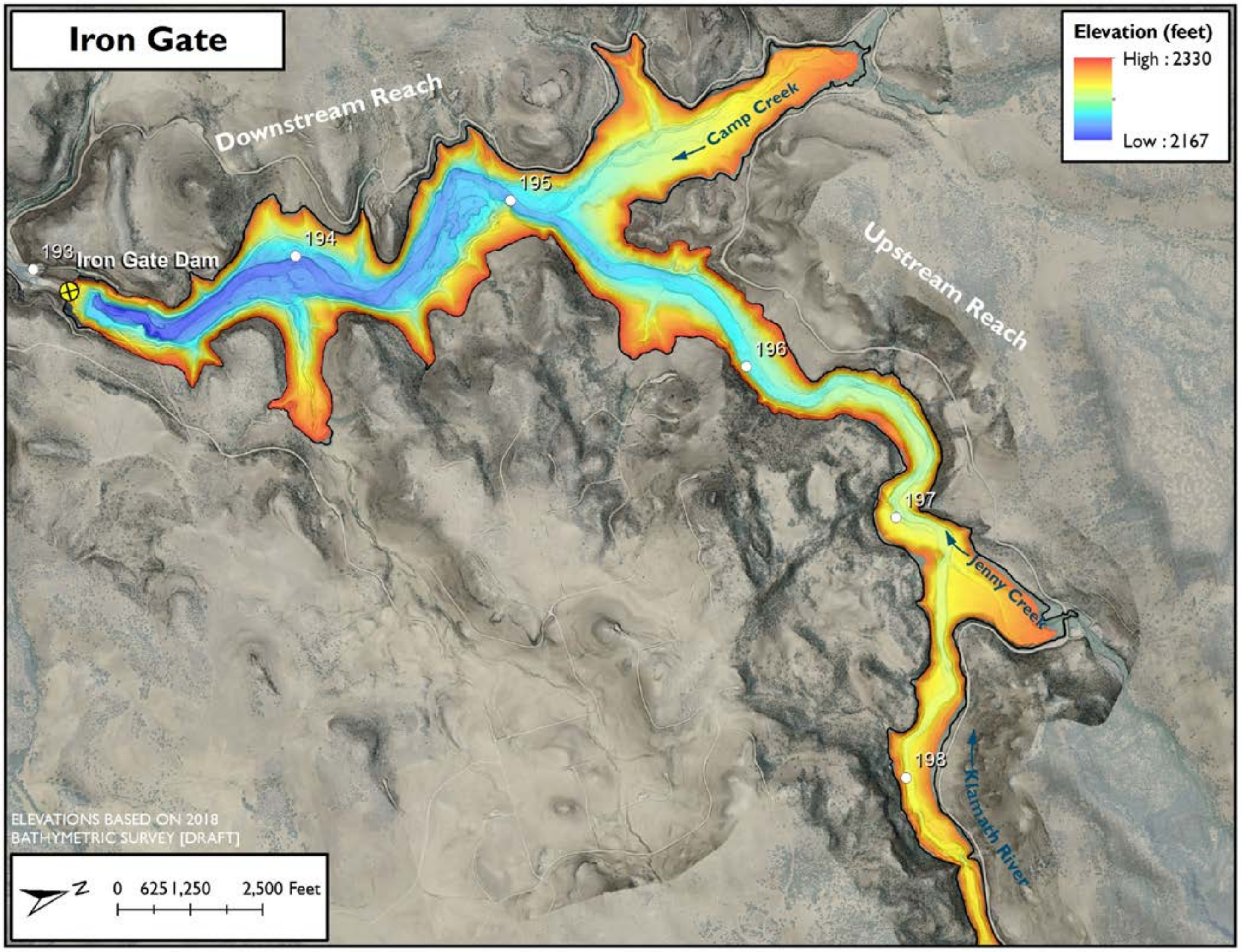


Figure 3-13 Slopeshades of bare earth 1-m LiDAR overlaid with aerial imagery and 2018 30 cm bathymetry of Iron Gate Reservoir area. River miles and reach designations are noted.

3.3.2 Current Conditions

The Iron Gate Reservoir geometry is consistent with inundation of a cross-sectionally uniform, deep, and narrow canyon, whereby reservoir width and water depth decrease with distance upstream from the dam, except at tributary valleys where the reservoir widens into coves. Iron Gate Reservoir is the deepest of the three reservoirs with maximum water depths of 150 ft near the dam (Figure 3-13).

Iron Gate Dam impounds an estimated 4.71 million ± 1.30 million CY of fine-grained sediment, which has the highest clay content and thinnest deposits of the three reservoirs and a high concentration of dead algae and organic matter (USBR, 2011c). Sediment thicknesses are deeper in the historical channel than the historical floodplain and current reservoir margins. Maximum sediment thickness is 4 to 5 ft and decreases with distance upstream from the dam. Mirror Cove has relatively uniform sediment thicknesses of 2 to 3 ft.

The maximum sediment thicknesses of 5 to 6 ft are located at the Jenny Creek confluence and indicate the relative significance of the creek as a sediment source. Accumulated reservoir sediment is approximately 60% clay, 25% silt, and 15% sand in the Downstream Reach and approximately 35% clay, 45% silt, and 20% sand in the Upstream Reach (USBR, 2011c). Reservoir deposits are underlain by fine-grained weathered Tertiary volcaniclastic material with varying concentrations of gravel and sand (USBR, 2010). At the reservoir – pre-reservoir contact, six cores had a layer of decaying organic matter and intact organic fragments (e.g., vertical roots, grasses, twigs, bark) in the upper portion of the pre-reservoir material (USBR, 2010). In locations of some mapped geomorphic features, such as the Jenny Creek confluence and alluvial terraces in the Downstream Reach, layers of Quaternary alluvial gravel and sand are interbedded between the reservoir sediments and Tertiary volcanics (USBR, 2010). The accumulated in-situ reservoir sediments have high moisture contents of nearly 200% in the Upstream Reach and nearly 300% in the Downstream Reach with low cohesion, low strength, and high erodibility (USBR, 2011c). The measured friction angle from a sediment core located at RM 195.5 is approximately 32 degrees (USBR, 2011c).

Upland vegetation is similar to historical conditions and consists of grass covered land with oaks and junipers. Vegetation is generally sparse around the reservoir margins. Higher concentrations of native grasses and shrubs are mapped around the full margin of the reservoir (see Appendix C, USBR, 2011c). Rushes and invasive yellow star thistle are more abundant on the banks of southern aspect slopes, whereas oak are on the banks of northern aspect slopes based on site surveys and observations (USBR, 2011c). Willows are primarily found on the margins of Mirror Cove and on the banks upstream of Fall Creek (USBR, 2011c).

Temperature and rainfall patterns at Iron Gate are expected to be adequately described by the data from the Copco No. 1 Dam weather station (Figure 3-10) information and description.

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Chapter 4: Anticipated Reservoir Conditions

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4. ANTICIPATED RESERVOIR CONDITIONS AFTER DRAWDOWN

KRRC proposes drawdown of all three reservoirs for the months of January, February and March to take advantage of high flows that will maximize erosion of stored sediments and minimize downstream impacts to aquatic resources. This section provides an overview of the general conditions expected in the reservoirs after drawdown and focuses on the characteristics of the residual reservoir sediments and expected revegetation. Each reservoir has distinct features and characteristics, so additional information and description of the likely response of the individual reservoir areas are also discussed below for each reservoir. Table 4-1 summarizes historical water features in each of the reservoirs.

Table 4-1 Summary of mainstem river, side channel, tributaries and area currently inundated in each reservoir

Location	Mainstem River Length* (mi)	Side Channel Length* (mi)	Tributary Length* (mi)	Number of Tributaries*	Inundated Reservoir Area (acres)	Exposed Reservoir Area (acres)
J.C. Boyle	3.3	-	0.2	10	347	222
Copco No. 1	6.9	1.2	1.5	18	972	863
Iron Gate	6.8	-	2.5	52	942	840
Total	**17.0**	**1.2**	**4.2**	**80**	**2,261**	**1,925**

**USFWS 2009*

4.1 Conditions Common to All Reservoirs

KRRC's contractor will simultaneously draw down the J.C. Boyle, Copco No. 1, and Iron Gate reservoirs, and the accumulated sediment will naturally erode and evacuate from the reservoir areas to the extent possible. The accumulated sediment is predominantly silt, clay, and organic material that is over 80% water and highly erodible. USBR used both one-dimensional (1D) and two-dimensional (2D) sediment transport models to predict likely sediment transport and river conditions in the reservoirs after dam removal. USBR estimated that approximately 50% of the stored sediment in the reservoirs will be eroded during drawdown for a median water year with a range of 41% to 65% for dry and wet years, respectively (USBR, 2011c).

The 2011 Plan (USBR, 2011c) summarizes the previous hydraulic modeling completed by USBR and responses of the reservoir areas to drawdown. Forecasted steps in the evolution of the reservoir deposits include initial erosion of reservoir deposits during drawdown, slumping of saturated sediment deposits toward the river channel due to low shear strength and draining of water from the pore spaces in the deposits, and drying, consolidation, cracking and hardening of remaining deposits (USBR, 2011c). Next steps in the process include the establishment of herbaceous vegetation, erosion of the floodplain deposits during storms, and the gradual weathering of the deposit (USBR, 2011c).

KRRC based discussion herein of the conditions anticipated at the individual reservoirs after drawdown on previous studies and analysis documented by USBR (2011c) and the results from experimental testing of reservoir sediments and revegetation completed in 2017 and 2018. Testing focused on 1) changes in reservoir sediment properties when exposed to cycles of wetting and drying, and 2) evaluation of reservoir sediments as growth medium and the success of specific revegetation species. Section 8.1documents the methodology, results, and implications of this experimental testing.

4.2 J.C. Boyle

KRRC expects the geomorphic evolution of the J.C. Boyle Reservoir in response to dam removal to be relatively minor and straightforward. The accumulated reservoir sediments are limited primarily to the historical channel and are thickest in the confined Canyon Reach. Lacking alternative flow pathways in the confined lower reach, the river will readily scour out the reservoir sediment down to the bedrock prominent in the historical river channel bed. Narrow, but potentially several feet thick, deposits may persist outside the channel banks. The Upstream Reach will be exposed early during drawdown because the water depths are shallow. KRRC anticipates the channel here to preferentially erode its historical channel bed and leave the broad (approximately 1,000 ft wide) deposits on the channel margins relatively intact. KRRC does not anticipate significant slumping of these deposits during drawdown because of shallow depths (< 2 ft) and low topographic slopes (< 0.1 ft/ft). These deposits will reduce in height and volume by up to 50% as the material dries and consolidates. Water levels in the J.C. Boyle Reservoir are sensitive to river flows because of the small size of the reservoir. As a result, high flow events can inundate and modify the deposits in the period between the onset of drawdown and removal of the dam. A 5-year event, for example, will increase reservoir elevations by more than 20 ft (USBR, 2011b). There are only a few tributaries on these marginal deposits, and some are ephemeral, so KRRC expects little subsequent evacuation after removal of the dam. Given the low relief of the Upstream Reach, high flow events will periodically inundate and modify the remnant reservoir surfaces. The modeled 100-year flood inundates nearly the entire Upstream Reach (Figure 3-1). It is uncertain if pre-dam bedforms, such as the large mid-channel bar (Figure 3-2), will be reestablished post-drawdown.

The Canyon Reach is highly confined and will have relatively little upland or floodplain area available for revegetation. This geometry should efficiently evacuate the reservoir sediments, and the coarser pre-dam substrate will be exposed readily and support revegetation with woody riparian species in some locations. Drawdown in the Upstream Reach will expose a large low-gradient area of relatively thin reservoir sediments. The existing wetlands in the Upstream Reach, e.g., at the Spencer Creek confluence, may disappear after drawdown, but the seedbank germination study results suggest that wetlands may re-establish naturally, albeit in a new location closer to the historical channel. The sediments at J.C. Boyle contain the lowest amount of clay and the highest amount of arsenic of the three reservoirs, and they will be best suited for planting of native grassy vegetation and trees (e.g., Douglas fir, ponderosa pine, Oregon white oak) that are currently growing in the reservoir vicinity. Each planting zone species assemblage successfully established in the moist J.C. Boyle sediments, and the upland species were able to grow in the desiccated samples, albeit with frequent irrigation and moderate temperatures. Air temperatures at J.C. Boyle typically fluctuate diurnally above and below freezing during the winter months when drawdown is scheduled to occur. As a result, the sediments will drain and dry with warmer daytime temperatures but freeze at night. These conditions, which will persist for months in the Upstream Reach, will be challenging for young plants, particularly those with shallower root systems. Dried sediment thickness will only be on the order of a foot thick, so the roots of plants that establish in the sediments will have access to the historical floodplain surface and materials. The sediments and hydrologic conditions in the historical materials may be more suitable for plant establishment, although it is unknown how reservoir inundation may have modified these characteristics.

4.3 Copco No. 1

KRRC expects the reservoir sediments in the sinuous historical channel footprint to erode during drawdown, and large areal extents of residual sediments several feet in thickness will persist on the low gradient upland surfaces of the historical lake bed. KRRC proposes to begin the drawdown of the 2,609-ft elevation Copco Reservoir water surface on November 1, prior to drawdown of Iron Gate and J.C. Boyle reservoirs, at a rate 2 ft/day. Beginning January 1, drawdown rate will increase to a maximum of 5 ft/day.

The low-gradient, historical lake bed surfaces (elevation approximately 2,580 ft), which extend throughout the Downstream Reach, will be exposed in mid-January under all modeled hydrologic scenarios. These deposits will not be subjected to secondary inundation during large flow events in the period between drawdown and dam removal, except potentially in far upstream portions of the reservoir. These flat surfaces will not be accessible from the river. KRRC anticipates reservoir deposits on these low gradient upper surfaces (except at the edges of vertical bluffs) will be relatively stable and not subject to appreciable slumping or hydraulic erosion. The gradients on these surfaces are typically less than 2 degrees, as measured from the current high resolution bathymetric data, and are well below even the lowest estimates (6 degrees) for the aerial angle of repose for the reservoir sediments.

Larger tributaries, such as Deer Creek and Beaver Creek, can begin to rework their delta deposits and contribute bedload to the mainstem upon aerial exposure. The Deer Creek confluence (elevation approximately 2,560 ft) will be fully exposed in mid-January for dry and median years but as late as late-February for wet years and the notching drawdown option. The dynamic Beaver Creek confluence area (elevation approximately 2,540 ft) will be exposed in mid- to late-January for median to dry years and sometime in February for wet years, depending on the timing of flow events. Large events following aerial exposure will increase the amount of sediment reworking by the mainstem and tributaries. Increases in reservoir water surface elevation due to, for example, a 5-year flood are in the range of 5 to 15 ft.

Copco No. 1 Reservoir sediment thicknesses vary with pre-existing valley topography such that the lower elevation historical channel contains deeper deposits than higher elevation terraces and ancestral lake bed. USBR predicted the spatial patterns of erosion by two-dimensional morphodynamic modeling of Copco Reservoir during drawdown (USBR, 2011b). Erosion in excess of 5 ft was concentrated within the sinuous historical channel and in the cut-off meander bend, which will be re-occupied by Beaver Creek following drawdown. The model predicts nearly zero erosion outside of the historical channel. The model does not simulate fluvial bank erosion or bank failure, nor does it incorporate erosion from tributaries, springs, or concentrated surface runoff from hillslopes. Therefore, the spatial extent of modeled erosion is potentially a minimum prediction, and it is likely that more material will naturally evacuate from other areas during drawdown. The 2D modeling used the formulation for the erosion rate of fine-grained cohesive sediments and measured parameter values from Simon et al. (2010) to simulate erosion under easier to erode and harder to erode scenarios (Table 8-9). The model is far more sensitive to the modeled hydrology than the variation in the erosion rate parameters. The hard to erode τ_C and k values used were more than an order of magnitude lower and higher, respectively, than the maximum values measured in the wetting-drying experiments (Table 8-6). However, given the large proportion of sediment eroded during the drawdown period and its location in the historical channel, the modeling results do not change with the new shear strength data. Hardened, resistant sediment is more likely located in upland and higher elevation floodplain areas less affected by initial drawdown and erosion by the Klamath River.

Given the high relative elevation, low gradient, and large width of ancestral lake bed and upland surfaces, reservoir deposits 2 to 6 ft thick and hundreds of feet in lateral extent may persist at elevations tens of feet above the mainstem active channel post-drawdown. Tributaries and springs may erode these deposits in some places, and the remaining sediments will undergo the physical changes associated with desiccation. The volume reduction during consolidation may lower the surfaces up to 50% of the deposit thickness, and KRRC expects cracks to form. These cracks may concentrate flow from surface runoff in the future and be foci of subsequent erosion of the deposit by rilling and gullying.

The historical Copco No. 1 valley topography was created by a complex sequence geologic and geomorphic events and a diversity of landforms and materials will be exposed following drawdown. The pre-dam valley relief was high in the Downstream Reach with elevation differences in excess of 50 ft between the channel bed and the higher elevation, low-gradient ancestral lake bed. These steep 5 to 50 ft tall banks on the outside banks of the meander bends and the material underlying much of the historical valley bottom are composed of fine-grained and porous diatomite. However, the diatomite, which is mechanically capable of supporting tall vertical bluffs when dry, has been inundated for 100 years, and the pores are likely now filled with water. The drawdown rates of 5 feet per day (0.2 inches per hour) likely exceed the hydraulic conductivity of the diatomite, and the combination of steep and tall valley geometry with saturated porous rock could lead to slope failure during drawdown. The effect of saturation on diatomite mechanical strength and the result of dewatering with drawdown are poorly constrained, but on-going data collection and analysis by KRRC are investigating the stability of the diatomite. The products of diatomite slope failure could persist in the valley bottom and potentially alter the course, but probably not dramatically, of the Klamath River away from the historical alignment and cause increased lateral erosion of diatomite bluffs. KRRC does not anticipate significant vertical incision into the historical valley floor post-drawdown because of the presence of bedrock grade control at the entrance to Ward’s Canyon upstream of Copco No. 1 dam. As such, KRRC expects access by the Klamath River to its historical floodplain to only be limited by the presence of residual reservoir sediments in riparian areas.

The sediment texture at Copco Reservoir is on average much finer than that at J.C. Boyle and ranges from clay to silty clay loam on a USDA texture triangle, and the size grades from fine texture near the dam to the coarsest texture at the upstream portion of the reservoir. Textural gradations will be reflected in the vegetation palette, which will include a larger proportion of native perennial bunch grasses, trees and shrubs in the upstream area where coarser, well-aerated soils will be able to support these deep rooting species. Each planting zone species assemblage successfully established in the moist Copco sediments, and the riparian bank and riparian floodplain species were able to grow in the desiccated samples, albeit with frequent irrigation and moderate temperatures. Air temperatures at Copco typically fluctuate diurnally above and below freezing during the winter months when drawdown is scheduled to occur. As a result, the sediments will drain and dry with warmer daytime temperatures but freeze at night, a combination that will be challenging for young plants. Irrigation may not be possible in the ancestral lake bed uplands and many other upland portions of the Copco valley given the large areal extents and distance from surface water sources. Access to the upland areas must be from the road, rather the channel.

4.4 Iron Gate

At Iron Gate, KRRC anticipates the Klamath River to efficiently evacuate the majority of the reservoir sediment because the reservoir deposit layers are thin, the reservoir water depths are large, drawdown will be more rapid, and the historical channel occupied a narrow pre-dam valley with steep adjacent hillslopes (USBR, 2011c). KRRC proposes to begin drawdown of the 2,330-ft elevation reservoir water surface on January 1. At maximum drawdown rates of 5 ft/day, Fall Creek (approximately 2,310 ft) will be completely exposed in the first week of drawdown and modification of the local deposits by Fall Creek are expected during subsequent storm events. The Jenny Creek delta (minimum elevation approximately 2,270 ft) will have full aerial exposure by mid-February for wet and above-normal years and mid-January for median and dry years (USBR, 2011b) and will experience reworking during subsequent high flows. The Jenny Creek delta has the thickest and coarsest deposits in the Iron Gate Reservoir and will function as a source of bedload to the mainstem. The Mirror Cove confluence area (elevation approximately 2,230 ft) won't be exposed until the end of January for median and dry years and the beginning of March for wet years USBR, 2011b), although upstream portions of Mirror Cove and its tributaries will rework their deposits (maximum sediment thickness 5 ft) at all stages of drawdown.

Most of the historical roads and the railroad along the Downstream Reach of Iron Gate (Figure 3-13) are not exposed until reservoir levels are below 2,230 ft. Assuming maximum drawdown rates, the road will not be exposed until the end of January for median and dry years and the beginning of March for wet years (USBR, 2011b). Several weeks will likely be required before reservoir sediment has stabilized and the certainty of road stability has been verified. Until that point, the floodplain in the Downstream Reach of Iron Gate and Mirror Cove may be inaccessible.

Drawdown operation at Iron Gate will be impacted not only by hydrology but also by releases from Copco and the discharge capacity of the diversion tunnel. KRRC's contractor will control the discharge capacity by a new slide gate, and values of 11,000 cfs, approximately a 5-year recurrence interval flood, are used in models of drawdown. A flow of this magnitude occurring after the onset of drawdown but before dam removal will result in an increase in the reservoir water surface elevation by up to 90 ft, which will backwater Klamath River nearly to the Fall Creek confluence and inundate the historical roads, most of Mirror Cove, and the Jenny Creek delta. This secondary inundation could persist for days to weeks depending the elevation and magnitude of the event and potentially re-saturate or erode residual sediments. Fine-grained sediments will be subject to potential breakdown from an additional cycle of wetting and drying. Secondary inundation is not expected in normal or dry years when flow events do not exceed the discharge capacity of the diversion tunnel.

Reservoir sediments do not exceed 5 ft in thickness except at the Jenny Creek delta, so KRRC expects residual sediment persisting after drawdown to reduce in thickness to less than 3 ft. Given the relatively more rapid drawdown proposed at Iron Gate and steep side slopes, reservoir deposit erosion from slumping should be more efficient (USBR, 2011c). There are several mapped low relief terraces, fans, and historical floodplains in the valley bottom (particularly in the Downstream Reach) on which larger areal extents of sediment may be stable (Table 8-1). The greatest uncertainties relate to the deposit erosion by tributaries, particularly the Camp-Scotch-Dutch Creek complex in Mirror Cove. The valley is wider in Mirror Cove relative to the size of the historical tributaries, and therefore, KRRC expects a larger areal extent of sediment relative to the mainstem areas to remain after drawdown. These deposits are only 2 to 3 ft thick, however, and will consolidate upon drying.

Challenging access into the Iron Gate canyon will limit active revegetation and restoration efforts. Germination and plant growth was successful in the reservoir sediments, but growing conditions were idealized relative to those in the restoration time period which go from below freezing temperatures during drawdown to hot and dry summer. Irrigation is logistically challenging with the steep canyon walls, which limit both groundwater and surface water access. The sediment texture at Iron Gate Reservoir is the finest of all three reservoirs with clay content up to 78% at the IG2 sampling site. Similar to other reservoirs, the sediment textural gradient progresses from finest near the dam to the coarsest at the upstream end of the reservoir and at the Jenny Creek confluence. This gradation will be reflected in the vegetation palette that will include a larger proportion of native perennial bunch grasses, trees and shrubs in the upstream area where coarser, well-aerated soils will be able to support these deep rooting species.

Chapter 5: Reservoir Area Restoration

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5. RESERVOIR AREA RESTORATION

This section provides an overview of the anticipated timeline and restoration plan for each reservoir area along with detailed descriptions for restoration actions. Restoration actions consist of strategic, physical alterations of the reservoir areas including grading and installation of large wood features, as well as revegetation techniques to maximize ecological recovery of the reservoir areas.

5.1 Restoration Time Periods

The 2011 Plan (USBR, 2011c) was developed with an emphasis on stabilizing remaining sediment in the reservoir areas after drawdown to minimize the potential for future, large-scale sediment releases in the Klamath River. In addition to sediment stabilization, the Klamath Restoration Working Group recommended additional actions for the reservoir areas to develop wildlife and aquatic habitat while at the same time restoring natural river function and processes. This RAMP seeks to combine revegetation practices with physical habitat restoration techniques to re-instigate sustainable river function and natural processes. To further describe restoration actions and critical time stages, the following time periods are defined:

1. **Pre-dam removal period** (1–2 years pre-drawdown) activities include: seed collection, seed propagation, IEV control, sediment testing, grow experiments.
2. **Reservoir drawdown period** (January to March, year of drawdown) activities include: reservoir drawdown with natural erosion and assisted evacuation of reservoir sediment deposits, initial stabilization of sediments and exposed areas with aerial seeding, salvage and plant existing wetland and riparian vegetation, evaluation of restoration sites.
3. **Dam removal period** (spring, summer and fall immediately after drawdown) activities include: additional seed application in problematic areas and in remaining unseeded reservoir deposits, irrigation system installation in bank riparian areas, IEV control, active restoration of identified floodplain areas by grading, large wood installation, and habitat features.
4. **Post-dam removal period** (after dam removal is complete) activities include: additional seeding in difficult and underperforming areas, IEV control, continued installation of pole cuttings and seed plantings, maintenance of existing and previously planted vegetation, modification and adaptive improvements to installed habitat features, and installation acceptance inspections to commence a 5-year monitoring period.
5. **Plant establishment period** (Year One, after completion of revegetation) activities include: continued monitoring and maintenance of vegetation, irrigation system maintenance, removal of IEV, fish passage monitoring, and enhancement and/or augmentation of habitat features as needed.
6. **Maintenance and monitoring period** (Years Two to Five, after completion of revegetation) activities will include: regular monitoring and report preparation, re-seeding and re-planting as necessary, IEV control, fish passage monitoring, irrigation system repair, and adaptive management and maintenance of physical habitat features.

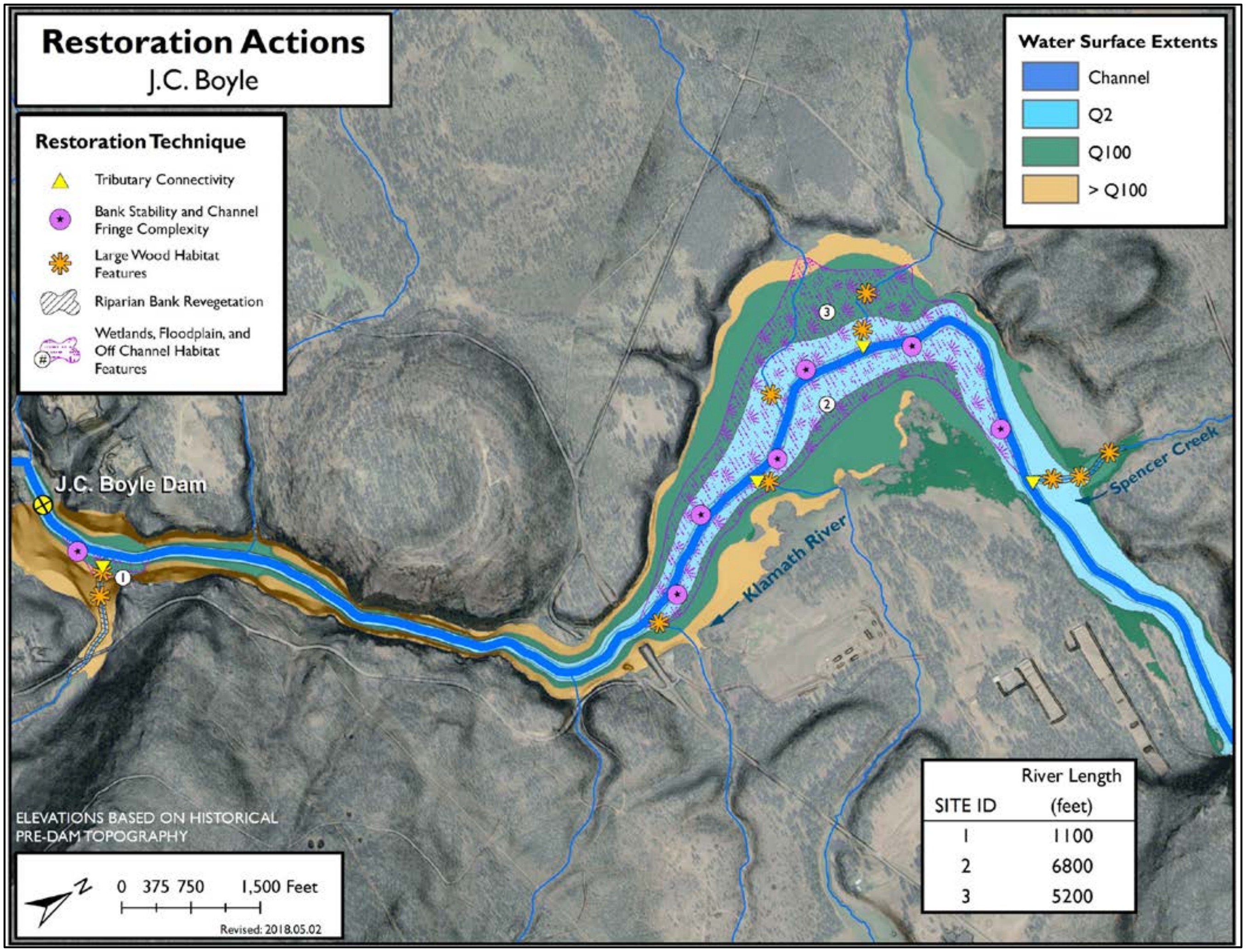
Table 5-1 details the restoration timeline with major tasks KRRC's contractor will implement in relationship to the reservoir drawdown and dam removal activities. A five-year monitoring period is incorporated in the timeline including an intensive one-year plant establishment period that will consist of close attention to monitoring and control of IEV, adaptive re-seeding and re-planting of vegetation in under-performing areas, and careful management of the riparian bank zone irrigation system.

Table 5-1 Restoration Timeline

RESTORATION PERIOD:	Pre-Dam Removal (DR)			DD / DR	Post-DR	Plant Establ.	Maintenance & Monitoring			
Monitoring Period:	Preparation			Construction		Y1	Y2	Y3	Y4	Y5
Calendar Year:	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Task:										
Seed Collection										
Seed Propagation										
Prepare Construction PS&E for Pilot Growing Tests										
Pilot Growing Tests with Monitoring and Data Gathering										
Restoration PS&E Preparation										
Invasive Exotic Vegetation Control										
Construction and Dam Removal (DR)										
Drawdown (DD)										
Site Mass Ggrading at Reservoir Restoration Areas										
Bank Stability and Channel Fringe Actions										
Install Large Wood for Habitat (Ground/Aerial)										
Tributary Connectivity in Reservoir Areas										
Aerial Pioneer Crop Seeding (Repeated)										
Salvage & Planting of Exist. Ripar/Wetland Vegetation										
Pole Cutting Installation										
Cross-rip Compacted Areas in Disturbed Uplands										
Pioneer Crop Mowing and/or Rolling										
Permanent Seed Mix Broadcasting by Vegetation Zone										
Irrigation Installation and Maintenance										
Plant Maintenance										
Key Inspections										
Installation of Deer Fence Enclosures in Selected Areas										
Performance Criteria Monitoring										
Deer Fence and Irrigation Removal										

5.2 J.C. Boyle Reservoir Restoration Overview

Figure 5-1 provides an overview map of the reservoir area with proposed restoration locations and techniques. This map shows the historical channel location, water surface inundation limits for the 2-year and 100-year peak flows based on pre-dam topographic surface, and areas above the 100-year water surface elevation contained within the existing reservoir extents.



Historical topography of J.C. Boyle Reservoir area with flood inundation extents for the 2-year (Q2) and 100-year (Q100) floods are shown for context. Length of river bordering the wetlands, floodplain, and off-channel habitat features restoration sites is included.

Figure 5-1 Map of historical Klamath River centerline, tributaries, and locations of potential restoration actions in JC Boyle Reservoir.

After drawdown, the existing reservoir will have two distinct areas as described in Sections 3 and 4. Little or no opportunity exists for restoration actions in the rocky reach downstream of the Highway 66 Bridge.

Upstream of the bridge, a large and relatively well-connected floodplain will support wetlands and off-channel habitat features. Therefore, at JC Boyle, the KRRC will conduct floodplain shaping and excavation of stored sediments to create areas for floodplain and wetland development along with habitat features that promote process-based restoration of the floodplain areas, and the KRRC will monitor and improve tributary connectivity to ensure volitional fish passage. The KRRC will strategically place LW on the floodplain and within the tributaries to maximize development of natural habitat features. The KRRC will limit habitat enhancement at the Spencer Creek confluence area to LW placement, using a helicopter, due to the probability of culturally significant resources and desire to minimize ground disturbance. The KRRC will construct bank stability measures where appropriate and install channel fringe complexity features in strategic locations to provide habitat only and will not hinder natural formative processes. All proposed restoration efforts will work in concert with the revegetation plans in the reservoir area to maximize the potential long-term habitat benefits.

Figure 5-2 Spencer Creek, a large tributary to JC Boyle Reservoir, provides a good opportunity as a reference site for the restored wetland and riparian zones at JC Boyle after drawdown.

The revegetation approach at JC Boyle Reservoir will be similar to other reservoirs; however, the KRRC will adjust the seed mix and planting palettes to reflect its higher elevation, shallower reservoir depth and different plant communities around the reservoir. KRRC will perform IEV control before the restoration implementation begins. Spencer Creek, which drains into the reservoir, will serve as a reference site for the revegetation portion of the restoration.

Because of the striking topographical contrast between the two reaches of the reservoir, there will be a large difference in the revegetation approach. The Upstream Reach above the Hwy 66 bridge has mostly gentle slopes and includes large and broad riparian floodplains that will have favorable hydrology for riparian and wetland habitat restoration, while the Canyon Reach downstream of the bridge passes through a narrow rocky gorge with minimal restoration opportunities.

Figure 5-3 The Canyon Reach of JC Boyle provides little opportunities for restoration because of its steep rock walls and bedrock river bottom that limit areas for vegetation to restore.

The development of broad segments of emergent wetlands and bank wetlands, as well as bank and floodplain riparian habitats on both banks of the Upstream Reach, will restore a high quality, well-functioning floodplain. Together, the wetland and riparian habitats may constitute up to 50% of the restored areas around the JC Boyle Reservoir; the largest percentage of the three reservoirs in these habitats. Because of the very gradual slope in parts of the Upstream Reach, this reservoir will also have a wider Rocky Wake Zone (RWZ). Because of the shallow depth and very gentle slope, in many areas, the RWZ will have finer remaining substrate left and restoration will be feasible without additional soil import.

The Canyon Reach will not be able to support much vegetation because the bedrock riverbed and the constricting rock wall bank conditions will result in high water velocities, expedited removal of any fine sediment, and very little suitable growing substrate along the narrow banks. KRRC's contractor will implement revegetation by seeding only areas with suitable growing substrate.

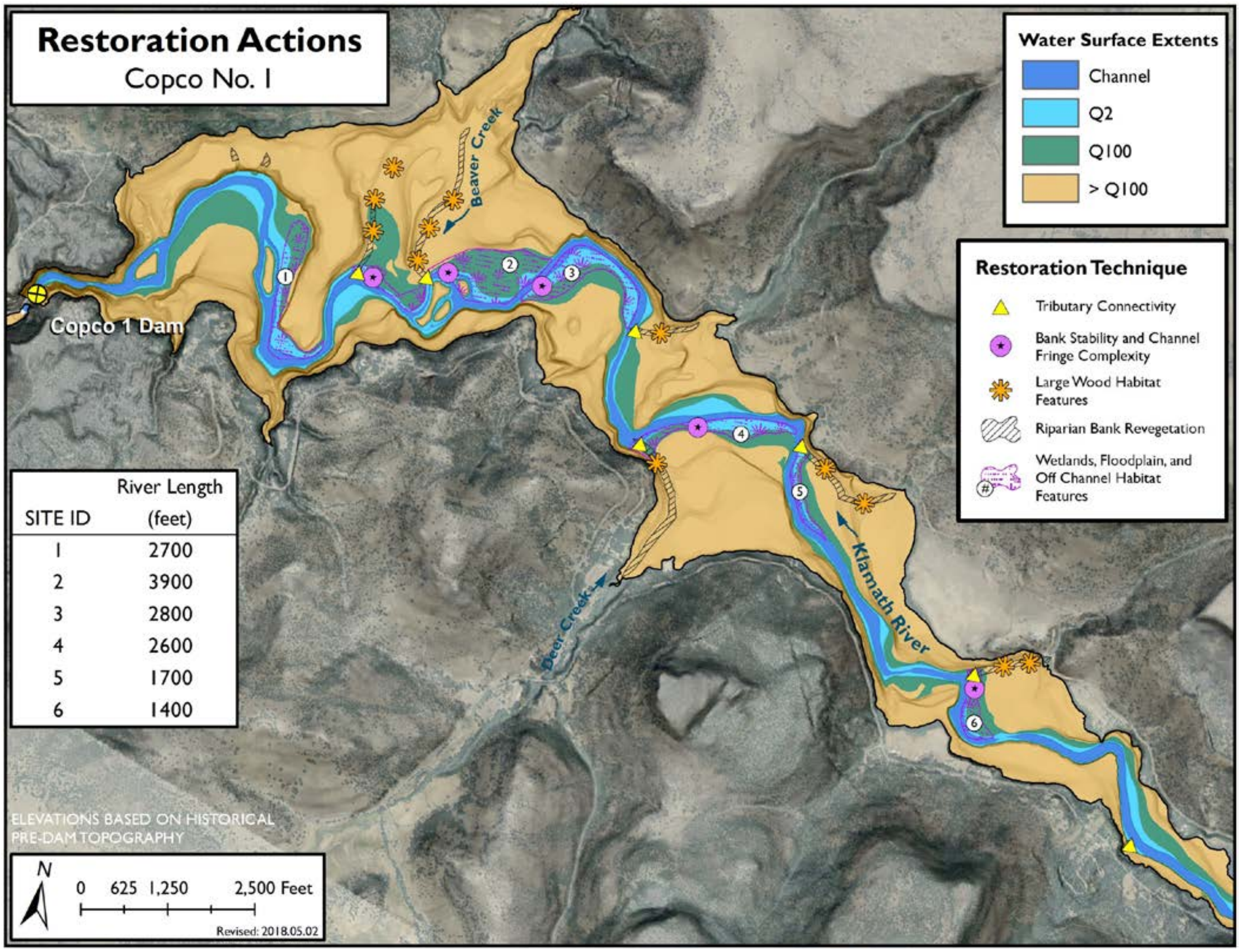
5.3 Copco No. 1 Reservoir Restoration Overview

Copco No. 1 reservoir area has the largest potential for active restoration due to the meandering nature of the river in this reach along with the wider canyon. Hydraulic modeling of the pre-dam topographic surface shows that the river was better connected with the adjacent floodplain at the downstream end of the reservoir and not well connected in the upper half of the reservoir during typical 2-year recurrence interval peak flows (Figure 5-4) along with proposed restoration locations and habitat features. This map shows the historical channel location, water surface inundation limits for the 2-year and 100-year peak flows based on pre-dam topographic surface, and areas above the 100-year water surface elevation contained within the existing reservoir extents. The majority of the area currently inundated is higher than the 100-year floodplain after drawdown and only a narrow band of area is contained in the 2-year floodplain.

During drawdown, KRRC will use barge mounted pressure sprayers to maximize the amount of stored sediment to evacuate the floodplain areas and minimize the amount of depositional sediment on the historical floodplains to promote river inundation on the historical floodplain during high flow events. After drawdown, the KRRC will excavate six areas identified for excavation of remaining sediments and grade those areas to historical floodplain elevation to create wetlands, connected floodplain areas, and off-channel habitat features. These areas are primarily within the historical 2-year floodplain and create ideal locations for restoration.

In addition to the floodplain grading areas, the KRRC will monitor and improve tributary connectivity to ensure volitional fish passage. The KRRC will strategically place LW on the floodplain and within the tributaries to maximize development of natural habitat features as designated. The KRRC will install bank stability and channel fringe complexity features in strategic locations to provide habitat only and will not hinder natural formative processes. All proposed restoration efforts will work in concert with the revegetation plan in the reservoir area to maximize the potential long-term habitat benefits.

The KRRC will focus the revegetation approach at Copco No. 1 on restoration of the wetland and riparian habitats, which will comprise approximately 25% of the restored area around the reservoir, the second largest area after JC Boyle. The KRRC will adjust the seed mix and planting plan to reflect the reservoir's higher elevation than Iron Gate, and different plant communities surrounding the reservoir. The KRRC will perform IEV control early in the revegetation process at Copco No. 1.



Historical topography of Copco No. 1 Reservoir area with flood inundation extents for the 2-year (Q2) and 100-year (Q100) floods are shown for context. Length of river bordering the wetlands, floodplain, and off-channel habitat features restoration sites is included.

Figure 5-4 Map of historical Klamath River centerline, tributaries, and locations of potential restoration actions in Copco No. 1 Reservoir.

The KRRC will use main tributaries, Beaver, Raymond, Spannaus, Long Prairie, and Deer Creeks for wetland and riparian habitat restoration at their confluence with the Klamath River, and will modify their streambeds to provide volitional fish passage. The Copco Reservoir is far more developed that the other two reservoirs, with 86% of the surrounding land being privately owned. The KRRC will use denser seeding and planting, and frequent monitoring in areas with large IEV infestations to safeguard the newly restored areas. Uplands below RWZ will be the largest restored vegetation zone, approximately 60% of the restored area around Copco.

Figure 5-5 Copco vegetation is denser than at Iron Gate, especially on north facing slopes.

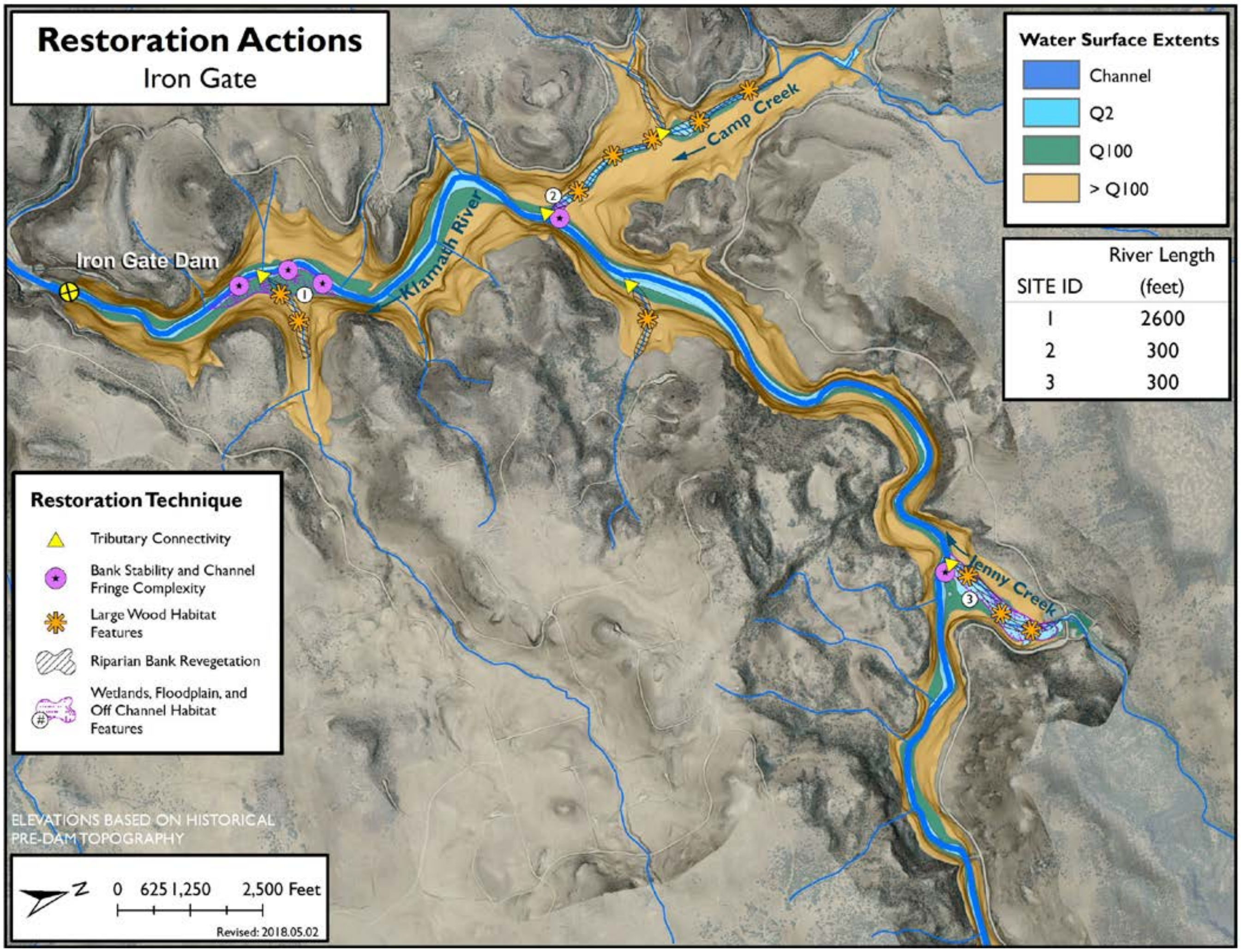
5.4 Iron Gate Reservoir Restoration Overview

The historical Klamath River in the Iron Gate reservoir area had very little floodplain connectivity due to the configuration of the narrow, confining canyon. Figure 5-7 shows the 2-year and 100-year inundation limits based on hydraulic modeling and pre-dam topography. The modeling shows that few areas exist for river-floodplain interaction and the primary areas of potential restoration are at the confluences with larger tributaries. However, KRRC identified culturally significant resources at the confluence areas which limit the amount of restoration that can be done in these areas.

Figure 5-6 Long Prairie Creek joins the reservoir just upstream of the town and provides an opportunity for wetland and riparian habitat restoration at its confluence with the river.

The KRRC identified three areas where wetlands, floodplain, and off-channel habitat features can be restored. The KRRC will excavate the areas to historical ground and grade the areas to maximize interaction with flows from the river and will add habitat features in those areas. Thee KRRC will augment several areas with LW and will ensure tributary connectivity for volitional fish passage in the tributaries. The KRRC will coordinate any restoration modifications around culturally significant resource areas to ensure minimal or no ground disturbance.

The Klamath River passing through the Iron Gate area has formed a very deep and narrow channel with steep rocky banks, providing little opportunity for the restoration or extensive wetland or riparian habitats. As a result, the KRRC will restore nearly 85% of the reservoir area bed after drawdown as uplands with Uplands below Rocky Wake Zone as the dominant planting zone. The KRRC will restore these areas similar to the other reservoirs with native grasses such as annual hairgrass, small fescue, squirreltail grass, blue wildrye, and California brome and with woody upland species such as western juniper, Oregon white and California black oaks. The KRRC will perform IEV control prior to drawdown at Iron Gate.



Historical topography of Iron Gate Reservoir area with flood inundation extents for the 2-year (Q2) and 100-year (Q100) floods are shown for context. Length of river bordering the wetlands, floodplain, and off-channel habitat features restoration sites is included.

Figure 5-7 Map of historical Klamath River centerline, tributaries, and locations of potential restoration actions in Iron Gate Reservoir.

5.5 Description of Restoration Actions

The KRRC will use both revegetation techniques and physical site modifications to initiate process-based restoration and long-term habitat formation to restore the reservoir areas post drawdown. The KRRC considered historical documentation of the reservoir areas before dam construction and reservoir area inundation, past performance of similar dam removal and restoration projects, and current restoration practices, to develop an effective technique useful for the reservoir areas as described below.

Figure 5-8 Steep banks and narrow valley of Iron Gate Reservoir limit opportunities for wetland and riparian habitat restoration.

The 2011 Plan (USBR, 2011c) focused on control of invasive exotic plant species and revegetation of the reservoir areas with native grasses, shrubs and trees as the primary method for restoration. This approach is consistent with nearly all dam removal and reservoir restoration plans in the past 10 years wherein restoration efforts have emphasized revegetation of newly exposed floodplain areas with native plants while actively controlling invasive exotic vegetation. The following subsections describe the approach in this RAMP to restore the project area; specifically, the proposed sediment evacuation, revegetation process, the acquisition of native plant materials, the invasive exotic vegetation control, and the revegetation methodology.

5.5.1 Reservoir Drawdown Sediment Evacuation

A primary objective during the reservoir drawdown period is to maximize natural erosion of stored sediments. This objective has two purposes: 1) reduce the amount of un-natural, stored sediment remaining on the historical floodplain and reservoir area surfaces and 2) minimize the potential for future sediment releases in the Klamath River. For a median water year, hydraulic modeling predicted that approximately half of the stored sediment would naturally erode and vacate the reservoir area (USBR, 2011b). The existing sediment in the reservoir area is highly erodible and has a high water content. To further maximize the amount of sediment eroded during drawdown, KRRC's contractor will use additional manual augmentation during drawdown as described below.

Figure 5-9 Jenny Creek, the largest Iron Gate Reservoir tributary creek also provides the best opportunity for floodplain restoration at its confluence with Klamath River.

The KRRC will use sediment jetting with a barge mounted water jet (Figure 5-10) that has been used on past dam removal projects to maximize stored sediment erosion at the Copco No. 1 and Iron Gate reservoirs. The Contractor will develop a detailed plan for use of sediment jetting.

During reservoir drawdown, some areas near existing roads will provide easy access for machinery, such as bulldozers and excavators, and in those areas, the Contractor will grade and then transport the sediment. The KRRC will designate culturally sensitive areas prior to drawdown to ensure these areas are not entered with machinery. The Contractor will perform area grading between January and April of the drawdown year and will only grade depositional surface sediment and will not extend below the historical ground surface prior to dam construction. The Contractor will develop plans for this grading for approval prior to drawdown.

5.5.2 Tributary Connectivity

As KRRC's contractor lowers reservoir water surfaces during drawdown and beyond, tributaries will be further exposed creating longer reaches of free-flowing water conditions. Figure 5-11 shows where Iron Gate reservoir was drawn down in 2018 approximately 20 ft and how Jenny Creek interacts with the drawdown. The newly exposed tributaries will flow over depositional areas of fine sediment that will likely transport these sediments downstream; however, some larger sediment and debris may create fish passage barriers or un-natural discontinuities in the longitudinal profile. To rectify this, the KRRC will use light equipment and manual labor will be able to move materials and enhance access and longitudinal connectivity of the tributaries with the mainstem Klamath River. In addition, the KRRC may add LW to tributaries to promote habitat complexity as further described below.

Figure 5-10 Sediment jetting on Mill Pond reservoir using a barge and excavator with pump and spray nozzles to maximize stored sediment erosion during reservoir drawdown (photo from Envirocon)

Another aspect of tributary connectivity is volitional fish passage. Many of the tributaries have road crossing at the current reservoir water surface with culverts and stream crossings that do not allow volitional fish passage. In addition, there are historical tributary crossings that area currently within the reservoir inundation zone and will likely create fish passage barriers. The KRRC will prepare an inventory of fish passage barriers in the tributaries after reservoir drawdown and will rectify as many of these as funding allows.

Figure 5-11 Jenny Creek tributary on Iron Gate reservoir with reservoir drawn down approximately 20 ft showing deposition and small delta where it intersects with reservoir in 2018

5.5.3 Wetlands, Floodplain and Off-Channel Habitat Features

Incorporating natural features, such as surface undulations, into newly exposed floodplains is a restoration strategy that promotes ecosystem diversity and natural processes. Based on historical pictures, it appears that three main types of floodplain features could be supported on the newly exposed floodplain areas: wetlands, floodplain swales, and side channels. Likewise, floodplain roughness features can be supported to further instigate natural processes while enhancing wildlife habitat.

Wetlands are depressional or low-lying features with standing water or saturated soils for a portion of the growing season sufficient to support wetland vegetation such as willows, sedges and rushes. Wetlands provide a wide range of ecological functions such as water quality improvement, flood attenuation, and habitat for both terrestrial and aquatic organisms. Including wetlands in restoration will help address several limiting factors including water quality and lack of habitat diversity for wildlife. Wetland restoration strategies for the reservoir areas include preservation of existing wetlands, hydrologic connection of off-channel wetlands with the river, or creation of new wetlands at lower elevations corresponding to the post-dam removal surfaces and hydrologic regime.

Floodplain swales are small depressional areas incorporated into the floodplain that provide microsites where floodplain vegetation can establish at slightly lower elevations (closer to the water table) than adjacent floodplain surfaces. Floodplain swales also provide storage for flood water and sediment at variable flows, in addition to broadening the range of ecological niches available on the floodplain surface to support different life stages (and behaviors) of plant, bird, amphibian, and many other terrestrial wildlife species. To maximize diversity, floodplain swales vary in size and depth, but do not extend below the anticipated baseflow elevation.

Side channel restoration is a strategy to improve instream habitat diversity. Side channels provide off-channel habitat for juvenile rearing and high flow refugia for other aquatic species. Like floodplains, side channels exchange water, sediment and nutrients between the main channel and off-channel areas thus supporting diverse vegetation communities. Side channel restoration strategies include modifying inlet and outlet hydraulics, improving hydraulic complexity with wood structures or realignment, and delivery of water to higher floodplain surfaces.

Figure 5-12 Example of existing floodplain features upstream of Copco No. 1 reservoir (i.e., wetland area)

Floodplain roughness is a technique applied to newly exposed areas where frequent interaction with the river channel is anticipated. Floodplain roughness helps address the initial geomorphic limiting factor on the newly exposed areas - lack of established, stable vegetation. Floodplain roughness also reduces browse pressure by making access more difficult, particularly for geese which require unobstructed runways for landing and takeoff. Installation of roughness features creates complexity and microsites on new floodplain surfaces to trap and protect seed and other plant propagules, and to provide resistance to erosion by reducing velocities and limiting rill formation. Floodplain roughness is created using equipment to roughen the floodplain surface with microtopography and partially bury brush, limbs, and wood in the soil. Microtopography creates variation in the constructed floodplain surface ranging from 0.5 ft above to 0.5 ft below the design floodplain surface. Brush and wood increases IN soil moisture retention creates protective microsites for establishing seed and plants and promotes soil development by introducing organic material as illustrated in Figure 5-17.

5.5.4 Bank Stability and Channel Fringe Complexity

Lack of initial roughness along channel margins results in higher than normal near-bank velocity and shear stress. This increase in active channel margin energy negatively affects aquatic species by requiring increased energy for migration and holding while also transporting desired gravels and depositional features downstream. Velocity shadows created by bankline complexity (i.e. vegetation, rootwads, etc.) and LW create zones of complex hydraulic interactions that provide resting zones, feeding seams, cover and velocity refugia during high flow. Reaches that will benefit from these treatments are typically single thread, like the Klamath River, where the channel is laterally confined. In addition, bank roughness can improve bank stability and reduce un-natural erosion that degrades water quality. Channel fringe complexity is best improved through the strategic addition of LW as described in the following section and the establishment of riparian vegetation. Likewise, KRRC's contractor will not implement this restoration technique where it will disrupt natural, process-based channel and floodplain evolution within the reservoir areas.

Figure 5-13 Example of restored floodplain area six months after construction in an arid climate showing new vegetation and wood roughness elements that provide habitat complexity and immediate, large scale roughness

5.5.5 Large Wood Habitat Features

Large wood (LW) is a naturally occurring element in the Klamath Basin that hydraulically influences the movement of debris and sediment, causing local scour and deposition as well as hydraulic energy dissipation similar to rock outcrops. LW obstructions lead to flow mechanics that result in a fining of stream substrate particles. Suspended sediment particles can drop out of the water column due to flow deceleration caused by LW skin roughness, form drag and turbulent energy dissipation around LW obstructions, hydraulic jumps over LW steps, and a general decline in water surface slope and energy gradient due to physical blockage of flow and backwater effects caused by LW obstructions (Buffington, 1995). LW can be used to disperse flow energy (Buffington and Montgomery, 1999), stabilize channel banks and bed forms (Bilby, 1984), increase aquatic habitat (Bryant and Sedell, 1995), narrow a stream and reduce the width to depth ratio (Sedell and Froggatt, 1984), cause localized deposition, form pools (Bilby and Ward, 1989), and route flood water. Although historical photos do not show LW as a predominant geomorphic feature, it can be used to improve habitat and promote reservoir area conditions that restore natural ecosystem processes and protect vegetation during the initial years of establishment.

Ground-Based Equipment Placement

Use of track hoes (Figure 5-14) and industrial log moving equipment are typical methods for moving and placing wood to build LW habitat structures along river and floodplain areas. KRRC's contractor will use these standard methods for construction in specific areas of the reservoirs based on accessibility and amount of residual reservoir sediment remaining. In culturally sensitive areas, KRRC's contractor will not use ground-based equipment to install LW.

Figure 5-14 Example of LW structure being built for habitat benefits using ground-based equipment

Helicopter Placement

For access to difficult sites or culturally sensitive areas, and to minimize overall site impacts, LW can be efficiently placed using a helicopter. A standard twin rotor helicopter (Figure 5-15) can lift loads in excess of 10,000 lbs. that is roughly equivalent to log lengths over 80 ft with diameters of 24 inches or greater that are ideal for floodplain and tributary stream habitat forming features. Use of a helicopter also enables better preservation of limbs and rootwads with the LW that can help increase the amount of habitat created and the long-term stability of the wood. It is planned that helicopter log placement will take place in areas that are difficult to access and in areas that will potentially disturb culturally significant areas if wood is placed by ground-based equipment.

The following sections contain additional details for each reservoir area and likely restoration actions. KRRC developed restoration actions for each reservoir with consideration to historical context of the reservoir areas prior to dam construction, past performance of similar dam removal and restoration projects, and current restoration practices to determine techniques suitable for improving habitat conditions in the reservoir areas. KRRC envisions that the proposed restoration actions will be evaluated at the time of reservoir drawdown to adapt to conditions that are exposed in the reservoir areas. It is likely that some areas will be slightly modified to fit the surrounding terrain and may be limited by machinery access. Likewise, the areas identified represent the largest footprint that will likely be disturbed.

5.5.6 Revegetation

The reservoir area revegetation process will consist of six distinct periods listed above and described in more detail below. The aquatic and wildlife habitat restoration process will be closely dependent on the dam removal schedule and will be subject to changes that may be triggered by construction implementation or permitting and access issues.

Figure 5-15 Example of LW being transported and placed with a twin rotor helicopter

Pre-Dam Removal Period (from 2 Years before Drawdown to Drawdown)

In the years before drawdown, the KRRC will focus its revegetation activities on acquisition and close review of existing data about the reservoirs, invasive exotic species mapping and control, collection and propagation of native plant seed in preparation for restoration implementation. The KRRC will conduct an on-site pilot growing test on sediments extracted from the reservoirs in order to determine the initial performance of the seeded vegetation on the substrate under actual field conditions. The KRRC will also survey listed plant and IEV, identify and biologically survey restoration reference sites, test plot growing experiments to determine the best prescriptions for successful establishment of desired species, test sediment, prepare contingency plans, and coordinate with relevant agencies.

Drawdown Period (Drawdown Year - January to March)

The KRRC will aerially seed pioneer seed mixes with a variety of riparian and upland common native and non-native sterile species and mycorrhizal inoculant on all of the exposed reservoir basins during and/or immediately after the drawdown. The KRRC will apply these mixes as the reservoir water level drops and before the exposed sediments dry and form a surface crust, to facilitate expedited seed germination through retained residual soil moisture. The KRRC will re-seed any seeded areas that are re-inundated by larger storm events during the drawdown after flood waters recede. The exposed sediment will not be initially seeded with valuable, less common native species because it may not be able to reliably support native vegetation as it will not immediately possess typical topsoil characteristics; specifically, the soil microbiota component will be missing and many minerals such as iron, manganese, arsenic and vanadium will be at levels toxic to plant life because of their solubility when submerged. Once they are oxidized, within days after drawdown, their plant availability and toxicity will be greatly reduced (Wallace, 2017). Additionally, soil test results have indicated that most of the sediment samples are acidic, have a high clay content, high shrinkage and swelling factor, high organic content, no soil structure, and are at a high risk of compaction. The KRRC will use the pioneer plant seeding in order to develop soil structure, facilitate the conversion of sterile sediment into productive topsoil for native vegetation through the re-introduction of soil microorganisms into the sediment, and for erosion control. The KRRC will support natural movement of sediment out of the reservoir basins during drawdown by jetting sediment out of key riparian floodplain areas that will be essential for the correct hydrological function and connectivity to the river. The KRRC will transplant existing riparian and wetland plants that can be easily salvaged from the rim of the reservoirs to these newly formed riparian and wetland bank areas. Riparian and wetland zone specific seed mixes, tree and shrub seed, acorns, and pole cuttings will be installed in the riparian and wetland bank zones depending on feasibility and other factors such as weather, water level in the river, availability, and access.

Dam Removal Period (Drawdown Year - March through December)

The KRRC will continue the drawdown period restoration activities in the riparian and wetland bank zones into the dam removal period, including the harvesting and salvaging of existing live riparian and wetland vegetation. The KRRC will continue this work potentially into late May or early June. The KRRC will salvage existing riparian flora that will eventually die as a result of the drawdown as an inexpensive source of viable pole cuttings and mature, locally ecotypic rooted plant material. The KRRC will establish woody riparian species in riparian areas to perform many key ecological functions, provide shaded aquatic riverine habitat for fish, maintain cool water temperatures, and increase natural bank stability and function. To expedite the riparian bank zone development, the KRRC will install irrigation systems along key segments of the river banks where the riparian zone width will warrant this expense. Vegetation zones above the riparian bank zone will have only minimal activities occurring during the spring and summer seasons. The KRRC will monitor cover crop growth and establishment and supplement seeding or local irrigation in areas of poor performance or in case of drought. The KRRC will roll or mow the cover crop in the late fall and broadcast zone-specific seed mixes over the drying and disintegrating cover crop.

Post-Dam Removal Period (First Year after Dam Removal)

During the second year of revegetation, the KRRC will re-seed areas that failed to establish and will collect and install additional pole cuttings. The KRRC will maintain previously seeded and planted areas with intensive weed removal efforts and irrigation system upkeep. The KRRC will install deer fence enclosures in selected floodplain areas. In cases where cover crop mulch has moved/degraded or otherwise exposed bare soil, the KRRC will supplement seeding to help prevent excessive soil erosion. The KRRC will perform inspections during this period to confirm restoration work installation acceptance and an official start of the plant establishment period.

Plant Establishment Period (Year One after Completion of Revegetation)

The most important activities during plant establishment will be IEV control, herbivore control, and irrigation system maintenance. The Contractor will develop a Weed Control Plan with the key objective to limit IEV cover. The KRRC will monitor compliance the Weed Control Plan. The KRRC will monitor IEV and the implementation of timely control measures to control high and medium priority invasive exotic vegetation (e.g., Himalayan blackberry, yellow star thistle, Russian knapweed, and others listed in Table 5-4). The KRRC will control low priority IEV species only if they interfere with the successful establishment of native vegetation.

Maintenance and Monitoring Period (Years Two to Five after Completion of Revegetation)

The maintenance and monitoring period will consist of activities that will keep revegetation efforts on track to achieve performance criteria set for each monitoring year. It will consist of re-seeding/re-planting of native vegetation (as necessary), invasive plant management, herbivore control, irrigation maintenance and other activities as situations arise (e.g., implementation of erosion repairs). KRRC will base specific activities on the monitoring results and activity thresholds. For purposes of monitoring the revegetation plan success and achieving natural conditions, KRRC will develop performance criteria with the regulatory agencies for upland, riparian floodplain, riparian bank, and wetland zones, as well as for invasive exotic plant management. The general monitoring approach will be to observe the vegetation re-establishment trend, compare it to conditions expected for early-successional habitats in reference areas, and take corrective action when necessary to steer the development trend. KRRC will monitor plant species and cover, the density of woody riparian vegetation, acres of wetlands, and noxious weed levels. Monitoring will occur for a total of five years (one year of plant establishment period and four years of maintenance and monitoring period) or until the performance criteria have been met.

Plant Material Procurement

The KRRC will revegetate the reservoir areas during and after drawdown and dam removal as determined by the monitoring protocols. Although some degree of natural revegetation development will occur, the revegetation approach will use a combination of seeding, pole-cutting installation, tree and shrub seed planting (acorns, samaras, etc.), and salvage/ transplanting of existing vegetation to accelerate the natural succession to stable native plant communities. The KRRC will divide the former reservoir area beds into upland, floodplain riparian, bank riparian, and wetland planting zones and will employ different implementation techniques and plant species will be employed in each zone based on hydrology, sediment texture, slope aspect and other characteristics. Revegetation of each of the proposed planting zones is described in detail below in subsection 5.2.5.

Native Plant Seed Collection and Propagation

The KRRC will seed native grasses, sedges, rushes, forbs and shrubs in all revegetation zones, possibly with addition of a very small amount of sterile wheat to enhance the initial erosion protection function of the herbaceous vegetation. To revegetate the large reservoir beds of the four dams the KRRC will require large quantities of seed, on the order of 200,000 lbs. of pure live seed (PLS).

Figure 5-16 Bluebunch wheatgrass (*Elymus spicatus*) is a perennial native bunchgrass that is common in the uplands above the reservoirs

The most efficient method for acquiring seed for the revegetation will be early collection of native seed from the project vicinity, and subsequent large-scale seed propagation. Because the Project needs a large amount of seed, and the procurement, collection and growing processes are time consuming, the KRRC is beginning this work in 2018. The KRRC will implement these tasks throughout the pre-dam removal, drawdown, dam removal and post dam removal periods.

Collected seed will be grown by specialty commercial growers to produce large amounts of native seed. To achieve good native vegetation coverage, successfully combat invasive vegetation, and effectively prevent soil erosion, KRRC's contractor will seed approximately 80 lbs of pure live seed (PLS) per acre in several steps resulting in the need for about 200,000 lbs. PLS for the 2,500 acres of the project area. To obtain this amount of seed, KRRC's contractor will gather 175 pounds of wild collected seed each of the four years before the 2022 fall season. It is expected that on average 7 lbs. of PLS/acre of wild collected seed will produce at least 2,000 lbs. PLS/acre in agricultural settings on specialized seed propagation farms. The commercial growers will plant native seed on approximately 25 acres, resulting in about 50,000 lbs. The commercial grower will clean and store the seed in climate controlled warehouses and in some cases pre-treat it. The KRRC contacted several large-scale growers and will engage one or more of them in the near future to propagate the native seed. The growers will collect native plant seed from existing vegetation around the reservoirs and within the larger Upper Klamath Basin Watershed. Vegetation inventories were completed around the reservoirs in 2009 and 2010 as part of the EIS/R preparation (USBR, 2011c). The KRRC will conduct a new seed collection areas reconnaissance survey utilizing the previous inventories, and including key tributaries, and other areas within the Upper Klamath River Watershed with an elevational range similar to that around the reservoirs (2,300'–3,800'). The seed collection contractors will implement seed collection in a way that will not cause damage to the existing plant populations or parent plants. During seed collection activities by seed collection contractors, the KRRC will conduct several random inspections to ensure compliance with the specification limiting damage to parent plants. Time, budget or availability constraints may make it necessary to acquire some seed and plant materials from commercial seed companies or nurseries. KRRC will source commercially only species common in similar environmental conditions in the adjacent watersheds, or species that will not be able to reproduce in the project area. The KRRC will conduct investigations of conditions and timing to improve initial germination rate of seed material as part of pre-project test plot revegetation experiments described below in Section 5.6.4.

The KRRC will rely only on mycorrhizal inoculants to promote the long-term growth of seeded native species in the project area. The KRRC will not use fertilizers in the revegetation process unless necessary as determined by soil analyses in areas of poor vegetation establishment. Previously identified (USBR 2011a), and other important species suitable for the reservoir areas' seeding are listed in Table 5-2. The KRRC will use these species as the backbone of the revegetation for the Project and will collect other native species to be used in some planting zones based on suitable soil texture, slope aspect, local topography and hydrology as described below, or as backup species in case native seed collection of keystone species does not produce sufficient amounts of seed (Table 5-2).

The KRRC will collect Oregon white oak (*Quercus garryana*) and California black oak (*Quercus kelloggii*) acorns in the fall after dam removal, for cold stratification through the winter and early spring, and installation in mid- to late spring during the post-dam removal period in the riparian zones and mesic parts of the upland zones if feasible. The KRRC will collect and install additional acorns in the fall of the post-dam removal year. The KRRC will collect and plant seeds of other native woody species based on availability (Table 5-2 below).

Table 5-2 Seeded species Proposed for Collection and Propagation

Common name	Scientific name	Life Form
bigleaf maple	*Acer macrophyllum*	large deciduous tree
common yarrow	*Achillea millefolium var. lanulosa*	perennial herb
Spanish lotus	*Acmispon americanus [Lotus purshianus]*	annual herb
spike bentgrass, spike redtop	*Agrostis exarata*	perennial grass
white alder	*Alnus rhombifolia*	deciduous tree
western serviceberry	*Amelanchier alnifolia*	small deciduous tree
mugwort	*Artemisia douglasiana*	perennial herb
Oregon grape	*Berberis aquifolium*	small evergreen shrub
devil's beggartick	*Bidens frondosa*	annual herb
California brome	*Bromus carinatus*	perennial grass
incense cedar	*Calocedrus decurrens*	large coniferous tree
water sedge	*Carex aquatilis*	perennial herb
slender beak (wheat) sedge	*Carex athrostachya*	perennial herb
Nebraska sedge	*Carex nebrascensis*	perennial herb
woolly sedge	*Carex pellita [lanuginosa]*	perennial herb
clustered field sedge	*Carex praegracilis*	perennial herb
awlfruit sedge	*Carex stipata*	perennial herb
buckbrush	*Ceanothus cuneatus*	evergreen shrub
deerbrush	*Ceanothus integerrimus*	semi-deciduous shrub
birchleaf mountain mahogany	*Cercocarpus betuloides*	semi-deciduous shrub
western water hemlock	*Cicuta douglasii*	perennial herb
smooth dogwood	*Cornus glabrata*	large deciduous shrub
red-osier dogwood	*Cornus sericea*	large deciduous shrub
turkey mullein	*Croton [Eremocarpus] settiger*	annual herb

Common name	Scientific name	Life Form
tufted hairgrass	*Deschampsia caespitosa*	perennial grass
annual hairgrass	*Deschampsia danthonioides*	annual grass
saltgrass	*Distichlis spicata*	perennial grass
needle spikerush	*Eleocharis acicularis*	perennial herb
common spikerush	*Eleocharis macrostachya [palustris]*	perennial herb
bluebunch wheatgrass	*Elymus [Pseudoregneria] spicatus*	perennial grass
squirreltail grass	*Elymus elymoides*	perennial grass
blue wildrye	*Elymus glaucus*	perennial grass
common rabbitbrush	*Ericameria [Chrysothamnus] nauseosa var. leiosperma*	semi-deciduous shrub
common woolly sunflower	*Eriophyllum lanatum*	perennial herb
western goldenrod	*Euthamia occidentails*	perennial herb
small fescue	*Festuca [Vulpia] microstachys*	annual grass
Idaho fescue	*Festuca idahoensis*	perennial grass
red buckthorn	*Frangula [Rhamnus] rubra*	evergreen shrub
Oregon ash	*Fraxinus latifolia*	deciduous tree
meadow barley	*Hordeum brachyantherum ssp. b.*	perennial grass
California barley	*Hordeum brachyantherum ssp. californicum*	perennial grass
Baltic rush	*Juncus balticus*	perennial herb
toad rush	*Juncus bufonius*	perennial herb
common rush	*Juncus effusus var. pacificus*	perennial herb
sword-leaved rush	*Juncus ensifolius*	perennial herb
western rush	*Juncus occidentalis*	perennial herb
iris-leaved rush	*Juncus xiphioides*	perennial herb
junegrass	*Koeleria macrantha*	perennial grass
rice cutgrass	*Leersia oryzoides*	perennial grass
Great Basin wildrye	*Leymus cinereus*	perennial grass
creeping (beardless) wildrye	*Leymus triticoides*	perennial grass
silvery lupine	*Lupinus argenteus*	perennial herb
chick lupine	*Lupinus microcarpus*	annual herb
field mint	*Mentha arvensis*	perennial herb
seep monkey flower	*Mimulus guttatus var. guttatus*	Annual herb
mat muhly	*Muhlenbergia richardsonis*	perennial grass
watercress	*Nasturtium officinale*	perennial herb
knotgrass	*Paspalum distichum*	perennial grass
hot rock penstemon	*Penstemon deustus*	perennial herb
royal penstemon	*Penstemon speciosus*	perennial herb
varied leaf phacelia	*Phacelia heterophylla var. virgata*	perennial herb
Lewis' mock orange	*Philadelphus lewisii*	deciduous shrub
ponderosa pine	*Pinus ponderosa*	coniferous tree
pine (Sandberg) bluegrass	*Poa secunda*	perennial grass

Common name	Scientific name	Life Form
water pepperweed	*Polygonum hydropiperoides*	perennial herb
Klamath plum	*Prunus subcordata*	small deciduous tree
chokecherry	*Prunus virginiana var. demissa*	small deciduous tree
Douglas fir	*Pseudotsuga menziesii var. menziesii*	coniferous tree
antelope brush	*Purshia tridentata*	Deciduous shrub
Oregon white oak	*Quercus garryana*	deciduous tree
California black oak	*Quercus kelloggii*	deciduous tree
fragrant (three-leaf) sumac	*Rhus aromatica [trilobata]*	deciduous shrub
whitestem gooseberry	*Ribes inerme*	deciduous shrub
plateau (desert) gooseberry	*Ribes velutinum*	deciduous shrub
California rose	*Rosa californica*	deciduous shrub
Pacific blackberry	*Rubus ursinus*	deciduous shrub, vine
California dock	*Rumex californicus*	perennial herb
narrow-leaf willow	*Salix exigua*	deciduous shrub
red willow	*Salix laevigata*	large deciduous tree
arroyo willow	*Salix lasiolepis*	deciduous tree
shining willow	*Salix lucida ssp. lasiandra*	deciduous tree
blue elderberry	*Sambucus nigra ssp. caerulea [mexicana]*	large deciduous shrub
hardstem bulrush	*Schoenoplectus [Scirpus] acutus*	perennial herb
broadfruit bur reed	*Sparganium eurycarpum*	perennial herb
rigid hedge nettle	*Stachys ajugoides var. rigida*	Perennial herb
Lemmon's needlegrass	*Stipa [Achnatherum] lemmonii*	perennial grass
western needlegrass	*Stipa [Achnatherum] occidentalis var. occidentalis*	perennial grass
common snowberry	*Symphoricarpos albus*	deciduous shrub
creeping snowberry	*Symphoricarpos mollis*	deciduous shrub
tomcat clover	*Trifolium willdenovii*	annual herb
common cattail	*Typha latifolia*	perennial herb
stinging nettle	*Urtica dioica ssp. holosericea*	perennial herb
California grape	*Vitis californica*	deciduous vine
rough cockleburr	*Xanthium strumarium*	annual herb

Pole Cuttings

The KRRC will engage with restoration contractors to harvest and store live pole cuttings for the Project. The restoration contractor will plant live pole cuttings in the bank wetland, bank riparian and parts of floodplain riparian zones to expedite the recovery of these habitats to natural succession. In existing riparian areas along the Iron Gate, Copco and JC Boyle reservoir edges that contain robust populations of willows and other native riparian species suitable for pole cuttings harvest or whole plant salvaging and transplantation the restoration contractors will cut some of these parent plants to the ground approximately one to two years before dam removal, to increase the number of new stems and suckers available to harvest, and to extend their survival time after drawdown. The restoration contractors will be engaged to harvest and store pole cuttings for the Project. The restoration contractors will harvest native species listed in Table 5-3 for pole cuttings, as close to planting period (winter to early spring) as possible, maintain the pole cuttings until planting time, and install the pole cuttings in the riparian areas as soon as access is feasible. If there is a need to ship the pole cuttings off-site for storage, the restoration contractors will ensure the pole cuttings are refrigerated and held for a maximum of 3 months to ensure viability (Tilley and John, 2012), (Logar and Scianna et al., 2005). The restoration contractor will plant the pole cuttings between February and March, if possible, and year-round with sufficient supplemental irrigation, or on high ground water table, if necessary.

Figure 5-17 Sandbar willow is an important riparian bank shrub that provides shade over water surface, reducing temperatures. The background tree is Oregon ash.

Table 5-3 Primary Pole Cutting Species to be Collected and Stored

Common name	Scientific name	Lifeform
western serviceberry [2]	*Amelanchier alnifolia*	small deciduous tree
smooth dogwood [3, 12]	*Cornus glabrata*	large deciduous shrub
red-osier dogwood [1, 8]	*Cornus sericea*	large deciduous shrub
black cottonwood [5, 11, 12]	*Populus balsamifera ssp. trichocarpa*	large deciduous tree
fragrant (three-leaf) sumac [6]	*Rhus aromatica [trilobata]*	deciduous shrub
California rose [11, 12]	*Rosa californica*	deciduous shrub
Pacific blackberry [7]	*Rubus ursinus*	deciduous shrub, vine
narrowleaf willow [1, 9, 7, 12]	*Salix exigua*	large deciduous shrub
red willow [1, 4]	*Salix laevigata*	large deciduous tree
arroyo willow [1, 12]	*Salix lasiolepis*	small deciduous tree
shining willow [1, 12]	*Salix lucida*	small deciduous tree
common snowberry [1, 10]	*Symphoricarpos albus*	deciduous shrub

Footnotes:

1 Source: Burgdorf, 2007. 2 Source: USDA, 2002. 3 Source: CNPS, 2014a. 4 Source: CNPS, 2014b. 5 Source: USDA, 2018. 6 Source: Taylor, 2004. 7 Source: WSU, 2003. 8 Source: CNPS, 2014c. 9 Source: Tilley and Loren, (2012). 10 Source: Darris, (2002). 11 Source: Holzworth and Batchelor, (1984). 12 Shaded rows indicate keystone species.

Invasive Exotic Vegetation Control

The KRRC will integrate the control of IEV with the revegetation work. The focus of this RAMP is on extensive seeding of diverse native species and a robust monitoring schedule for early detection and control of IEV as described below in Section 6.1.4. The KRRC will begin active control of IEV in the project areas several years before drawdown and will continue until the required performance criteria are met. The KRRC will use revegetation and weed control to accelerate succession and help reduce the amount of open space available for exotic species establishment.

The KRRC will evaluate all methods of invasive species control for both their benefits and their risks to the surrounding ecosystems. The KRRC will control IEV through manual weed pulling, mowing or cutting, mechanical eradication by tilling in larger areas, grazing, shading (covering ground with paper or black plastic), and solarization (covering ground with clear plastic). The KRRC will apply herbicides as a last resort and upon approval, application of herbicides will be used if necessary, either by brushing (stumps and cut stems), wicking and/or spraying. The benefits and constraints of each technique are summarized below:

- Hand pulling. The KRRC will use this method on a limited basis for controlling small IEV infestations, emerging infestations or infestations at the fringes of a large patch as hand pulling is typically more effective on annual species and species that are not rhizomatous.
- Mowing or cutting. The KRRC will use this method for invasive annuals and to reduce seed production in biennials and perennials to prevent seed set, exhaust the nutrient reserves, and reduce plant vigor, and reduce the buildup of thatch, as is common in infestations of medusahead and goat grass, so that native species seed has access to light for germination. The KRRC will use this method in areas where there are extensive solid stands of invasive species to avoid damage to native species.
- Tilling and Disking. The KRRC will use this method as an agricultural weed eradication method in solid stands of invasive species, in order to disrupt and bury the plant or to separate the root from the plant after soil dries out to have the largest impact. The KRRC will use this method only in level heavily infested areas where erosion is not a concern and culturally significant resources are not expected.
- Grazing. The KRRC will use this method of control of invasive vegetation palatable for cattle, sheep and goats and the timing, quantity and will select the type of livestock to address different invasive species.
- Solarization. This technique can kill not only the plant but the seeds of most plant species. (Moyes et al., 2005) and involves heating the soil by capturing the radiant energy from the sun, by air-tightly covering the infested ground with plastic for at least 4-6 weeks. The KRRC will use this technique only in areas where there are large swathes of invasive vegetation and during the warm season.
- Herbicides –The KRRC will use this method only when other methods prove to be ineffective or could potentially cause more harm than benefit within the environment. The KRRC will use only herbicides that have been approved for use by the BLM, California Department of Fish and Wildlife (CDFW), Oregon Department of Fish and Wildlife (ODFW), Regional Water Quality Control Board (RWQCB), U.S. Fish and Wildlife Service (USFWS) and NMFS in both California and Oregon. The KRRC will evaluate the effect of all potential herbicides on aquatic species. If herbicide application becomes the necessary method for effective IEV removal, the KRRC will consider only those application methods with the least side-effects to native vegetation and wildlife and will base application methods on plant reproduction, structure, and growth.

After a close review of available documentation on the past extent of IEV in the project area prepared by PacifiCorp's consultants and the BLM, the KRRC determined that the information is dated, and that surveys reflecting the current condition are needed in order to effectively eradicate IEV in the project area to the maximum extent feasible. The KRRC will survey an area from the existing water line to the project boundary to obtain information on the exact location of each invasive species and information on the diversity of invasive species in the limits of work, and develop a GIS based IEV map set for the project area in order to prepare an effective and targeted IEV eradication plan. The KRRC began IEV surveys in the project area in the fall of 2017. Based on California Department of Fish and Wildlife (CDFW) definition, and for the purposes of this Project: "*Invasive species are organisms that are not native to an environment, and once introduced, they establish, quickly reproduce, spread, and cause harm to the environment, economy, or human health*" (REF). Table 5-4 lists previously observed, and potentially occurring IEV species in the project area, and their state, county, and other agency invasiveness ratings. The KRRC will coordinate closely with the objectives of the various agencies with jurisdiction over the project area, because they will most likely steward this land in the long term. Based on Table 5-4 a final IEV control target species list will be developed consisting of plants with the largest potential to (1) spread quickly, (2) take over extensive areas, (3) compete for resources with native species, and (4) cause any other environmental damage. The KRRC will review the IEV control target species list and refine with the resource agencies and other stakeholders involved in the Project to form the backbone of the IEV removal plan which will span from the pre-dam removal period to the end of the KRRC long-term maintenance and monitoring period. The KRRC will adaptively manage IEV removal throughout the revegetation process as discussed.

Table 5-4 Invasive exotic plant species present in the project area with a potential to re-establish.

Scientific Name	Common Name	CDFA[1]	ODA[2]	Cal-IPC[3]	Klamath County[4]	Siskiyou County[5]	Klamath NF[6]	# of Agencies[7]	Priority[8]
Chondrilla juncea	skeleton weed	AW	B & T	Moderate	A	CA-A	High	5	High
Centaurea diffusa	diffuse knapweed	AW	B	Moderate	A	CA-A	High	4	High
Centaurea virgata ssp. squar.	squarrose knapweed	NR	A & T	Moderate	A	CA-A	High	4	High
Euphorbia esula	leafy spurge	AW	B & T	NR	B	CA-A	High	4	High
Onopordum acanthium	Scotch thistle	AW	B	High	B	CA-A	High	4	High
Acroptilon repens	Russian knapweed	BW	NR	Moderate	A	CA-A	High	3	High
Carduus acanthoides	plumeless thistle	AW	NR	limited	A	NR	High	3	High
Centaurea stoebe ssp.micr.	spotted knapweed	NR	B	High	B	CA-A	High	3	High
Cytisus scoparius	Scotch broom	BW	B	High	A	CA-C	High	3	High
Lepidium latifolium	perennial pepperweed	BW	B & T	High	B	NR	High	3	High
Lythrum salicaria	purple loosetrife	BW	B	High	A	NR	High	3	High
Carduus nutans	musk thistle	AW	B	Moderate	B	CA-A	High	2	High
Fallopia japonica	Japanese knotweed	BW	NR	Moderate	A	NR	High	2	High
Linaria dalmatica	Dalmatian toadflax	NR	B	Moderate	B	CA-A	High	2	High
Onopordum tauricum	Taurian thistle	AW	A	NR	NR	NR	High	2	High

Scientific Name	Common Name	CDFA[1]	ODA[2]	Cal-IPC[3]	Klamath County[4]	Siskiyou County[5]	Klamath NF[6]	# of Agencies[7]	Priority[8]
Sonchus arvensis	field sowthistle	AW	NR	NR	NR	NR	High	2	High
Tamarix parviflora	small flower tamarisk	NR	NR	High	NR	NR	High	2	High
Anchusa officinalis	alkanet	NR	B & T	NR	NR	NR	NR	1	Medium
Bromus madritensis ssp. rubens	foxtail brome	NR	NR	High	NR	NR	NR	1	Medium
Bromus tectorum	cheatgrass	NR	NR	High	NR	NR	NR	1	Medium
Centaurea solstitialis	yellow starthistle	CW	B	High	B	CA-C	Moderate	1	Medium
Cirsium ochrocentrum	Beaumont thistle	AW	NR	NR	NR	NR	NR	1	Medium
Convolvulus arvensis	field bindweed	CW	B & T	NR	NR	NR	NR	1	Medium
Crupina vulgaris	bearded creeper	AW,Q	B	Limited	NR	NR	NR	1	Medium
Dipsacus fullonum	teasel	NR	B	Moderate	A	NR	NR	1	Medium
Elymus caput-medusae	medusahead	CW	B	High	C	NR	NR	1	Medium
Foeniculum vulgare	fennel	NR	NR	Moderate	NR	NR	High	1	Medium
Halogeton glomeratus	saltlover	AW	B	Moderate	NR	NR	NR	1	Medium
Isatis tinctoria	dyer's woad	BW	B	Moderate	A	CA-B	Moderate	1	Medium
Linaria vulgaris	butter and eggs	NR	B	Moderate	A	NR	NR	1	Medium
Phalaris arundinacea	reed canary grass	NR	B & T	Not Listed	NR	NR	NR	1	Medium
Rubus armeniacus	Himalayan blackberry	NR	B	High	NR	NR	NR	1	Medium
Salvia aethiops	Mediterranean sage	BW	B	Limited	B	NR	High	1	Medium
Tribulus terrestris	puncture vine	CW	B	Limited	B	NR	High	1	Medium
Xanthium spinosum	spiny clotbur	NR	B	None	A	NR	NR	1	Medium
Aegilops cylindrica	goatgrass	BW	B	Watch	NR	NR	NR	0	Low
Avena barbata	slender oat	NR	NR	Moderate	NR	NR	NR	0	Low
Brassica nigra	black mustard	NR	NR	Moderate	NR	NR	NR	0	Low
Bromus diandrus	ripgut grass	NR	NR	Moderate	NR	NR	NR	0	Low
Cirsium arvense	Canada thistle	BW	B	Moderate	B	CA-B	Moderate	0	Low
Cirsium vulgare	bull thistle	NR	B	Moderate	C	CA-C	Low	0	Low
Conium maculatum	poison hemlock	NR	B	Moderate	B	NR	Low	0	Low
Festuca arundinacea	tall fescue	NR	NR	Moderate	NR	NR	NR	0	Low
Hirschfeldia incana	summer mustard	NR	NR	Moderate	NR	NR	NR	0	Low
Hordeum murinum	foxtail barley	NR	NR	Moderate	NR	NR	NR	0	Low
Hypericum perforatum	Klamath weed	CW	B	Limited	B	NR	Low	0	Low
Lepidium draba	hoary cress	BW	NR	Moderate	B	NR	Moderate	0	Low
Leucanthemum vulgare	oxeye daisy	NR	NR	Moderate	NR	NR	NR	0	Low
Marrubium vulgare	white horehound	NR	B	Limited	NR	NR	NR	0	Low
Mentha pulegium	pennyroyal	NR	NR	Moderate	NR	NR	NR	0	Low
Persicaria wallichii	Himalayan knotweed	BW	NR	Watch	NR	NR	NR	0	Low

Scientific Name	Common Name	CDFA[1]	ODA[2]	Cal-IPC[3]	Klamath County[4]	Siskiyou County[5]	Klamath NF[6]	# of Agencies[7]	Priority[8]
Rumex acetosella	common sheep sorrel	NR	NR	Moderate	NR	NR	NR	0	Low
Torilis arvensis	field hedge parsley	NR	NR	Moderate	NR	NR	NR	0	Low

Footnotes: (Lighter cells indicate a high priority to the corresponding agency)

1. California Department of Food and Agriculture (CDFA): California Noxious Weed List (CDFA, 2016); Ratings descriptions as follows:

"A" A pest of known economic or environmental detriment and is either not known to be established in California or it is present in a limited distribution that allows for the possibility of eradication or successful containment. If found entering or established in the state, A-rated pests are subject to state (or commissioner when acting as a state agent) enforced action involving eradication, quarantine regulation, containment, rejection, or other holding action.

"B" A pest of known economic or environmental detriment and, if present in California, it is of limited distribution. At the discretion of the individual county agricultural commissioner they are subject to eradication, containment, suppression, control, or other holding action.

"C" A pest of known economic or environmental detriment and, if present in California, it is usually widespread. If found in the state, they are subject to regulations designed to retard spread or to suppress at the discretion of the individual county agricultural commissioner. There is no state enforced action other than providing for pest cleanliness.

"Q" An organism or disorder suspected to be of economic or environmental detriment, but whose status is uncertain because of incomplete identification or inadequate information.

"W" This notation indicates that a plant is included in the CCR Section 4500 list of California State Noxious Weeds.

2. Oregon Department of Agriculture (ODA) Noxious Weed Policy and Classification System (ODA, 2017). (Equivalent to the Pacific Northwest Invasive Plant Council (PNW-IPC)). Ratings descriptions as follows:

A A weed of known economic importance which occurs in the state in small enough infestations to make eradication or containment possible; or is not known to occur, but its presence in neighboring states make future occurrence in Oregon seem imminent. Recommended action: Infestations are subject to eradication or intensive control when and where found.

B A weed of economic importance which is regionally abundant, but which may have limited distribution in some counties. Recommended action: Limited to intensive control at the state, county or regional level as determined on a site specific, case-by-case basis. Where implementation of a fully integrated statewide management plan is not feasible, biological control (when available) shall be the primary control method.

T A designated group of weed species that are selected and will be the focus for prevention and control by the Noxious Weed Control Program. Action against these weeds will receive priority.

3. California Invasive Plant Council (CAL-IPC). The Cal-IPC Plant Inventory (Cal-IPC, 2018). Ratings descriptions as follows:

High These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment.

Moderate These species have substantial and apparent-but generally not severe-ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance.

Limited These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

Alert An Alert is listed on species with High or Moderate impacts that have limited distribution in California, but may have the potential to spread much further.

Watch	These species have been assessed as posing a high risk of becoming invasive in the future in California.
4. Klamath County Board of Commissioners (KCBC). Noxious Weeds in Klamath County for the year 2018 (KCBC, 2018). Ratings descriptions as follows:	
A	A weed of known economic importance which occurs in the county in small enough infestations to make eradication/containment possible, or if not known to occur, but its presence in neighboring counties make future occurrence in Klamath County seem imminent.
B	A weed of economic importance which in some parts of the county is abundant, but may have limited distribution in other parts of the county. Where implementation of a fully integrated county wide management plan is infeasible, biological control shall be the main control approach.
C	A weed which in most parts of the county is abundant. While not subject to enforcement regulations, these species can cause similar economic and ecological impacts as other noxious weed species. Education and control recommendations will be the main approach.
5. Siskiyou Department of Agriculture (SDA). Identification and Characteristics of Invasive Noxious Weed Infestations. (SDA, 2015). Ratings:	
A	"A" Rated: A pest of known economic or environmental detriment and is either not known to be established in California or it is present in a limited distribution that allows for the possibility of eradication or successful containment. A-rated pests are prohibited from entering the state. A-rated pests are subject to state (or commissioner) enforced action involving eradication, quarantine regulation, containment, rejection, or other holding action.
B	"B" Rated: A pest of known economic or environmental detriment and it is of limited distribution. Subject to state endorsed holding action and eradication to provide for containment. At the discretion of the individual county agricultural commissioner they are subject to eradication, containment, suppression, control, or other holding action.
C	"C" Rated: A pest of known economic or environmental detriment and is usually widespread. They are subject to regulations designed to retard spread or to suppress at the discretion of the individual county agricultural commissioner. There is no state enforced action other than providing for pest cleanliness.
6. U.S. Forest Service (USFS-KNF): Klamath National Forest Noxious Weed and Non-native Invasive Plant List (KNF, 2013). Ratings descriptions as follows:	
High	These species are currently either limited in distribution, highly invasive, or not present on the KNF. Treatment may vary by location.
Moderate	These species are generally common, and are treated on a case by case basis depending on location (Wilderness and Research Natural Area (RNA) increase the priority for treatment).
Low	These species are either widespread throughout the KNF, or are not considered to be highly invasive in our area. Usually not treated unless located in a high priority area, such as Wilderness or RNA.
7. Number of Agencies Considering Plant a High Priority for Eradication	
8. Invasive Exotic Vegetation (IEV) Survey and Control Priority	

Integrated Pest Management in the project area will consist of the following key elements:

- Prevent invasive exotic weeds from establishing through use of weed-free plant materials and straw. KRRC will employ experienced seed production companies and will provide seed analysis for each collected and propagated species indicating seed purity, weed and hard seed amounts. KRRC will inspect any containerized plants or transplants for presence of invasive weeds. KRRC will allow only certified weed free straw.
- Regular monitoring to facilitate early detection of emerging invasive exotic weeds. Monitoring will consist of bi-weekly surveys of the areas and tagging or immediate removal of invasive weeds during the establishment period (Year One), and less frequent surveys (monthly) in later years. See section 6.1.3 for further details about this schedule.

- Utilize appropriate and cost-effective strategies to reduce or eliminate weed populations. Typical methods include cultural, biological, mechanical, and chemical control methods.
- KRRC's contractor will use chemical herbicides only when they offer an effective method for control and eradication of noxious weeds and when all other methods have failed. Herbicides will be applied by a certified applicator and in accordance with all applicable laws and regulations.
- Establish a program of monitoring and observation to determine the effectiveness of the applied weed control methods.

KRRC's contractor will use the following best management practices to control the emergence and limit the spread of invasive exotic weeds:

- Planning and scheduling - Coordinate weed management with all aspects of the revegetation and dam removal management activities to prevent introduction of any new weed species into the project area and limit existing weed species to no greater occurrence than currently present on nearby reference sites. Weed populations maps that were created in 2003 by PacifiCorp consultants will be updated, and weed areas close to revegetation areas, limits of work, and access roads will be treated before work begins to reduce the risk of spreading the weeds.
- Training – Require or encourage weed awareness and prevention efforts among staff and contractors through contract requirements of incentives. Distribute Weed Control Guidelines that will be prepared by the restoration contractor based on the construction specifications requirements.
- Cleaning machinery – Control the spread of weeds to newly exposed ground through cleaning of construction equipment.
- Expedite revegetation with native plants.
- Implement appropriate weed control methods – Methods available for weed control depend upon the severity of the infestation and the lifecycle stage at which the weed is observed. Mechanical and chemical methods are available to control many weeds, although caution must be exercised that mechanical control methods do not contribute to the spread of invasive exotics. Chemical control will adhere to label requirements. Herbicides must be on regulatory agencies approved chemical list.
- Assign weed severity priority – As weeds are identified in the limits of work, they will be classified according to the California Invasive Plant Council (Cal IPC) and Oregon Department of Agriculture. Weed control will be prioritized based on classification and potential to interfere with revegetation efforts.
- Monitor to identify and eradicate any invasive exotic species impeding achievement of the revegetation objectives – The Weed Control Plan will require strict adherence to the monitoring schedule and regularly planned weed removal activities.
- Evaluate effectiveness – A continual process of active management ensures the success of the weed control program.
- Revisit and reestablish goals or methods to achieve the objective – Methods will be adjusted in the event that either the Weed Control Plan and Guidelines prove inadequate to limit the spread of the

weeds present to the baseline condition, or new species are introduced requiring the development of a new weed control strategy and plan.

This adaptive approach to weed management is illustrated below in Section 6, which further discusses adaptive management and monitoring of the sites.

Irrigation

The project area lies in an inland area on the California/Oregon border with very high evapotranspiration rates and an extended dry season with little or no precipitation in the late spring, summer, and early fall. The KRRC will provide only the Bank Riparian Zone with an irrigation system in order to establish robust vegetation in that zone for the re-establishment of ecological functions in and along the river. The two planting zones below the Riparian Bank Zone (Bank Wetland and Emergent Wetland) will be able to draw sufficient amounts of water from the river and irrigation runoff. The KRRC will intermittently irrigation planting zones above the Riparian Bank Zone with a temporary irrigation system that will be setup only if initial restoration efforts are unsuccessful because of lack of water or extended drought. This temporary system will consist of aluminum latch lateral irrigation pipe with sprinkler risers. The KRRC will initially provide the seed of woody plants (oak acorns, juniper berries, pine nuts, Oregon ash samaras and shrub seeds) in planting areas above the Riparian Bank Zone with water through biodegradable, paper mache derived, donut shaped containers that will be installed in the ground and, surround the seed (Figure 5-19).

Figure 5-18 Aluminum Latch Pipe and Sprinklers

The KRRC will install independent irrigation systems in the Riparian Bank Zone. The KRRC will install a “permanent” irrigation system that is a surface mounted PVC pipe with tall irrigation risers and large throw rotary gear sprinkler heads for the duration of the KRRC maintenance and monitoring period. The KRRC will design the irrigation system with proper sprinkler spacing and pipe sizing to prevent erosion and runoff while matching the infiltration rate of the existing soil. The irrigation system will draw water from the river by portable, skid mounted, gas powered pumps set up on the bank of the river in heavy duty shallow plastic basins to prevent spills. In addition to pumps, the irrigation system will consist of main and lateral PVC lines, isolation, quick coupling and control valves, in-line filters, irrigation controllers and other accessories. Irrigation sprinklers will be installed on 4’-6’ high risers braced in three directions with #4 rebar and spaced at a distance of 50’-80’ and will provide full, head-to-head irrigation coverage. Irrigation heads will be installed at the boundary between the Bank Riparian and Floodplain Riparian Zones to allow for partial irrigation of the Floodplain Riparian Zone without full head-to-head coverage. Their throw, arc and angle will be fully adjustable to facilitate quick field adjustments. The precipitation rate of the nozzles used in the irrigation heads will closely match the soil infiltration and site evapotranspiration rates. Irrigation lines will be schedule 40 PVC pipe installed on the surface of the ground and anchored with U-shape bent #3 rebar staples. Pipes will be sized to maintain flow and pressure required for proper performance of each sprinkler head, while maintaining pipe water velocities below five feet per second, reducing risk of pipe damage and friction losses. Selected pipes will be sufficiently oversized to accommodate future expansion of the irrigation system into adjacent riparian areas upstream and downstream of the primary floodplain areas if this is necessary in order to provide water to these areas because of extended drought.

Figure 5-19 Irrigation cocoon installed around the base of a tree seedling.

Irrigation system control valves may be both remotely and manually operable and will be designed to operate each individual lateral branch of the system. This will enable the maintenance contractor to run laterals independently as necessary during irrigation events to accommodate areas with warmer aspects with larger amount of water. Valves will be grouped together and installed inside a locking valve box or series of boxes near the irrigation pump to facilitate easy central operation. An in-line filter with cleanable stainless steel #200 mesh screen elements will be installed on the main line downstream of the pump before it branches out. The filter will be important for reliable functioning of the irrigation head nozzles and even water distribution. Additional pre-filtering of river water will be also provided through the submersible suction basket anchored in a still area of the river. A metal wire mesh cage with openings small enough to prevent small fish entry will house the suction basket. The irrigation controllers will be either removable or mounted directly on top of control valves and will be adequately sized for the required number of irrigation valves. They will be either battery or ambient light powered and will allow for independent schedule setting of each individual irrigation valve. Other potential irrigation accessories important for smooth operation of the system will be quick couplers to allow for hose watering of selected areas, low point drainage valves for irrigation system winterization, pressure gages, and air relief valves. The irrigation system will be well designed both for potential flooding events and for vandalism or theft.

Figure 5-20 Carmel River riparian bank zone irrigation system

Revegetation Planting Zones

The project area will be divided into the following nine distinct planting zones based on expected hydrology:

1. Emergent Wetland
2. Bank Wetland
3. Bank Riparian
4. Floodplain Riparian
5. Uplands below Rocky Wake Zone
6. Rocky Wake Zone
7. Uplands above Rocky Wake Zone
8. Upland Stockpiles
9. Undisturbed Uplands

The KRRC will determine the distribution and planform of the planting zones within the project area by local hydrology, soils data, flood water surface elevations, historical maps and photographs, and reference site information. Initially, at the time of winter drawdown, KRRC's contractor will seed the project area with pioneer species capable of dealing with the poor soil conditions, inclement weather, and complex hydrology at the time of aerial seeding. The pioneer seed mix will contain common native plant species, sterile wheat, and mycorrhizal inoculant. The pioneer seed mix will be developed based on site pilot growing experiments to ensure quick erosion control, expedient reconstruction of topsoil microbiology, effective adaptation to initial sediment toxicity, and good invasive vegetation suppression. The KRRC will broadcast planting zone specific permanent seed at the end of the dam removal period, in the fall of the drawdown year. The KRRC will adaptively perform several repeat seedings as necessary during the first two years after drawdown in order to increase native vegetation coverage in underperforming areas.

The KRRC will select native species for the planting zones based on plants known to be native in the project area, expected to establish readily, and anticipated to thrive within their planting zones. The KRRC will conduct small-scale test plot growing experiments to determine the most effective species selection for each planting zone, seeding rate, timing, and other factors in order to meet the goals of the Project. Planting material collected on-site will be used as transplants or as nursery stock to propagate additional seed or plants in the required amounts.

Figure 5-21 Existing emergent wetland zone with hardstem bulrush below Iron Gate Dam.

Emergent Wetland Zone

The emergent wetland zone will consist of restoration areas of low water velocities that occur approximately between the base flow water surface elevation and 2-ft water depth as they occur in several segments of the river near the reservoirs (Figure 5-21). These zones will be adjusted on a case by case basis and depending on local topography and modelled water velocities. Many emergent wetland areas within the drawdown areas are expected to support river imported wetland vegetation propagules readily. Emergent wetland areas may re-vegetate naturally and relatively quickly where hydrology is favorable, however, this may include the risk of invasive exotic plant colonization of the same habitats earlier and faster, and the substantial cost associated with the invasives' removal and replacement with native species. Potential invasive species can include reed canarygrass and tall fescue at the upper edges, tamarisk, pennyroyal, and purple loosestrife. Active revegetation of emergent wetland areas will consist of relocation of existing emergent vegetation from the rim of the reservoirs to suitable newly formed emergent wetland habitats with slower moving water. Wetland species such as common cattail, hardstem bulrush, broad fruit burr-reed, sedges, rushes, and spikerushes will be transplanted and installed using transplants and ballast buckets Figure 5-22 and Figure 5-24) made of coir fabric, and weighed down with cobbles to reduce their buoyancy and potential to be washed out during high flows. This will happen during or immediately after drawdown, in late winter or early spring. To prevent desiccation and die-off of the existing reservoir rim vegetation before relocation, small areas with high densities of existing emergent wetland vegetation will be bermed off with clayey soil and irrigated to maintain a pool of water or saturated soil until transplantation. The salvaged plants will be planted 20' on center (O.C.) along the banks of the river. The following spring, once the plants have established, propagules will be harvested from installed salvaged plants and planted 10’ O.C., between the plants from the prior year. The native wetland plant species proposed for the emergent wetland zone are listed in Table 5-5.

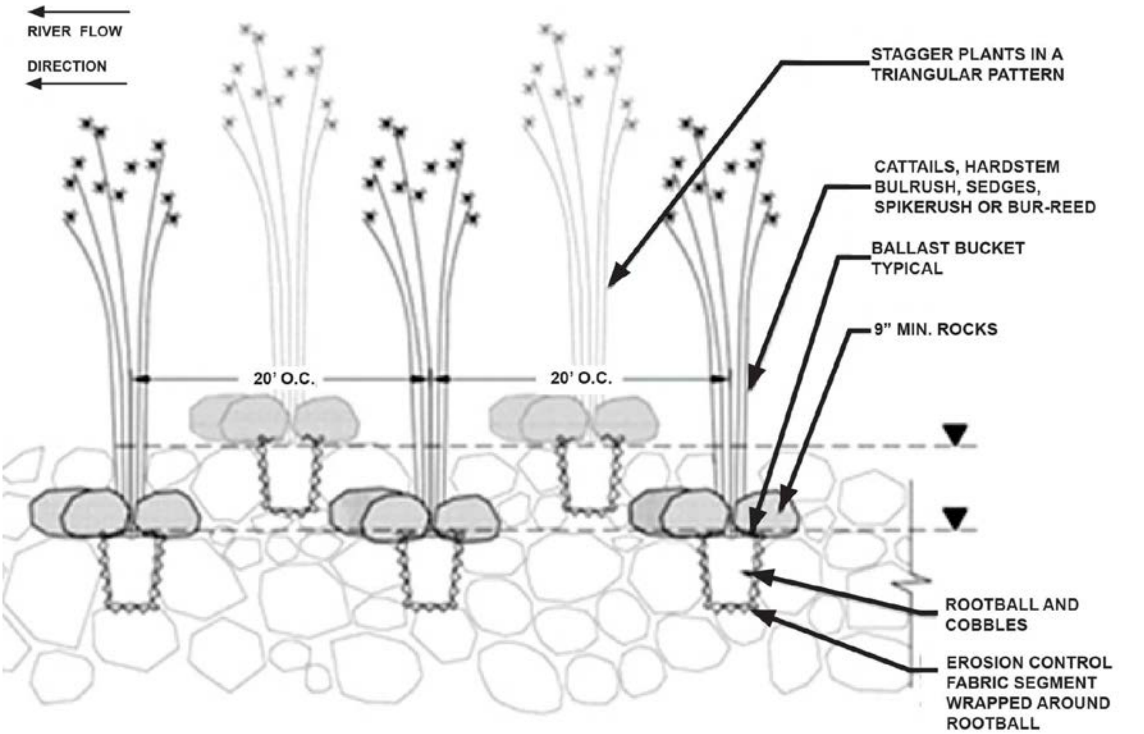


Figure 5-22 Coir fabric and cobble ballast buckets with emergent wetland vegetation.

Table 5-5 Native plant species proposed for the Emergent Wetland Zone

Common name	Scientific name	Lifeform
devil’s beggartick *	*Bidens frondosa*	annual herb
water sedge	*Carex aquatilis*	perennial herb
Nebraska sedge *	*Carex nebrascensis*	perennial herb
woolly sedge *	*Carex pellita [lanuginosa]*	perennial herb
awlfruit sedge *	*Carex stipata*	perennial herb
western water hemlock	*Cicuta douglasii*	perennial herb
needle spikerush	*Eleocharis acicularis*	perennial herb
common spikerush	*Eleocharis macrostachya [palustris]*	perennial herb
Baltic rush *	*Juncus balticus*	perennial herb
iris-leaved rush *	*Juncus xiphioides*	perennial herb
rice cutgrass *	*Leersia oryzoides*	perennial grass
watercress *	*Nasturtium officinale*	perennial herb

Common name	Scientific name	Lifeform
water pepperweed *	*Polygonum hydropiperoides*	perennial herb
hardstem bulrush *	*Schoenoplectus [Scirpus] acutus*	perennial herb
broadfruit bur reed *	*Sparganium eurycarpum*	perennial herb
common cattail *	*Typha latifolia*	perennial herb

* keystone species

Figure 5-23 Bank wetland area at J.C. Boyle Reservoir

Bank Wetland Zone

Bank wetland zones will be delineated as areas suitable for plant growth approximately between the base flow and 2-year flood event water surface elevations (Q_2), similar to where they currently occur within the project boundary (Figure 5-23). These zones will be adjusted on a case by case basis and depending on local topography.

Many bank wetland areas within the reservoir basins after drawdown are expected to support existing and river imported wetland vegetation propagules more readily than the species seeded in the riparian seed mix. The seed bank germination study indicated a high degree of viability and variability of wetland species seed in the reservoir deposit (see USBR, 2011b), even after many years or even decades under water. This suggests wetland areas may re-vegetate naturally and relatively quickly where hydrology is favorable, however, because of the critical importance of this zone for the health of the river, the anadromous fish, and the high risk of invasive exotic plant establishment in this zone, it will be revegetated by seeding, transplanting of salvaged vegetation, pole cutting and ballast bucket installation. The proposed layout is shown in Figure 5-25 and the anticipated native wetland species are listed in Table 5-6. All of these plants are already present in the project area.

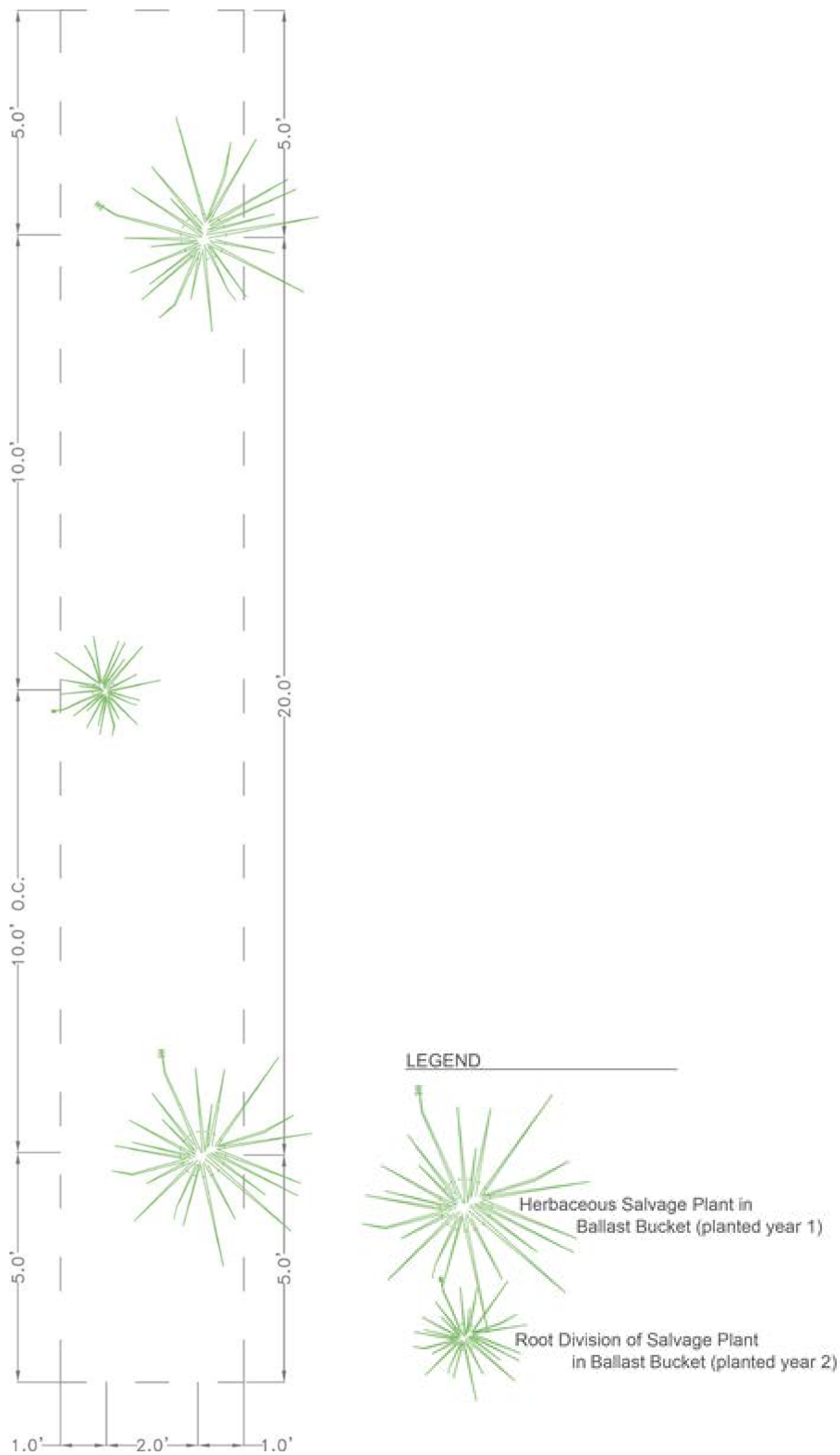


Figure 5-24 Emergent wetland typical plant layout.

Bank wetland areas will be very susceptible to non-native exotic plant invasions. A number of wetland invasives already occur in the project area and are listed in Table 5-4. The most widespread invasive exotic species present along the banks of the reservoirs are reed canarygrass (*Phalaris arundinacea*), pennyroyal (*Mentha pulegium*), and teasel (*Dipsacus fullonum*).

After reservoir drawdown, a re-assessment of areas selected for installation of salvaged riparian plants and pole cuttings will be performed in the field. The best suitable areas for the planting of pole cuttings, and for the transplanting of reservoir rim riparian trees, will be identified along the banks of the Klamath River based on environmental factors such as sediment depth, accessibility, soil texture, local topography, slope, aspect, and hydrology described in detail below.

Four pole cuttings and one transplant from the existing reservoir rim vegetation also be installed every 100 SF. This will occur in the initial stage of planting in the early spring after drawdown. Plant layout for all cuttings will be performed by the contractor's crews marking each planting spot with a pin flag for an overall review by a restoration ecologist. In the early spring of the following year, an additional one pole cutting per 100 SF will be laid out and installed (Figure 5-25).

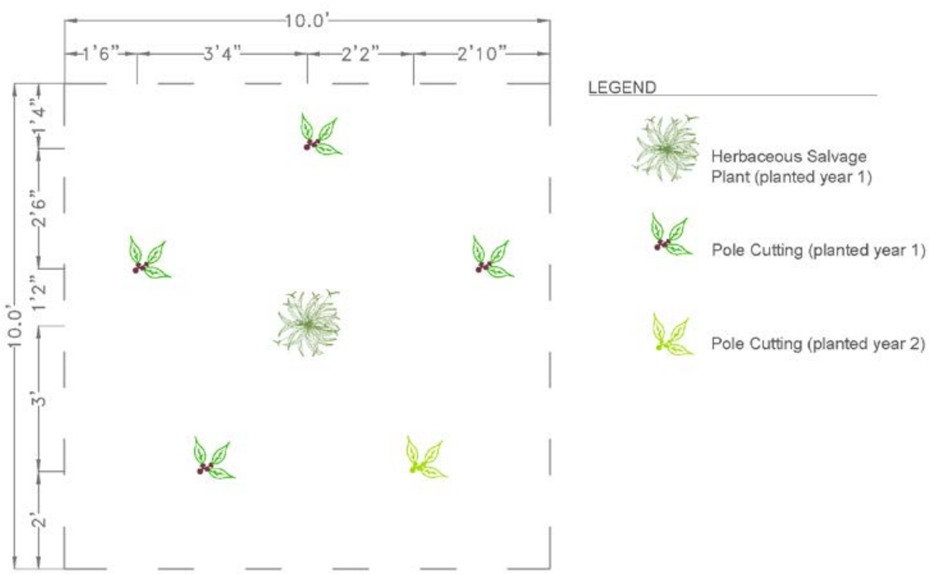


Figure 5-25 Bank Wetland Typical Layout

Table 5-6 Native plant species proposed for the Bank Wetland Zone

Common name	Scientific name	Lifeform
white alder *	*Alnus rhombifolia*	deciduous tree
mugwort	*Artemisia douglasiana*	perennial herb
slender beak (wheat) sedge	*Carex athrostachya*	perennial herb
Nebraska sedge	*Carex nebrascensis*	perennial herb
woolly sedge	*Carex pellita [lanuginosa]*	perennial herb
awlfruit sedge *	*Carex stipata*	perennial herb
common spikerush *	*Eleocharis macrostachya [palustris]*	perennial herb
common horsetail *	*Equisetum arvense*	fern-like herb
western goldenrod	*Euthamia occidentails*	perennial herb
Baltic rush	*Juncus balticus*	perennial herb
common rush	*Juncus effusus var. pacificus*	perennial herb
sword-leaved rush *	*Juncus ensifolius*	perennial herb
western rush *	*Juncus occidentalis*	perennial herb
iris-leaved rush	*Juncus xiphioides*	perennial herb
seep monkey flower	*Mimulus guttatus var. guttatus*	Annual herb
knotgrass	*Paspalum distichum*	perennial grass
narrow-leaf willow	*Salix exigua*	deciduous shrub
arroyo willow	*Salix lasiolepis*	deciduous tree
shining willow	*Salix lucida ssp. lasiandra*	deciduous tree
rigid hedge nettle	*Stachys ajugoides var. rigida*	Perennial herb
stinging nettle *	*Urtica dioica ssp. holosericea*	perennial herb
rough cockleburr *	*Xanthium strumarium*	annual herb

** keystone species.*

Bank Riparian Zone

Figure 5-26 Bank Riparian Zone on the Klamath River below Copco Dam. Sandbar willow at the water's edge, Oregon ash and black oak beyond

While the bank riparian zone will not be the largest in area compared to other planting zones, it will be the most critical zone for rapid re-establishment of riparian habitat, short-term stability of the channel and banks, and for long-term establishment of an important transitional area between the riverine features and floodplain habitat areas. It will extend approximately from the 2-3-year (Q_2-Q_3) to the 25-year (Q_{25}) flood water surface elevations (Q-lines) of the Klamath River and its tributaries occurring within the project boundary, excluding wetland areas. Its quick establishment will promote and restart a number of important ecological processes and greatly contribute to the creation of quality fish habitat in the river. The zone will extend in a continuous corridor paralleling both banks of the Klamath River. The bank riparian zone native plant species will be selected based on their adaptations to the edaphic and climatic conditions of Upper Klamath River Valley, their ability to survive fluctuating water tables, their preferred root depth to the water table, their flood inundation duration tolerance, and capability to resist exposure to high velocity flows. The riparian restoration planting palette will include both common and less common but ecologically desirable species. The existing riparian vegetation in the limits of work and its vicinity were used as the basis for the riparian vegetation palette. Revegetation plants in this zone will consist of native grasses, forbs, perennial herbs, riparian trees and shrubs, and are listed below in Table 5-7. Planting densities within the riparian-bank areas will be variable but will be on average approximately 2,673 woody plants per acre, or 5 pole cuttings and 1 transplant per 100 sq. ft. Similar to the bank wetland zone, one out of the 5 pole cuttings will be installed in the following spring, one year after drawdown (Figure 5-27).

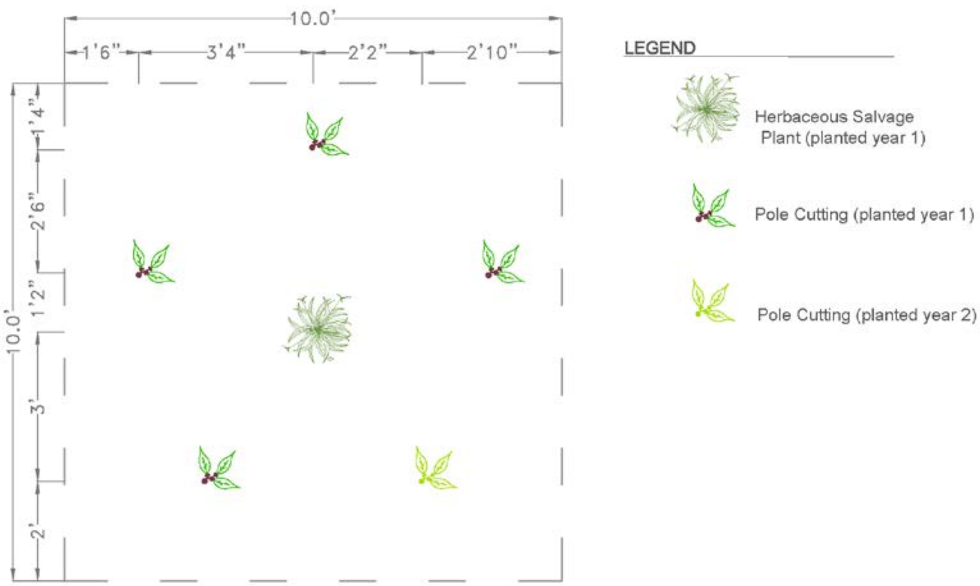


Figure 5-27 Bank Riparian typical plant layout.

Table 5-7 Bank Riparian Zone Proposed Species

Common name	Scientific name	Lifeform	Propagule
bigleaf maple	*Acer macrophyllum*	large deciduous tree	seed
spike bentgrass, spike redtop*	*Agrostis exarata*	perennial grass	seed
mugwort*	*Artemisia douglasiana*	perennial herb	seed, transplants
slender beak (wheat) sedge	*Carex athrostachya*	perennial herb	seed, transplants
clustered field sedge*	*Carex praegracilis*	perennial herb	seed, transplants
smooth dogwood*	*Cornus glabrata*	large deciduous shrub	cuttings
red-osier dogwood	*Cornus sericea*	large deciduous shrub	cuttings
tufted hairgrass*	*Deschampsia caespitosa*	perennial grass	seed
annual hairgrass	*Deschampsia danthonioides*	annual grass	seed
blue wildrye	*Elymus glaucus*	perennial grass	seed
small fescue	*Festuca [Vulpia] microstachys*	annual grass	seed
Oregon ash*	*Fraxinus latifolia*	medium deciduous tree	seed
meadow barley*	*Hordeum brachyantherum ssp. b.*	perennial grass	seed
toad rush	*Juncus bufonius*	perennial herb	seed
sword-leaved rush	*Juncus ensifolius*	perennial herb	seed, transplants
western rush*	*Juncus occidentalis*	perennial herb	seed, transplants
creeping (beardless) wildrye*	*Leymus triticoides*	perennial grass	seed, transplants
field mint*	*Mentha arvensis*	perennial herb	seed, transplants

Common name	Scientific name	Lifeform	Propagule
Lewis' mock orange*	*Philadelphus lewisii*	deciduous shrub	cuttings
black cottonwood*	*Populus balsamifera ssp. trichocarpa*	large deciduous tree	cuttings
California black oak*	*Quercus kelloggii*	large deciduous tree	seed
California rose*	*Rosa californica*	deciduous shrub	cuttings
Pacific blackberry*	*Rubus ursinus*	deciduous shrub, vine	cuttings
California dock	*Rumex californicus*	perennial herb	seed, transplants
narrowleaf willow*	*Salix exigua*	large deciduous shrub	cuttings
red willow*	*Salix laevigata*	large deciduous tree	cuttings
arroyo willow*	*Salix lasiolepis*	small deciduous tree	cuttings
shining willow*	*Salix lucida*	small deciduous tree	cuttings
common snowberry	*Symphoricarpos albus*	deciduous shrub	cuttings
California grape*	*Vitis californica*	deciduous vine	seed

**keystone species*

A large factor in the correct placement of the bank riparian planting zone will be the modeled hydraulics and the anticipated topography of the banks after drawdown. Key storm event water surface elevations will be used to determine the accurate extent and boundaries of this planting zone after drawdown. The 3, 5, 10, 25, 50 and 100-year storm water surface elevations will be modeled and in some areas sediment movement will be assisted with high pressure hosing to restore riparian bank and floodplain connectivity with the river. The bank riparian zone species that will be re-introduced in this zone are listed in Table 5-8.

Herbivore protection will be needed to increase the successful establishment of riparian-bank species. It may include screens, fencing, chemical deterrents, or overplanting. Herbivore protection is vital to successful establishment of planted cuttings and seedlings, since young plant cuttings and transplants will be highly susceptible to mortality from herbivory before root and shoot systems can sufficiently establish and are also often preferred browse material. The herbivores known from the project area are elk, deer, beaver, and black-tailed jackrabbit (TR, 2004).

Although estimates of groundwater depths and fluctuations are not currently available, the water table is expected to be relatively shallow (within the reach of the roots) in proximity to the newly established river channel. Other areas may have terraces along the river channel that are higher than they once were because of reservoir sediment. It may not be possible in all cases to plant pole cuttings of riparian species with immediate connection to groundwater. Supplemental overhead irrigation of riparian vegetation will be provided in the form of temporary, surface mounted irrigation system that will draw water from the river as described in detail in the Irrigation section above.

Floodplain Riparian Zone

Floodplain riparian zones will be delineated as those areas suitable for revegetation that occur approximately between the 25-year (Q_{25}) and 100-year (Q_{100}) flood water surface elevations of the Klamath River and its related tributaries and seeps occurring within the project boundary, excluding all wetland areas. These zones will be additionally adjusted on a case by case basis and depending on after drawdown topography.

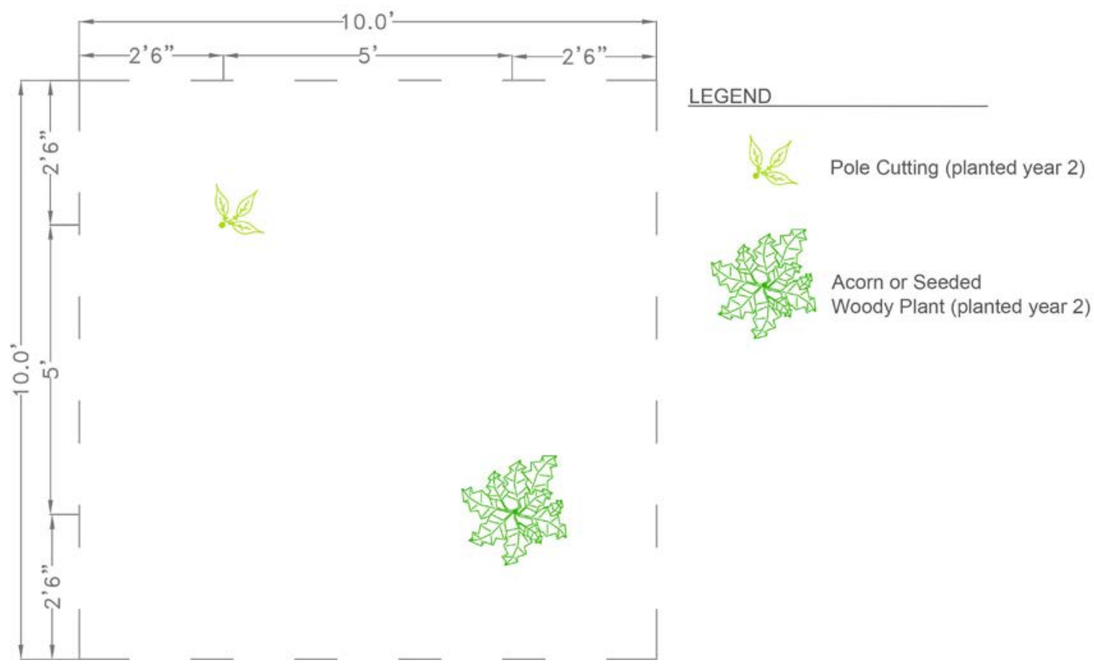


Figure 5-28 Floodplain Riparian typical plant layout.

Floodplain riparian zones will be seeded with a mix that will consist of seeds of native grasses, forbs and shrubs that will be collected and propagated for several years before the revegetation. California black oak and Oregon white oak acorns and willow and cottonwood pole cuttings, will be planted in selected areas within this zone based on environmental factors such as soil texture, slope aspect and ground water depth. For every 100 SF, 1 pole cutting will be installed the first year. One acorn or other seed of a woody tree or shrub will be installed every 100 SF after the establishment of the aerial seeding (Figure 5-28). Acorns stay viable only for approximately six months and will be either planted shortly after their collection in October and November or cold stratified and planted early in the spring. Bigleaf maple, western serviceberry, chokecherry, blue elderberry, fragrant sumac, whitestem gooseberry, snowberry and incense cedar are other potential candidate shrub and tree species for this zone. Additional, smaller planting zones may be introduced in the riparian floodplain zone based on the post-drawdown topographic complexity in order to encourage the formation of typical floodplain environments such as oxbows, floodplain depressions, overflow channels, seasonal wetlands and others. The riparian floodplain zone species are listed in Table 5-8. The average planting density on the riparian floodplain will be approximately 800 woody trees or shrubs per acre. Supplemental overhead irrigation of parts of the riparian floodplain zone may be provided in the form of temporary, surface mounted irrigation system that will draw water from the river.

Table 5-8 Floodplain Riparian Zone Proposed Species

Common name	Scientific name	Lifeform
bigleaf maple	*Acer macrophyllum*	large deciduous tree
Spanish lotus	*Acmispon americanus*	annual herb
spike bentgrass, spike redtop	*Agrostis exarata*	perennial grass
western serviceberry *	*Amelanchier alnifolia*	small deciduous tree
mugwort	*Artemisia douglasiana*	perennial herb
Oregon grape	*Berberis aquifolium*	small evergreen shrub
California brome *	*Bromus carinatus*	perennial grass
incense cedar	*Calocedrus decurrens*	large coniferous tree
bluebunch wheatgrass	*Elymus [Pseudoroegneria] spicatus*	perennial grass
squirreltail grass	*Elymus elymoides*	perennial grass
blue wildrye *	*Elymus glaucus*	perennial grass
small fescue	*Festuca [Vulpia] microstachys*	annual grass
Idaho fescue	*Festuca idahoensis*	perennial grass
California barley	*Hordeum brachyantherum sspp. californicum*	perennial grass
junegrass	*Koeleria macrantha*	perennial grass
Great Basin wildrye	*Leymus cinereus*	perennial grass
creeping (beardless) wildrye *	*Leymus triticoides*	perennial grass
silvery lupine *	*Lupinus argenteus*	perennial herb
chick lupine	*Lupinus microcarpus*	annual herb
ponderosa pine	*Pinus ponderosa*	coniferous tree
pine (Sandberg) bluegrass *	*Poa secunda*	perennial grass
black cottonwood *	*Populus balsamifera ssp. trichocarpa*	large deciduous tree
chokecherry *	*Prunus virginiana var. demissa*	small deciduous tree
Oregon white oak *	*Quercus garryana*	large deciduous tree
California black oak *	*Quercus kelloggii*	large deciduous tree
fragrant (three-leaf) sumac	*Rhus aromatica [trilobata]*	deciduous shrub
whitestem gooseberry	*Ribes inerme*	deciduous shrub
California rose *	*Rosa californica*	deciduous shrub
Pacific blackberry	*Rubus ursinus*	deciduous shrub, vine
blue elderberry *	*Sambucus nigra ssp. caerulea [mexicana]*	large deciduous shrub
Lemmon's needlegrass	*Stipa [Achnatherum] lemmonii*	perennial grass
western needlegrass	*Stipa [Achnatherum] occidentalis var. occidentalis*	perennial grass
common snowberry *	*Symphoricarpos albus*	deciduous shrub
creeping snowberry *	*Symphoricarpos mollis*	deciduous shrub

Common name	Scientific name	Lifeform
tomcat clover *	*Trifolium willdenovii*	annual herb

* keystone species.

Uplands below Rocky Wake Zone

Upland areas below Rocky Wake Zone will be areas suitable for revegetation that will extend from the post-removal 100-year flood water surface elevation to the lower end of the Rocky Wake Zone. These uplands will be the only formerly submerged areas where upland vegetation will be seeded on the sedimentary substrate. The restoration process will be the same as for the planting zones below; the pioneer seed mix with mycorrhizal inoculant will be aerially seeded in the early spring of 2021, and broadcast seeding of the native ecotypic permanent seed will be implemented in the fall. Because of the fine clayey texture of the sediment, the permanent seed mix for this upland zone will include species that are better adapted to highly conductive, low permeability soils. These species will be different from species that grow in the upland, coarser soil areas just above the reservoirs that will be used for the restoration of the current upland areas disturbed by the project activities. Typically, perennial bunch grasses, shrubs and trees dominate on well drained, coarse-textured soils, while primarily annual grasses and forbs thrive in clayey soils.

Figure 5-29 Grasses are an important component of the Upland Planting Zone. Their cover varies greatly with slope aspect.

Table 5-9 Uplands below Rocky Wake Zone Proposed Species

Common name	Scientific name	Lifeform
common yarrow *	*Achillea millefolium var. lanulosa*	perennial herb
California brome *[1]	*Bromus carinatus*	grass
buckbrush *	*Ceanothus cuneatus*	evergreen shrub
deerbrush *	*Ceanothus integerrimus*	semi-deciduous shrub
Douglas fir	*Pseudotsuga menziesii var. menziesii*	coniferous tree
birchleaf mountain mahogany	*Cercocarpus betuloides*	semi-deciduous shrub
turkey mullein	*Croton [Eremocarpus] settiger*	annual herb
bluebunch wheatgrass *	*Elymus [Pseudoroegneria] spicatus*	perennial grass
squirreltail *	*Elymus elymoides*	perennial grass
blue wildrye	*Elymus glaucus*	perennial grass
common rabbitbrush *	*Ericameria [Chrysothamnus] nauseosa var. leiosperma*	semi-deciduous shrub
common woolly sunflower	*Eriophyllum lanatum*	perennial herb
small fescue *	*Festuca [Vulpia] microstachys*	annual grass
Idaho fescue *	*Festuca idahoensis*	perennial grass
red buckthorn	*Frangula [Rhamnus] rubra*	evergreen shrub
California barley *	*Hordeum brachyantherum ssp. californicum*	perennial grass
junegrass *	*Koeleria macrantha*	perennial grass
hot rock penstemon	*Penstemon deustus*	perennial herb
royal penstemon	*Penstemon speciosus*	perennial herb
varied leaf phacelia	*Phacelia heterophylla var. virgata*	perennial herb
ponderosa pine	*Pinus ponderosa*	coniferous tree
Sandberg bluegrass *	*Poa secunda*	perennial grass
Klamath plum *	*Prunus subcordata*	small deciduous tree
antelope brush *	*Purshia tridentata*	Deciduous shrub
Oregon white oak	*Quercus garryana*	deciduous tree
California black oak	*Quercus kelloggii*	deciduous tree
fragrant (three-leaf) sumac *	*Rhus aromatica [trilobata]*	shrub
plateau (desert) gooseberry	*Ribes velutinum*	deciduous shrub
western needlegrass *	*Stipa [Achnatherum] occidentalis*	perennial grass

* keystone species

The revegetation seed mix listed above will be seeded in the fall of the first year and adjusted to include site specific species for each reservoir and applied to all topographically suitable areas, as well as stable slope areas (i.e., areas determined to be safe from further erosion and not in need of sediment removal) upon completion of all required earthwork. Repeated supplemental seeding will be applied in underperforming areas as necessary until good coverage is achieved.

Figure 5-30 Tree cover in existing upland areas around the reservoirs varies considerably in response to slope aspect. Grasslands dominate on south-facing slopes. Woodlands and scrub dominate on north-facing slopes

California black oak, Oregon white oak acorns, and other woody species seed will be planted in selected upland areas suitable for revegetation. They will be installed as soon as the weather begins to cool down and spring seeded areas become accessible to the restoration contractor's equipment and personnel. It is anticipated that this will occur in October of the drawdown/dam removal year. Fresh acorns will be harvested and planted immediately. Seeds of other woody species will be planted as appropriate based on environmental factors such as soil texture, slope aspect, local topography and hydrology as described below. The planting density in this zone will be four seeded woody plants per acre. Seed will be initially irrigated by the biodegradable donut-shape water bowl (Figure 5-31) made from recycled paper pulp (Cocoon).

Figure 5-31 Cardboard basin (Cocoon) tree planting of incense cedar

Water will be slowly delivered from the Cocoon filled with water through wicks placed near the seed. After the first season, trees will be self-sufficient and will be watered only supplementally with water trucks in case of extended drought or excessively hot weather. Proposed upland planting zone species are listed in (Table 5-9) and will be planted at an average density of four woody plants per acre.

Rocky Wake Zone

Rocky Wake Zone will be an area of approximately 213 acres around the reservoirs where long term wake and wave action at the elevational range between the reservoir full and typical annual low water surface elevations (6'-7' range) resulted in gradual erosion and washing away of soil and fine textured sediment. Typically, only gravel, cobbles, boulders and bedrock is left. After drawdown, these areas could form a "bathtub ring" marking the original extent of the reservoirs with a continuous barren zone. Clean soil salvaged from the demolition of the dams, and sediment removed during the grading of the riparian floodplain areas will be imported over large segments of this zone and spread to a depth of 12" to provide substrate for vegetation. In some areas, the banks are very steep or form sheer cliffs. In these cases where soil cannot be safely kept on the existing grade without substantial erosion protection or other engineering measures, the rocky wake zone areas will not be restored. They will become a part of their existing rugged surroundings. During the initial aerial seeding with pioneer seed mixes, the Rocky Wake Zone will be avoided to the extent feasible because there will be no growing substrate to support the seed. The topsoil import in the Rocky Wake Zone will begin in the spring of 2021, and the soil covered areas will be seeded with the permanent seed mix in the late fall of 2021. The planting densities will be the same as in the Uplands below Rocky Wake Zone planting zone; four seeded woody plants per acre with irrigation cocoons. The risk of invasive species will be higher than in the Uplands Zone, because the Rocky Wake Zone is adjacent to the existing upland zones, where there is a large invasive species seed bank and a high percentage of invasive species dominated areas.

Disturbed Uplands

The Disturbed Uplands Planting Zone will be areas totaling approximately 136 acres that currently lie above the reservoirs and consist of existing developed areas proposed for demolition, and recreational areas that will be abandoned and removed after drawdown. Because the majority of these areas will not be ready for seeding until the end of the Dam Removal Period, they will not be included in the initial pioneer aerial seeding. They will be broadcast-seeded with the permanent native seed mix later, in the fall of 2021 and some in 2022. Soil preparation will vary based on past uses and activities. Areas with highly compacted soil, the result of the past presence of paving, vehicular traffic, intensive recreational activities or other human uses will be cross ripped to a depth of 24" before fall seeding in order to loosen the soil and improve its structure. It is assumed that 75% of the disturbed upland areas will need decompaction. Compacted areas under existing large trees and in their vicinity will not be ripped in order to protect the tree roots. The invasive exotic vegetation pressure will be intense in these areas because they are typically surrounded by areas heavily infested with non-native species such as cheatgrass, yellow star thistle, medusahead grass, goatgrass, and many others. The invasive exotic vegetation control will start early, several years before drawdown.

Figure 5-32 Erosion within the Rocky Wake Zone at Iron Gate Reservoir

Upland Stockpiles

The Upland Stockpile Zone (51 acres) will consist of areas where overburden material generated by the removal of the dams and other demolished structures in the project area will be deposited. It is assumed that the topsoil covering the stockpile areas will be heavily compacted. It will be cross-ripped to a depth of 24" or as feasible in preparation for seeding. The Upland Stockpile Zone will be seeded with the permanent native seed mix similar to plant list in table Table 5-10 in the fall of 2021 or as soon as the stockpiles become available for seeding in order to prevent their erosion. Because of the coarse debris within the core of the stockpiles and their sloping sides, these areas will be very well drained and dry during the long hot summers in the project area. Supplemental irrigation will be provided at least during several initial years of establishment in order to maintain vegetation in good condition. Similarly as with other upland zones, a very close attention will have to be paid to invasive species.

Undisturbed Uplands

The Undisturbed Uplands Planting Zone will consist of 148 acres of areas above the reservoirs that may be only minimally disturbed by the eradication of invasive exotic vegetation. They will go through active weed removal for at least three years before drawdown. Potential bare and disturbed patches resulting from invasive species removal will be reseeded both with the pioneer and the permanent native seed mixes. The majority of these areas will have existing native vegetation and only 30% is expected to need restoration.

Table 5-10 Uplands Above Rocky Wake Zone Seed Mix

Common name	Scientific name	Lifeform
common yarrow *	*Achillea millefolium var. lanulosa*	perennial herb
California brome *[1]	*Bromus carinatus*	grass
buckbrush *	*Ceanothus cuneatus*	evergreen shrub
deerbrush *	*Ceanothus integerrimus*	semi-deciduous shrub
Douglas fir	*Pseudotsuga menziesii var. menziesii*	coniferous tree
birchleaf mountain mahogany	*Cercocarpus betuloides*	semi-deciduous shrub
turkey mullein	*Croton [Eremocarpus] settiger*	annual herb
bluebunch wheatgrass *	*Elymus [Pseudoroegneria] spicatus*	perennial grass
squirreltail *	*Elymus elymoides*	perennial grass
blue wildrye	*Elymus glaucus*	perennial grass
common rabbitbrush *	*Ericameria [Chrysothamnus] nauseosa var. leiosperma*	semi-deciduous shrub
common woolly sunflower	*Eriophyllum lanatum*	perennial herb
small fescue *	*Festuca [Vulpia] microstachys*	annual grass
Idaho fescue *	*Festuca idahoensis*	perennial grass
red buckthorn	*Frangula [Rhamnus] rubra*	evergreen shrub
California barley *	*Hordeum brachyantherum ssp. californicum*	perennial grass
junegrass *	*Koeleria macrantha*	perennial grass
hot rock penstemon	*Penstemon deustus*	perennial herb
royal penstemon	*Penstemon speciosus*	perennial herb
varied leaf phacelia	*Phacelia heterophylla var. virgata*	perennial herb
ponderosa pine	*Pinus ponderosa*	coniferous tree
Sandberg bluegrass *	*Poa secunda*	perennial grass
Klamath plum *	*Prunus subcordata*	small deciduous tree
antelope brush *	*Purshia tridentata*	Deciduous shrub
Oregon white oak	*Quercus garryana*	deciduous tree
California black oak	*Quercus kelloggii*	deciduous tree
fragrant (three-leaf) sumac *	*Rhus aromatica [trilobata]*	shrub
plateau (desert) gooseberry	*Ribes velutinum*	deciduous shrub
western needlegrass *	*Stipa [Achnatherum] occidentalis*	perennial grass

* keystone species

1. Fast and prolific growth after seeding then gradually surrenders to other natives, protects habitat from initial exotic spp. invasion (GS pers. conv. Erin Lonergan, USFS botanist)

5.5.7 Cattle Exclusion Fencing

Areas around the reservoirs currently have open-range with cattle able to move freely around the reservoir areas. To protect revegetation efforts and to replace the function of the reservoirs as natural barriers, the

KRRC is proposing to use cattle exclusion fencing around the reservoir areas after drawdown. The proposed fencing will be a wildlife friendly design that excludes open-range cattle while allowing the natural movement of deer, turtles, and other wildlife. An approximate length of 34.5 miles of fence may be required to fully isolate the reservoir areas. The KRRC will place exclusion fencing, in accordance with applicable Federal, State, and county regulation and guidance, around the reservoir restoration areas where they abut grazing land. The KRRC will not fence areas of the reservoir perimeters that provide natural topographic (e.g., steep rocky terrain) or land use (e.g., residential areas, managed forests) barriers.

5.6 Data Gaps and Informational Studies

Several data gaps were identified in the 2011 Plan and the KRRC is gathering additional information and performing studies to maximize the likelihood for successful restoration. These data gaps are identified below and the KRRC has already addressed several of them using data collected in 2017 and others will be addressed later in 2018.

5.6.1 Revegetation Species

Optimization of revegetation effectiveness will depend on identification of the ideal revegetation species mix for each drawdown planting zone (i.e., upland, floodplain, riparian, and wetland) in each reservoir. Detailed proposed lists of native plant species appropriate for revegetation of each planting zone are provided in appropriate subsections above. These lists are based on past botanical surveys in the project area, early greenhouse growing experiments that were combined with the wetting-drying experiments (see Section 8.1), plant nutrient availability analyses, and knowledge of the cultural preferences of each native species, such as water, light and soil texture requirements. The KRRC will further refine these lists based on the proposed future vegetation surveys, and on the results from pilot test growing experiments that will be conducted for several years starting in the fall of 2018. Through these tests, the KRRC will determine optimal conditions for seed germination and identify best native species that will be capable of germinating on wet reservoir sediment under potentially freezing conditions during the January – March drawdown period.

5.6.2 Availability of Revegetation Materials

The KRRC will harvest pole cuttings from willows in riparian areas around the reservoirs where it will be transplanted to newly formed riparian areas. By thinning the willows' canopies, they will be better adapted for transplantation because their evapotranspiration will be substantially reduced. The KRRC will avoid areas with known habitat for sensitive species, such as the willow flycatcher (*Empidonax traillii*), and areas where sufficient water will be available for the riparian vegetation after drawdown during pole cutting collection and vegetation salvage.

The KRRC will salvage and transplant existing riparian and wetland vegetation currently growing in a narrow strip around the reservoirs, outside of areas where it can potentially survive after drawdown, to complement other reservoir revegetation efforts. Plant community inventories were completed around the reservoirs in 2009 and 2010 as part of the EIS/R preparation (USBR, 2011c), however, these lack sufficient detail regarding wetland and riparian species. The KRRC will conduct an updated vegetation inventory in 2018 and 2019. The KRRC will estimate the number of salvageable trees based on the inventory result and expects that a sufficient number of riparian trees will be available to supplement pole cutting installation.

To identify seed sources, the KRRC will conduct reconnaissance surveys in 2018 in areas within the upper Klamath River watershed that are within an elevational range of 500 ft below the Iron Gate Reservoir through 500 ft above the JC Boyle Reservoir. The KRRC will map the seed collection areas using global positioning system (GPS) and provide the maps to seed collection contractors that will begin work in late summer of 2018. The KRRC will conduct IEV surveys in 2018 to determine the extent of infestation within portions of the project area above the reservoirs. The KRRC will identify riparian vegetation around the reservoirs perimeters to inform the salvage potential of existing vegetation, the removal of invasive weeds, and more accurately characterize achievable vegetative conditions for restoration. The KRRC will perform new vegetation surveys in 2018 to provide a more recent and thorough baseline for the restoration approach

Specialized native seed propagation contractors will annually collect and propagate native seed in the project vicinity within the upper Klamath River watershed over a four-year period on large fields in farm settings to provide sufficient amounts of seed for both pioneer and permanent seeding.

5.6.3 Reference Site Selection

Establishment and good documentation of physical and ecological reference conditions is important for developing target conditions and performance criteria for restoration of various habitats in the project area. Existing vegetation surveys were completed along the margins of each reservoir in 2009 and 2010 (USBR, 2011c), but these studies were relatively coarse and were conducted over a short period of time. The KRRC will update and expand those surveys to include several reference areas for each planting zone at each reservoir. The KRRC will survey the reference sites for species diversity, vegetation cover, tree and shrub density and invasive exotic vegetation cover.

5.6.4 On-site Pilot Growing Test

The effectiveness of the restoration implementation will depend on correct selection of the best combination of plant species for each vegetation zone. A basic list of potential plants for revegetation of different drawdown zones in the reservoirs has been previously compiled by USBR (USBR, 2011c). However, KRRC selected plants with the implicit assumption that the existing vegetation present around the reservoirs will grow in fine, high organic matter, poorly drained sediment with absent soil biota that is diametrically different from the coarse, shallow and poor soil in the areas surrounding the reservoirs. During the pre-dam removal period the KRRC will update the species list for each vegetation zone in response to the information provided by the new vegetation surveys, the results from wetting-drying and growing experiments in the greenhouse (Section 8.1), plant nutrient availability analyses of the reservoir sediment samples, and test plot growing experiments at the project area.

The KRRC will implement project area test plot growing experiments in 2018 to examine the soundness of the restoration approach, and to refine the optimal seed mix for each vegetation zone in each unique reservoir setting. The KRRC will set up test plots near the reservoirs in locations with representative environmental conditions. The KRRC pilot experiment will be made up of twelve to sixteen 10'W x 10'L x 24"D test plots, each plot testing one of three-four treatments for four planting zones and zone seed mixes. The set of plots for each planting zone will be built to mimic the hydrology of that zone. Construction of these plots will include plastic liners to mimic wetland areas and raised beds with good drainage to approximate soil conditions in future upland areas. All plots will be irrigated. The test sites will be fenced to prevent predation by deer, theft and vandalism. The experimental design of the test plots will include different environmental parameters, such as reservoir sediment texture, surface treatment, cover crop seed mixes, irrigation, and hydrology. KRRC will use surface grab collected reservoir sediments to grow species of seed mixes from every vegetation zone. Sediment extracted from the bottom of the reservoirs (the anticipated growing substrate) will be placed in each plot to a depth of 2' (this will result in about a 1.2' thickness after the previously observed average shrinkage and drying of 60%. Scientists will regularly visit the site to monitor the experiment and to gather data for use in the vegetation species selection and restoration plan. The KRRC will finalize the seed mixes within each vegetation zone based on the test plot results.

Chapter 6: Monitoring and Adaptive Management

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6. MONITORING AND ADAPTIVE MANAGEMENT

Dam removal is a rapidly evolving science and the study of dam removal effectiveness on river processes is expanding with each new dam removal. The KRRC reviewed several dam removal monitoring and adaptive management plans as summarized in Table 6-1. These plans utilized a range of protocols and various levels of effort to monitor the projects. Common themes from these plans include monitoring for at least 2 years after dam removal with a focus on physical processes and vegetation. The KRRC is proposing that monitoring and adaptive management take place for 5 years after drawdown as described in the following sections.

Table 6-1 Summary of dam removal monitoring and adaptive management plans

Dam Removal	Description
Elwha & Glines Canyon Dams on the Elwha River, Washington	The Elwha and Glines Canyon dams were removed in 2012 and 2014, respectively. Monitoring was proposed for six years post removal. The monitoring strategy consisted of physical processes and vegetation (Chenowith et al., 2011).
Savage Rapids Dam on the Rogue River, Oregon	Savage Rapids Dam was removed in 2009. Monitoring was proposed for two years post removal. The proposed effectiveness monitoring strategy consisted of three protocols: biological, physical, hydrological measurements (Bountry et al., 2013).
Gold Ray Dam on the Rogue River, Oregon	Gold Ray Dam was removed in 2010. Monitoring was proposed for four years but stopped after two years due to funding cuts. The proposed effectiveness monitoring strategy consisted of multiple protocols including biological, physical processes, vegetation and habitat.
Condit Dam on the White Salmon River, Washington	Condit Dam was removed in 2011. An Environmental Monitoring Plan proposed two years post removal monitoring consisting of water quality, sediment transport, slope stability, and vegetation monitoring (Wilcox et al., 2014).
Milltown Dam on the Clark Fork River, Montana	Milltown Dam was removed in 2009. Monitoring was planned for 15 years and consisted of physical processes and changes to the channel/floodplain, vegetation, water quality, and habitat (Evans, 2014).
San Clemente Dam on the Carmel River, California	San Clemente Dam was removed in 2015. A monitoring plan comprised of multiple years of monitoring protocols focused on channel geomorphology, structure stability and persistence, and vegetation establishment (AECOM personal communications, 2017).

6.1 Monitoring Metrics and Protocols for Reservoir Areas

Monitoring associated with restoration of the reservoir areas is designed to measure progress toward achieving the project goals, inform potential adaptive management and maintenance needs, and provide feedback into river and reservoir area conditions to determine if sites are trending towards or away from achieving project goals. Physical site characteristics have been identified as appropriate monitoring metrics using standard field techniques to produce data compatible with standard protocols derived from previously developed dam removal monitoring and adaptive management plans.

After drawdown of the reservoirs and removal of the dams, the KRRC proposes the following actions to establish “baseline” or “initial conditions”. The KRRC will use the initial condition reference data for monitoring and adaptive management related to reservoir restoration:

1. The KRRC will establish permanent ground photo points throughout the reservoir areas that enable sufficient vantage points of critical areas within the reservoirs. The KRRC will take photos to provide initial conditions for monitoring data to develop informed maintenance/corrective actions. The KRRC will monument each photo ground point will be monumented with 5/8” rebar and aluminum cap for long-term stability and documented with a northing, easting, and elevation using a survey-grade GPS.
2. The KRRC will complete high resolution aerial photos, sub-meter accuracy, for the reservoir areas.
3. The KRRC will collect LiDAR for the reservoir areas after sediment evacuation and initial ground cover stabilization to create initial conditions surface models.

The KRRC will use the baseline data to provide a clear starting point for initial conditions in the project area to help evaluate reservoir area restoration trends and trajectories. Project goals are described below along with desired future conditions for each goal that can be monitored. KRRC proposes a five-year monitoring plan.

6.1.1 Reservoir Sediment Stabilization

During an average water year, the KRRC expects that approximately 50% of the reservoir sediments will remain in the reservoir area on the floodplain and surrounding slopes after drawdown. To reduce potential water quality degradation from un-natural, episodic fine sediment releases, the KRRC will vegetate the remaining sediments. The KRRC will construct habitat features to promote natural river processes that may create minor areas of erosion, but overall the remaining sediments will be stabilized. The KRRC will monitor sediment stability using visual inspection (aerial and ground photos) and LiDAR as summarized in Table 6-2.

Table 6-2 Summary of reservoir sediment stability monitoring metrics

Project Goal	Monitoring Technique	Monitoring Metrics	Frequency
Stabilize remaining reservoir sediments	Visual inspection with photo points and physical measurements	Areal extent and limits of erosion	Yearly
Stabilize remaining reservoir sediments	LiDAR flight of reservoir areas	Surface model volume change	Yearly
Minimize invasive exotic vegetation and establish native vegetation cover	Visual inspection, aerial photos and ground-based photo points	Area of invasive vegetation	2 times per year
		Area of native vegetation cover	2 times per year

6.1.2 Reservoir Sediment Evolution Monitoring

The KRRC will conduct mapping of geomorphic features and sedimentary facies in the reservoirs to monitor reservoir sediment evolution following drawdown and identify the need for additional restoration actions. Fine-grained reservoir sediments not evacuated during initial drawdown are potential sources of suspended sediment that could be released during subsequent storm events if not stabilized and impact water quality. Deposit stabilization through active (e.g., planting and irrigating) revegetation techniques or erosion control measures (e.g., deposit excavation, erosion control mats) may be applicable where thick, fine-grained deposits persist in upland regions subject to overland flow and gully erosion and where revegetation efforts have been unsuccessful. In valley bottom and riparian locations where deposits are the thickest, dried and hardened residual reservoir sediments may physically obstruct flood waters from accessing the floodplain. In such cases, the KRRC will manually remove the obstructing deposits to increase floodplain connectivity. Restoration actions for deposit excavation may be triggered where sediment accumulations of specified threshold dimensions persist in riparian areas for more than a year after drawdown.

To document reservoir sediment evolution, the KRRC will map geomorphic features and sedimentary facies in the field and use remote analyses of bathymetric and LiDAR surfaces, aerial photos, and photo points. The KRRC will use viewshed GIS analysis to refine and optimize the locations of permanent ground photo points for monitoring and evaluate the ability to see post-drawdown features of interest (e.g., floodplains, regions with thick deposits) from specific vantage points prior to drawdown. The KRRC will compare the location and spatial extent of historical and post-drawdown geomorphic features of interest (e.g., channel banks, floodplains, and terraces) to modeled flood inundation extents (e.g., Figure 3-1, Figure 3-5, Figure 3-11). The KRRC will monitor residual reservoir sediment including the description of spatial extent and thickness, sediment texture and structure, and interpretation of the reservoir depositional environment and post-drawdown erosional environment (e.g., evolution by hillslope and gully processes or mainstem flooding). The KRRC will use field mapping to opportunistically target riparian and floodplain areas and locations where remote analysis has identified bare sediments and where erosion has exposed complete stratigraphic sections in the sediments. Estimates of residual sediment volumes will benefit from revised estimates of sediment thickness using the 30 centimeters (cm) resolution bathymetry and drill core data collected in 2018 along with historical topography and the previously collected sediment core data described in USBR (2011c).

The KRRC will conduct field inspection activities each year around April 1, and remote analysis will precede, and thereby inform, field mapping by several weeks. This timeline ensures both that the majority of large storms for the water year will have already occurred and that there will be sufficient time to prepare materials for permitting restoration actions during the "in water" work window to mitigate problematic residual reservoir deposits. The KRRC will use results of field and remote analyses to generate maps of residual reservoir sediments and geomorphic features that can be compared with surface run-off models and modeled flood inundation extents and can highlight possible locations for restoration actions.

6.1.3 Volitional Fish Passage Restoration

A goal of dam removal is to restore longitudinal river connectivity and natural river form and function that results in volitional fish passage. Experience from past dam removals show that potential fish passage barriers could exist beneath the reservoir water surface, that are not known now due to inundation caused by the dams. For example, there are often temporary structures built upstream of dams to control and bypass water during dam construction, and these structures often remain after dam construction and can create fish passage barriers once reservoirs are reverted to free-flowing systems. To address this uncertainty, the KRRC will enact a visual inspection and monitoring protocol as summarized in Table 6-3.

Table 6-3 Summary of volitional fish passage monitoring metrics

Project Objective	Monitoring Technique	Monitoring Metrics	Frequency
Restore fish passage to natural conditions	Visual inspection with ground photo points and physical measurements	Required fish jump height	After wet season, yearly
Restore fish passage to natural conditions	Visual inspection with ground photo points and physical measurements	Un-natural or man-made obstructions	After wet season, yearly

6.1.4 Revegetation, Invasive Exotic Vegetation Control and Natural Ecosystem Processes Restoration

To determine the progress and success of revegetation, invasive exotic vegetation control, and efforts to restore natural ecosystem processes, the KRRC will regularly monitor the project area for compliance with established performance criteria. The general approach to this monitoring will be to quantitatively record the progress, compare it to established performance criteria/reference site conditions, and take corrective action if and when necessary to guide further ecological succession on a trajectory to a fully functioning natural ecosystem. The key monitoring activities are summarized in Table 6-4.

Performance Criteria

For the purposes of monitoring, to determine the revegetation plan success, and to ascertain the degree of natural ecosystem processes re-establishment, the KRRC is proposing the following performance criteria for all native vegetation planting zones. The KRRC will refine these criteria once reference sites are identified and biometrically quantified.

Relative Vegetation Cover:

The relative vegetation cover for each project planting zone will be the following percentages of the average of the relative vegetation cover of approved reference sites for each monitoring year:

- Y1–70%

- Y2–75%
- Y3–80%
- Y4–85%
- Y5–90%

Rock outcrops, scree, and gravel covered areas and areas otherwise unable to support vegetation, will be excluded from the relative vegetation cover calculations.

Table 6-4 Summary of reservoir revegetation and invasive exotic vegetation monitoring metrics

Project Goal	Monitoring Technique	Monitoring Metrics	Frequency
Establish native vegetation cover	Visual inspection, aerial photography-based GIS desktop analysis, and ground based photo points	Relative vegetation cover	once per year
	ground based botanical surveys of selected sampling areas or along predetermined point intercept transects and photo points	Plant species diversity	once per year
	GPS identification of tree and shrub textural signatures to facilitate GIS desktop, field verification and data correction for complex/ambiguous areas, photo-documentation of tree and shrub growth, health and vigor from established on-the-ground photo point stations	Number of surviving trees and shrubs per acre	once per year
Minimize invasive exotic vegetation	GPS identification of textural signatures of IEV species, production of high resolution, drone generated aerial photo, a quantitative GIS based determination of relative percent cover, field verification and data correction, on the ground marking of IEV designated for removal, Daubenmire frame surveys along pre-determined transects for species not recognizable on aerial photography, photo-documentation of IEV cover from established on-the-ground photo point stations.	Invasive Exotic Vegetation Cover	Y1 – 20x/year Y2 – 10x/year Y3 – 5x/year Y4 – 4x/year Y5 – 2x/year

Plant Diversity:

The plant diversity for each project planting zone will be the following percentages of approved reference sites for each monitoring year:

- Y1–60%
- Y2–65%
- Y3–70%
- Y4–75%
- Y5–80%

Number of Surviving Trees and Shrubs per Acre:

The number of surviving trees and shrubs per acre will be the following percentages of the trees originally planted from seed for each monitoring year:

- Y1–90%
- Y2–85%
- Y3–80%
- Y4–75%
- Y5–70%

Naturally recruited native woody species shall count at 50%.

Invasive Exotic Vegetation Cover:

Percent relative cover by medium and low priority IEV shall be less than the average of the relative medium and low priority IEV cover in two nearby approved reference areas as follows:

- Y1–25%
- Y2–40%
- Y3–55%
- Y4–70%
- Y5–90%

No high priority invasive plants (as listed in Table 5-4 of this report) will be present in the limits of work.

Revegetation Monitoring Methodology

The KRRC will perform annual revegetation monitoring for five years after installation acceptance or until the performance criteria have been met. During the first monitoring year that will coincide with the Plant Establishment Period, IEV control will be crucial. During the plant establishment period, the KRRC will perform monthly monitoring during the cold season from November 1 through March 1, and bi-weekly monitoring the rest of the year, totaling approximately 20 visits. For the remaining four years of the 5-year monitoring period that will coincide with the Maintenance and Monitoring Period, the frequency of KRRC monitoring and maintenance will gradually decrease. In Year Two, the KRRC will conduct bi-monthly monitoring surveys will be conducted during the cool season from November 1 through March 1, and monthly surveys the rest of the year. In Year Three the KRRC will make 5 visits, one visit between November and April and four bi-monthly visits the rest of the year. In Year Four, visits will be bi-monthly from April through November, totaling 4 visits for the year. During the anticipated final year of monitoring and maintenance, the KRRC will make two visits, one in the spring and the other in the fall. During only one monitoring visit each year (approximately at the same time) the KRRC will gather data on performance criteria compliance needed to prepare the annual monitoring report. In the remaining monitoring visits, the KRRC will focus on identification of IEV populations and monitoring of restoration contactor compliance with the requirements of the plant establishment and maintenance contracts. The KRRC will base tasks for the maintenance period on the monitoring results, and performance criteria thresholds and will consist of re-seeding/re-planting of native vegetation (as necessary), invasive plant management, herbivore control, irrigation maintenance and other activities as situations arise (e.g., implementation of erosion repairs). Monitoring will be conducted by qualified plant biologists with expertise in local native plant ecology and invasive species control, and will include the following tasks:

Relative vegetation cover determination:

- A walking visual inspection to document the progress of native vegetation establishment in selected sampling areas or transects in each planting zone.
- GPS identification of textural signatures of sample bare ground areas and different types of vegetation to facilitate GIS desktop analysis of aerial photography for woody and larger aerial cover species and relative vegetation cover determination.
- Production of high resolution, drone generated aerial photos with sub-meter accuracy to be used as the basis of GIS desktop analysis to accurately determine vegetation cover for herbaceous and woody species in the project area.
- Photo-documentation of revegetation progress from established on-the-ground photo point stations.

Plant species diversity:

- Botanical surveys in selected sampling areas or point intercept surveys along pre-determined transects in each planting zone.
- GPS identification of sample textural signatures for different types of vegetation to facilitate GIS desktop analysis of aerial photography.
- Photo-documentation of revegetation progress from established on-the-ground photo point stations.

Number of surviving trees and shrubs per acre:

- GPS identification of textural signatures of tree and shrub species to facilitate GIS desktop analysis of aerial photography to determine the number of surviving trees and shrubs per acre in the project area.
- On the ground field verification and data correction for complex or ambiguous areas.
- Photo-documentation of tree and shrub growth, health and vigor from established on-the-ground photo point stations.

Invasive exotic vegetation cover:

- GPS identification of textural signatures of IEV species where feasible to facilitate GIS desktop analysis of aerial photography to determine the invasive exotic vegetation cover, species and extent.
- Production of high resolution, drone generated aerial photography with sub-meter accuracy for GIS desktop analysis.
- A quantitative GIS based determination of relative percent cover of IEV species within the limits of work, and a list of IEV species with recommendations on priority and method of removal.
- On the ground field verification and data correction for complex or ambiguous GIS areas.
- On the ground marking of IEV designated for removal by maintenance contractor.
- Daubenmire frame surveys along pre-determined transects for herbaceous species not recognizable on drone generated aerial photography.
- Photo-documentation of IEV cover from established on-the-ground photo point stations. Numbered photo point locations, camera focal length, and directions will be established during the initial inspection and comparative photos from the same photo points, in the same directions, and same camera settings will be taken in subsequent inspections.

The KRRC will prepare and submit an annual monitoring report by December 31 of monitoring Year One through Five. Each annual report will cover both the geomorphic and revegetation monitoring scheduled for that monitoring year.

If any scheduled revegetation monitoring inspection reveal that any of the monitoring criteria have not been met, the monitoring report for that year will include an evaluation of the potential factors that may be hindering project revegetation and propose a plan for improving performance. Suggestions for improving performance may include specific recommendations for removal of invasive exotic species or for an adaptive plan for supplemental native plantings.

Natural Ecosystem Processes Restoration Monitoring

Long-term restoration of the reservoir areas aims to restore a naturally functioning ecosystem that is sustainable without human intervention on a regular basis. This long-term goal is achieved primarily through establishment of vegetation throughout the reservoir areas and especially along the river and its tributaries. A healthy, vibrant, self-sustainable riparian corridor where target plant species recruit from naturally produced seed will help improve water quality, reduce thermal load (i.e., provides shaded aquatic riverine habitat), stabilize banks and sediment, slow and filter water, provide fish and wildlife habitat, and provide needed organic matter. Site monitoring to assess the achievement of this goal will be looking at monitoring metrics described above and determine if the reservoir areas are trending towards a restored natural ecosystem. KRRC will develop and implement corrective actions to improve the trend if it is not progressing toward a restored naturally functioning and self-sustaining ecosystem.

6.2 Framework for Adaptive Management Actions Based on Monitoring

Restoration of natural rivers is an evolving science and requires building in mechanisms to deal with uncertainty. Adaptive management is a comprehensive approach to natural resource management activities where feedback between observation and corrective action is emphasized to address uncertainty, as illustrated in the CDFW adaptive management diagram in Figure 6-1. Through this structured effort, a decision-making framework allows the project monitoring metrics to be interpreted and to take corrective actions as necessary. Likewise, monitoring provides the data necessary for tracking ecosystem health, for evaluating progress towards restoration goals and objectives (i.e., performance measures), and for evaluating and updating problem statements, goals and objectives, conceptual models, and restoration actions. Table 6-5 summarizes a simple framework for making decisions and actions based on monitoring of project metrics.

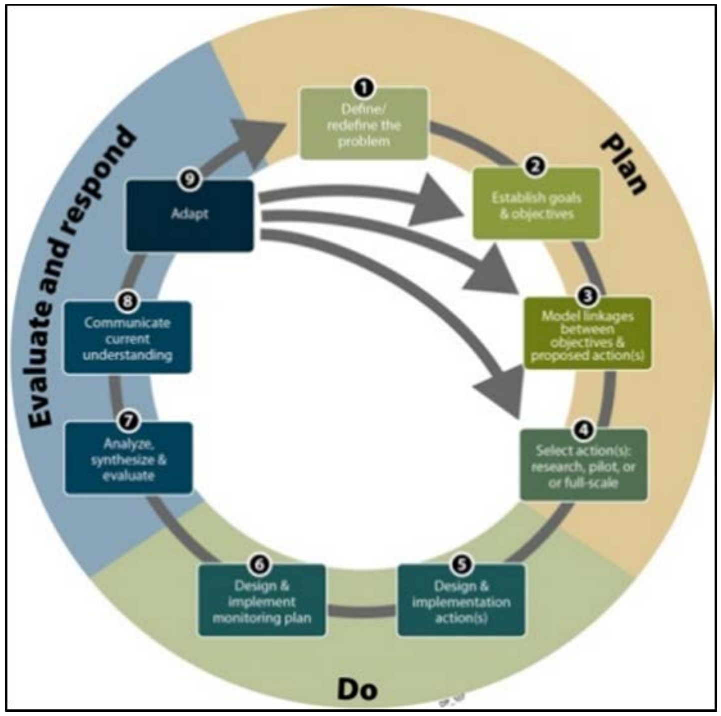

Figure 6-1 CDFW adaptive management diagram

Table 6-5 Monitoring decision making framework

Conclusion Categories	Decisions and Actions
Conclusion 1 - Project is meeting objectives based on values of monitoring metric and criteria.	• Evaluate the monitoring program (continue, reduce, or eliminate some metrics)
Conclusion 2 - Project is trending towards objectives based on values of monitoring metric and criteria.	• Evaluate the monitoring program (continue, reduce, eliminate some metrics) • Confer with project team to evaluate whether rates of progress toward objectives are appropriate

Conclusion Categories	Decisions and Actions
Conclusion 3 - Project is not meeting (or trending away from) objectives based on monitoring values of performance criteria.	• Evaluate causes • Confer with project team to assess the monitoring program to determine if appropriate data area being collected to assess and evaluate causes • Evaluate whether performance criteria metrics are appropriate • Develop a plan to address problems • Implement the plan and monitor results

The monitoring plan will include key monitoring attributes that will provide a feedback loop of the trends and trajectory of the restoration efforts used to determine maintenance needs for the Project. The project team will notify the regulatory agencies if monitoring demonstrates values outside of outlined thresholds as described in Table 6-6 below. If a monitoring metric is a “Pass”, then there is no action required. If, however, the monitoring metric is a “Fail”, then the project team will make an evaluation of the failure and a determination of potential maintenance and/or corrective actions dependent upon the severity and type of failure.

Table 6-6 Monitoring data trends, conclusions and responses for selected metrics

Metric	Thresholds	Decision Pathway	Corrective Action	Monitoring Technique
Longitudinal Stream Continuity	• No unnatural structures	• No unnatural structures (Pass) • Man-made or unnatural structure observed (Fail)	• Remove historical structure if it is problematic	Visual Inspection by Photo Points Physical Survey may be warranted if metric is found to be outside of threshold.
Fish Passage	• No unnatural barriers exceeding 6 inches • No unnatural channel headcut exceeding 6 inches	• No jump height barriers exceeding 6” (Pass) • Barriers/headcut present (Fail)	• Remove or rectify barrier • Restore and stabilize streambed through headcut	Visual Inspection by Photo Points Physical Survey may be warranted if metric is found to be outside of threshold.
Sediment Stability	• No significant sediment erosion or outside normal bank erosion	• No erosion threatening structures (Pass) • Bank erosion threatening structures (Fail)	• Perform stabilization actions to limit/reduce extent of erosion • Perform survey to evaluate trends in instability	Visual Inspection by Photo Points** Physical Survey may be warranted if metric is found to be outside of threshold.
Vegetation coverage	• % relative vegetation cover • Plant diversity • Tree and shrub survival % • % cover invasive exotic vegetation	• Low vegetation cover • Low plant diversity	• Additional vegetation seeding planting • Seeding additional species • Seeding add’l trees and shrubs • IEV eradication	On the ground physical surveys, Photo Points, GIS based analysis of aerial photography,

6.3 Data Storage and Reporting

6.3.1 Data Storage

KRRC and Klamath Basin Monitoring Program (KBMP), or their designated representative will store and maintain monitoring data. Data will be maintained in standard database(s) and will be made available to entities as requested and available on the KBMP website (kbmp.net). Data tables and observation forms will be standardized to avoid redundant data and to ensure consistent data formats among sampling events.

6.3.2 Data Analysis and Reporting

After each monitoring event, KRRC will analyze survey data. KRRC will prepare a brief site action memorandum and provide it to KBMP; the memo will include:

- Overview of site conditions,
- Monitoring metric conclusions based on metrics target thresholds, and
- Any maintenance or corrective actions recommended.

At the end of each monitoring season, an annual memorandum will be prepared that includes:

- Summary of each monitoring event site action memorandum,
- Monitoring metric conclusions based on metrics target thresholds observed over the monitoring season, and
- Any recommended maintenance or corrective actions.

KRRC will make these annual memos at the end of each calendar year. If significant issues or concerns are identified, KRRC will recommend future actions with sufficient time for planning and permitting prior to the "in water" work window. Lastly, KRRC will generate a final monitoring report to summarize monitoring data collected and adaptive management actions taken over the five years of monitoring including:

- Metrics for which data were collected; including any adjustments made to monitoring program,
- Summary of all monitoring data collected using tables and figures to depict observed trends over three years of monitoring,
- Individual Monitoring Metric Conclusions based on target thresholds observed over three years,
- Narrative discussions to explain results in the context of projects goals, success criteria, and performance standards, and
- Final recommended maintenance and corrective actions.

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Chapter 7: References

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Chapter 8: Supplementary Information

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8. SUPPLEMENTARY INFORMATION

8.1 Experiments to Inform Restoration Decisions

The following sections detail the experimental methodology, results, and implications of two experiments that were completed in 2017 and 2018 to address existing restoration data gaps: 1) Investigation of the physical responses of reservoir sediments to wetting-drying, and 2) Grow tests to evaluate the suitability of reservoir sediments as a growth medium and identify species likely to succeed in revegetation efforts.

8.1.1 Reservoir Sediment Characteristics

Results of Previous Studies

Testing of reservoir sediment characteristics can provide insight into the expected evolution of the material during and following drawdown. Previous analyses (J.C. Headwaters, 2003; Shannon and Wilson, 2006, USBR, 2010; Strauss, 2010; Simon et al., 2010), which are summarized in USBR (2011b and 2011c), examined the physical and behavioral properties, including grain size, Atterberg limits, water content, cohesion, shear strength, erodibility, and changes associated with desiccation (drying). Important results include the high clay content particularly in the downstream reaches of each reservoir, high water content, low material strength, and high erodibility of the fresh, moist reservoir sediments and the significant increase in material strength and decrease in erodibility of the sediments once dried (Simon et al., 2010). Critical shear stress, τ_c, for moist sediments (67 to 82% water content by weight) was 0.58 to 1.1 Pascals (Pa) (0.012 to 0.023 pound-force/square foot [lbf/ft^2]), similar to stresses required to entrain sand, and values increased to 5.9 to 56 Pa (0.123 to 1.17 lbf/ft^2) for dried sediments (48 to 67% water content), similar to stresses required to transport gravel and cobbles. Reservoir sediments from J.C. Boyle were observed to decrease in porosity and in thickness and volume by 40% and 66%, respectively, when air dried, and significant crack development occurred in concert with the decrease in volume (USBR, 2011c). These experiments informed predictions of the response of the accumulated reservoir sediments after drawdown. Specifically, the mechanically weak saturated sediments will erode rapidly during drawdown, but, upon drying in the summer after drawdown, the material will stabilize, the undisturbed reservoir surface elevations will be reduced, and cracks will form.

USBR (2011b) simulated sediment evacuation and suspended sediment concentrations during drawdown using a 1D model for all reservoirs. They demonstrated that the rate of erosion of reservoir sediments was primarily a function of hydrology during drawdown and the low-level outlet capacity of the dams. The range in reservoir sediment volume eroded varied from 41% to 66% depending on if a representative hydrograph from a dry or wet year, respectively, was simulated. These 1D model simulations used the median values for τ_c (0.2 Pa) and the erodibility coefficient, *k*, measured by Simon et al. (2010). Model sensitivity analyses using the 25th and 75th percentile moist values (Simon et al., 2010) for τ_c (0.03 and 1.2 Pa, respectively) showed negligible effect (USBR, 2011b). For the 1D modeling, an above water angle of repose of 15 degrees was used (USBR, 2011b). However, values vary from 6 degrees (10H:1V, Shannon and Wilson, 2006), 18 degrees (2H:1V) PanGeo (2008), and 32 degrees from the drill core friction angle (Strauss, 2010). Sensitivity analyses using lower values of 5 and 10 degrees showed increased the duration of moderately elevated suspended sediment concentrations as result of sand deposition from Copco Reservoir in Iron Gate and subsequent remobilization. Effects on eroded sediment volume were not reported. A single value of angle of repose will not be representative of all grain sizes in the reservoir sediments or the increase in stable angle with desiccation of sand and fine-grained cohesive sediments.

Measurements of friction slopes and shear strengths were used to calculate stable sediment thicknesses as a function of slope and measured cohesion (Table 8-1) using an infinite slope assumption and the US Army Corps of Engineers Slope Stability Engineering Manual (see summary in USBR, 2011b). The minimum measured cohesion value was 0.7 pound-force/square Inch (lbf/in^2), but given the difficulty measuring this quantity on the saturated sediments, a lower cohesion value is more reasonable. Results suggest that slopes with gradients below 10% should be stable with more than 4 to 8 ft of reservoir sediments. Greater slopes and thicknesses are predicted to lead to slope failure or slumping.

Table 8-1 Stable depth (ft) of reservoir sediments as a function of slope and cohesion for saturated and draining sediments from USBR (2011b).

Slope	Stable Depth for Different c' values			
	c' (lbf/in^2)			
	0.2	0.35	0.7	1
0.1	4.6	8.1	16.2	23.1
0.2	2.4	4.2	8.3	11.9
0.3	1.7	2.9	5.8	8.3
0.4	1.3	2.3	4.7	6.7

Sediment Sampling and Experimental Methodology

Additional testing of reservoir sediments was undertaken in winter 2018 to build upon these previous analyses. Sediments were monitored during desiccation, and experimental treatments targeted changes in physical properties of the sediment when exposed to cyclical periods of wetting and drying as would be experienced in the fall following drawdown. Samples (approximately 1 cubic foot [ft^3] each) were collected with a grab sampler from the uppermost 9 inches of substrate in 25 locations in total among the three reservoirs (Figure 8-1, Figure 8-2, Figure 8-3). Samples were placed into 15-inch by 23-inch containers to a depth of 4 to 5 inches and tested in a greenhouse environment. Control over environmental conditions in the greenhouse was limited by the thermostat and sprinkler characteristics and therefore do not simulate conditions at the reservoirs exactly. Greenhouse temperatures typically varied between 50 to 70 deg. F with extremes approaching 90 deg. F, and relative humidity ranged from 30 to 60%. Sample measurements included deposit dimensions and weight, time-lapse photography of volume changes and crack geometry development, infiltration rate, and shear strength, which was measured with a Torvane sampler and correlates with critical shear stress and the erodibility coefficient (see Simon et al., 2010). Samples were monitored during desiccation over a period of weeks until sample weight had stabilized (i.e., samples had fully dried out). Once dried, ¼ inch holes were drilled in the base of the sample containers to promote free draining, and samples were periodically rained on with an average application of 1.1 inches from the sprinkler system at a rate 1.65 inches per hour for a period of approximately 40 minutes. These rainfall events are similar to a 100-year event for this duration at the Copco climate station. Sample weight and shear strength were measured at the conclusion of rainfall events. Shear strength (τ_f, kPa) was compared to fractional sample weight $F = W/W_0$, where W is the measured sample weight (lbs) and W_0 is the initial weight (lbs) prior to desiccation.

Measured shear strength values were used to estimate variations in predicted erosion rates of reservoir sediments with desiccation using a simplified model. Critical shear stress (τ_c, Pa) and the erodibility coefficient (k, cm^3/N-s) are calculated from shear strength (τ_f, kPa) using empirical relationships from Simon et al., (2010): $\tau_c = 0.2151\tau_f^{1.5006}$ and $k = 0.7534\tau_f^{-0.6023}$. We use the rewritten form of the Ariathurai and Arulanandan (1978) excess shear stress relation for erosion rate (ε, m/s) of cohesive sediments from Partheniades (1965), $\varepsilon = k(\tau - \tau_c)$ for $\tau > \tau_c$ to explore the sensitivity of erosion rate to shear strength. Substituting the shear strength relationships for τ_c and k_d (Simon et al., 2010) shows that $\varepsilon = 0.8\tau_f^{-0.6}(\tau - 0.2\tau_f^{1.5})$ or $\varepsilon \propto \tau_f^{-0.6}\tau^1$. That is, the shear stress needed to cause erosion is a function of $\tau_f^{1.5}$, and for a given shear stress in excess of this critical value, erosion rate varies linearly with excess shear stress and with approximately the inverse square root of shear strength.

Results of Sediment Testing

Data collected during the drying of the samples confirmed many of the observations from previous studies. Wetting-drying tests were performed on paired samples from JCB1, CP2, and IG1, which are located near their respective dams where sediment deposits are thickest (Figure 8-1, Figure 8-2, Figure 8-3). Desiccation, which occurred solely through evaporative processes rather than gravity draining, resulted in significant reductions in fractional sample weight, F, and volume of up to 80% and 65%, respectively, over a period of one to two months (e.g., Figure 8-7, Figure 8-8, Figure 8-9 and Table 8-2, Table 8-3, Table 8-4). Over the first several weeks of drying, cracks several inches in width formed through the full thickness of the deposit and the sediment pulled back from the sides of the container (Figure 8-4, Figure 8-5, and Figure 8-6).

The increases in shear strength, (τ_f, kPa) were dramatic (Table 8-5, Table 8-6, Table 8-7) with reductions in fractional sample weight and tightly follow a negative power law (Figure 8-7, Figure 8-8, Figure 8-9). Shear strength increased rapidly after samples reached about 50% of the initial saturated weight, which occurred after several weeks. Maximum shear strength values were over two orders of magnitude greater than early, saturated measurements (Table 8-8). Samples eventually dried and hardened to the extent that the Torvane sampler could not be inserted into the sediment, and further measurements were not possible. Therefore, maximum shear strength values are potentially even higher than measured.

The maximum measured shear strength values were used to calculate changes in critical shear stress and the erodibility coefficient (Table 8-8). Critical shear stress increased by 2 to 3 orders of magnitude and were an order of magnitude greater than the maximum values, equivalent to values able to erode cobbles, that were measured by Simon et al. (2010) and used to model reservoir erosion (USBR, 2011b). Using the simple relationship for boundary shear stress for steady, normal flow, $\tau = \rho g H S$, a 2 to 3 order of magnitude increase in the depth-slope product would be required to initiate erosion in the dried sediment compared to the fresh, moist sediments. The decreases in erodibility, k, suggest decreases in erosion rate with desiccation by a factor of 6 to 30 for a given shear stress in excess of critical applied to the dried sediments (Table 8-8).

The effects of experimental rainfall events are visible in the shear strength and drying. While most of the rainfall was lost as surface runoff, some water entered the deposits resulting in maximum increases in *F* of 0.12 (approximately 6 lbs) at CP2b (Figure 8-8D). After wetting, reductions in shear strength were variable and generally ranged from 50 to 75 kPa. Wetted shear strength values were still two orders of magnitude greater than initial measurements (Figure 8-7 and Figure 8-8). The maximum decrease in shear strength was 200 kPa (see January 26 event in Figure 8-7D). Changes in deposit dimensions were negligible in response to rainfall events. An important response to cyclical wetting and drying was the disintegration and fracturing of the deposits into smaller fragments and dust. Most strikingly in the IG1 samples, new cracks and fractures appeared after each sequence of wetting and drying. In the IG1 samples, which had the highest clay content of the three wetting-drying samples, considerable disintegration occurred with additional watering even after seeding and root development (see Section 8.1.2).

Infiltration rates from single-ring infiltration tests were low (on the order of 10^{-2} inches per hour) on partially dried intact sediment surfaces. These rates are consistent with infiltration rates calculated from laboratory analyses of sediment texture (Wallace, 2017) using the Soil Water Characteristics model v. 6.02.74 (Keith Saxton, US Department of Agriculture [USDA]). On fully dried samples, water ponded in sediment depressions during greenhouse irrigation tests where rainfall rates were approximately 1.25 to 1.65 inches per hour. This observation provides an inferred upper limit on the infiltration rate. However, during single-ring irrigation tests on the dried samples, infiltration rates were very high, several inches per hour. These rates were influenced heavily by the presence of thin cracks in the deposit. The bulk infiltration rates for the reservoir sediment deposits were dominated by preferential flow paths along cracks and were much higher than expected from the high clay content of the sediments and reduction in porosity with desiccation.

Implications of Sediment Testing Results for Reservoir Evolution

The results presented above suggest additional complexities and potentially some deviations from the general reservoir response patterns described by USBR (2011c). Much of the water in the highly saturated sediment will drain rapidly with open-air exposure resulting in initial mass loss significantly greater than that measured in the greenhouse. Desiccation, and concomitant increases in shear strength, are expected to be more rapid in the field because of gravity draining even if temperatures were lower than in the greenhouse, where over a month of drying was required for the shear strength to increase over 50 kPa.

The remaining water content, however, could take weeks to evaporate out of the high clay content sediments, depending on meteorological and topographical conditions. Deeper sediments in thicker deposits will require longer to dry and stabilize if they are insulated from direct sunlight and the atmosphere by overlying sediment. Therefore, even though the surface sediments are dried and hard, the deposits could be deceptively unsupportive of heavy machinery in the weeks after drawdown, and the timing for such stability of the deposits remains poorly constrained. The dried material is firm but brittle, and surface-normal pressure (e.g., during tilling, soil compaction tests) resulted in fracture, rather than plastic deformation, of the sample deposits in the greenhouse. Field deposits will not have the shallow, hard boundary of the sample bin, so fracture behavior may differ somewhat. In situ sediment consolidation and strength was greater (and water content lower) at sediment depths of 6 to 10 ft (USBR, 2011b), so exposed basal sediments may not slump and erode as readily as surface sediments during drawdown.

Secondary erosion of the residual reservoir deposits is affected by the large increases in shear strength with desiccation, the prevalence of cracks, and the continued disintegration in response to wetting and drying cycles. Dried blocks tested in the lab retained high mechanical strength (critical shear stress values in excess of those required to transport cobbles) and may not readily erode (via rainsplash) nor reduce considerably in strength from rainfall alone. The low porosity and low infiltration rates of intact surfaces hindered the re-saturation of the deposits even with long durations of rainfall, such that high shear strength was retained. The prevalence of cracking will encourage gully erosion because the low infiltration rates will intensify surface run off and flow concentration in cracks. Gullies will incise and widen with time. The availability of erosive tools (i.e., sand and gravel) to abrade the fine-grained deposits may be an important factor encouraging gully erosion. Gullies closer to coarse sediment sources (e.g., near the steep hillslopes at Copco and Iron Gate) may have more effective secondary erosion than areas lacking those sediment sources (e.g., Upstream Reach of J.C. Boyle). The disintegration of sediments in response to wetting and drying cycles is effectively a reduction in the grain size of the sediment aggregates. Therefore, while the sediments retain high shear strength, they will be broken down smaller size classes that are more easily transported than the shear strength values suggest. Furthermore, the attrition rates of sediment aggregates are expected to be very high if mobilized, and the material will disintegrate rapidly. Flow routing and accumulation GIS analysis, particularly at Copco, could be used to predict locations where secondary erosion from hillslope runoff and gully erosion may be expected to occur. Such locations will be the first to naturally excavate reservoir sediments and expose historical soils in upland, terrace, and floodplain environments. Inasmuch as native vegetation might prefer the historical soils over reservoir sediments, these areas could be hubs for more targeted revegetation efforts.

The continued disintegration of the dried sediments to easily erodible fine particles and aggregates in response to wetting and drying suggests that the exposed reservoir sediments may be unstable post drawdown despite the initial increases in the shear strength. There is potential for the bare sediments to produce elevated suspended sediment concentrations during fall rain events if not stabilized with vegetation. The disintegration in response to wetting-drying was most dramatic in the IG1 samples, which suggests that high clay content enhances this effect. Therefore, we may expect this behavior to be a larger factor in deposit evolution in Iron Gate Reservoir and in the downstream portions of each reservoir. Vegetation was successful in reducing disintegration for the CP2 sample.

Infiltration results have important implications for surface run-off responses to precipitation, moisture availability for revegetation, deposit evolution by gully erosion, and associated river suspended sediment concentrations. High intensity rainfall (e.g., rainfall rates in the greenhouse, but also likely smaller events) will largely run off the intact sediment surfaces and flow preferentially in cracks and gullies. High surface runoff will reduce the amount of moisture absorbed into the low porosity, hardened surface sediments, and therefore less moisture will be available in the shallow subsurface for plant uptake relative to more mature soils with similar characteristics that lack the crack development. Infiltration will be dominated by preferential flow in cracks, and crack densities should be sufficient for the effective infiltration rate for the sediment body to be high.

Wetting and Drying Test Data and Figures

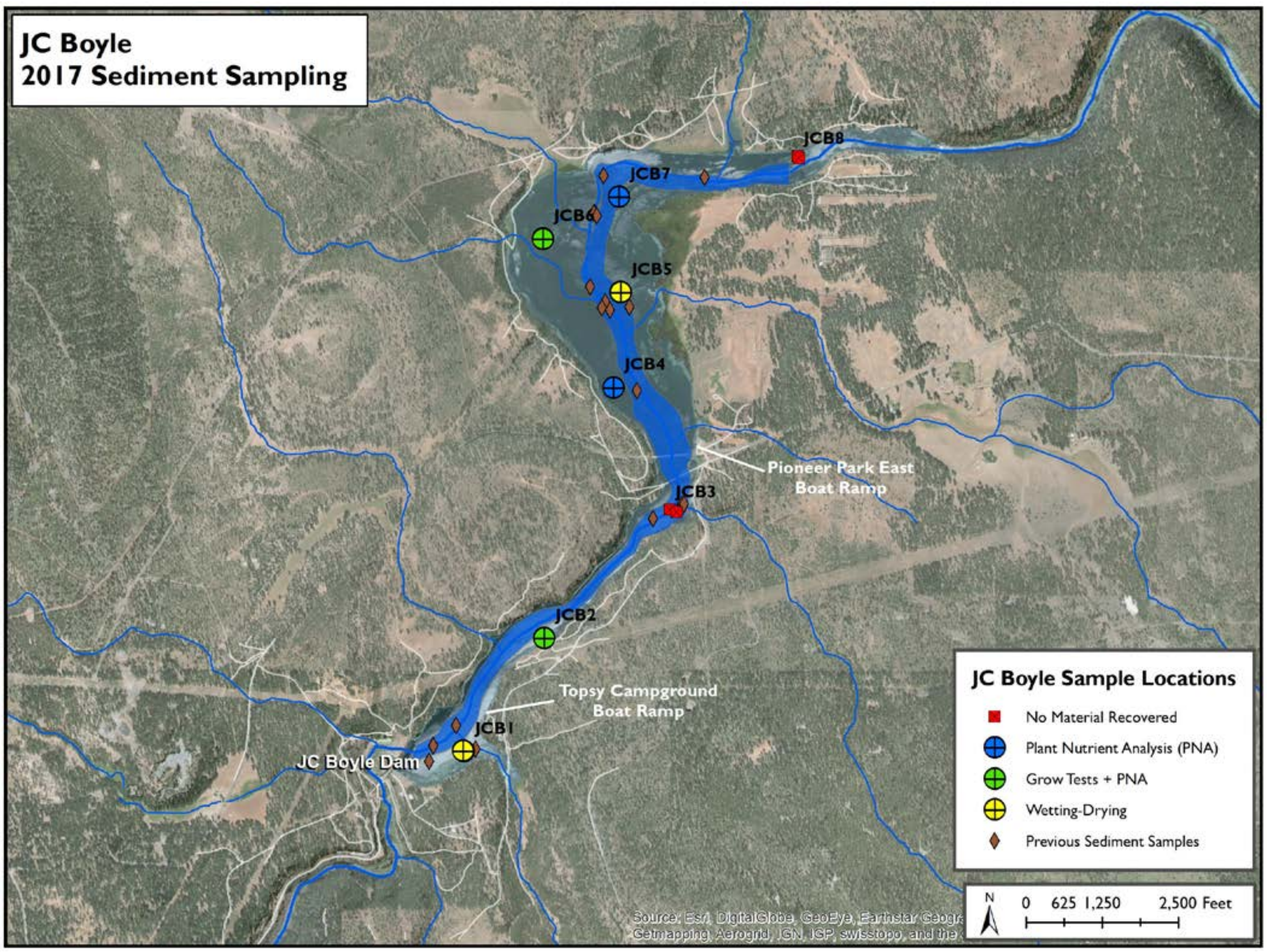


Figure 8-1 Sediment sampling locations at J.C. Boyle for wetting-drying, grow tests, and plant nutrient availability analysis.

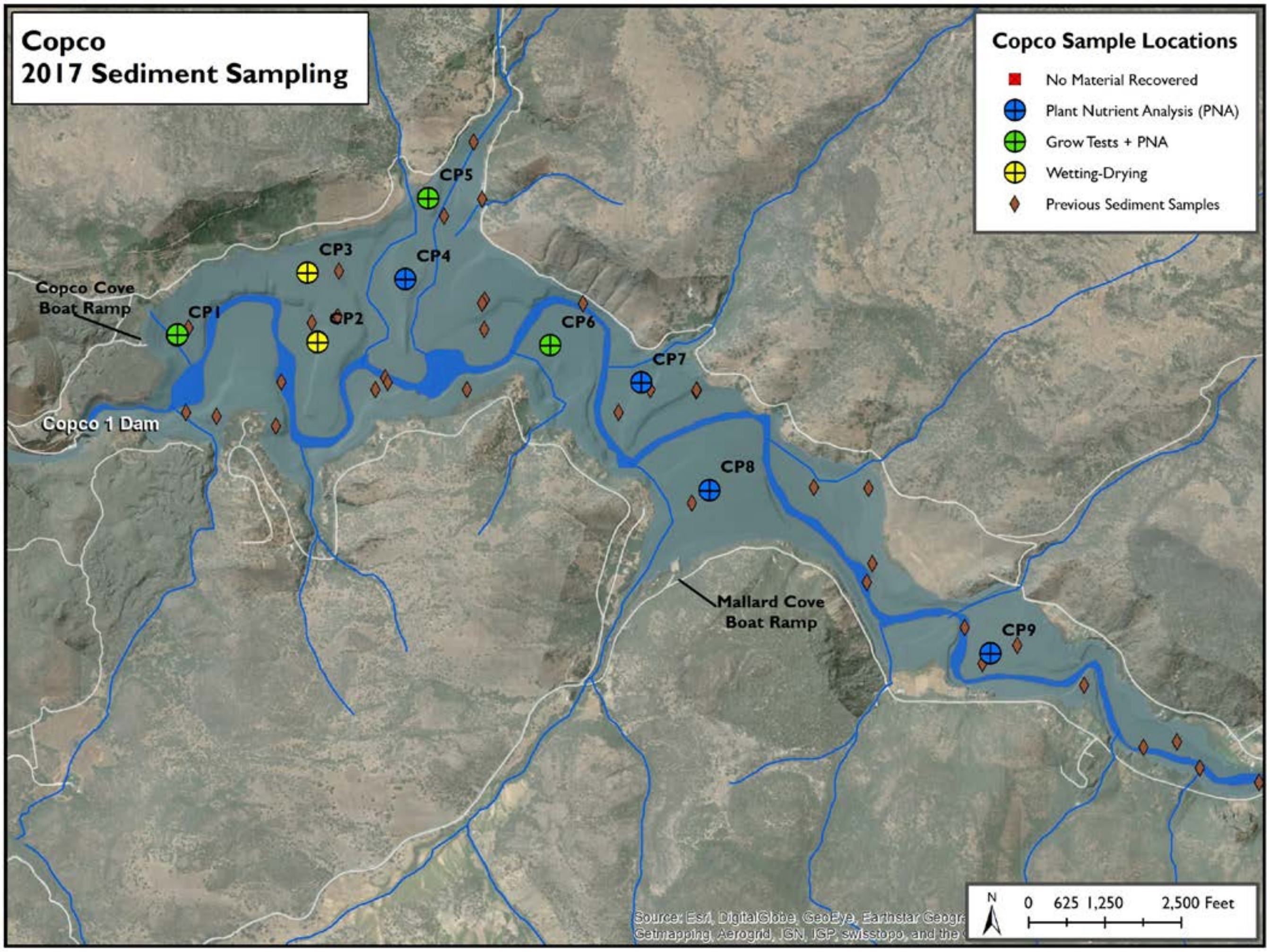


Figure 8-2 Sediment sampling locations at Copco for wetting-drying, grow tests, and plant nutrient availability analysis.

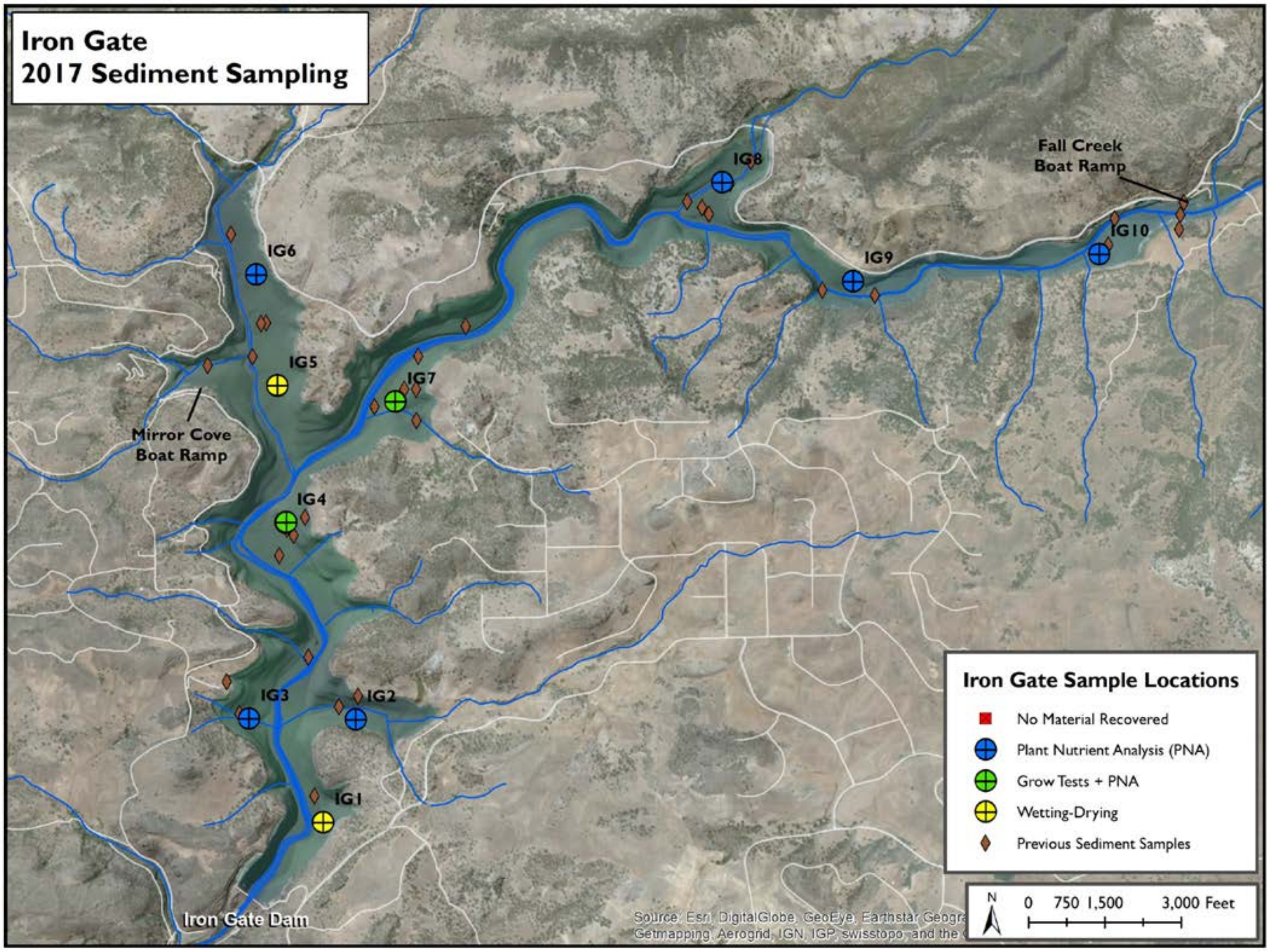
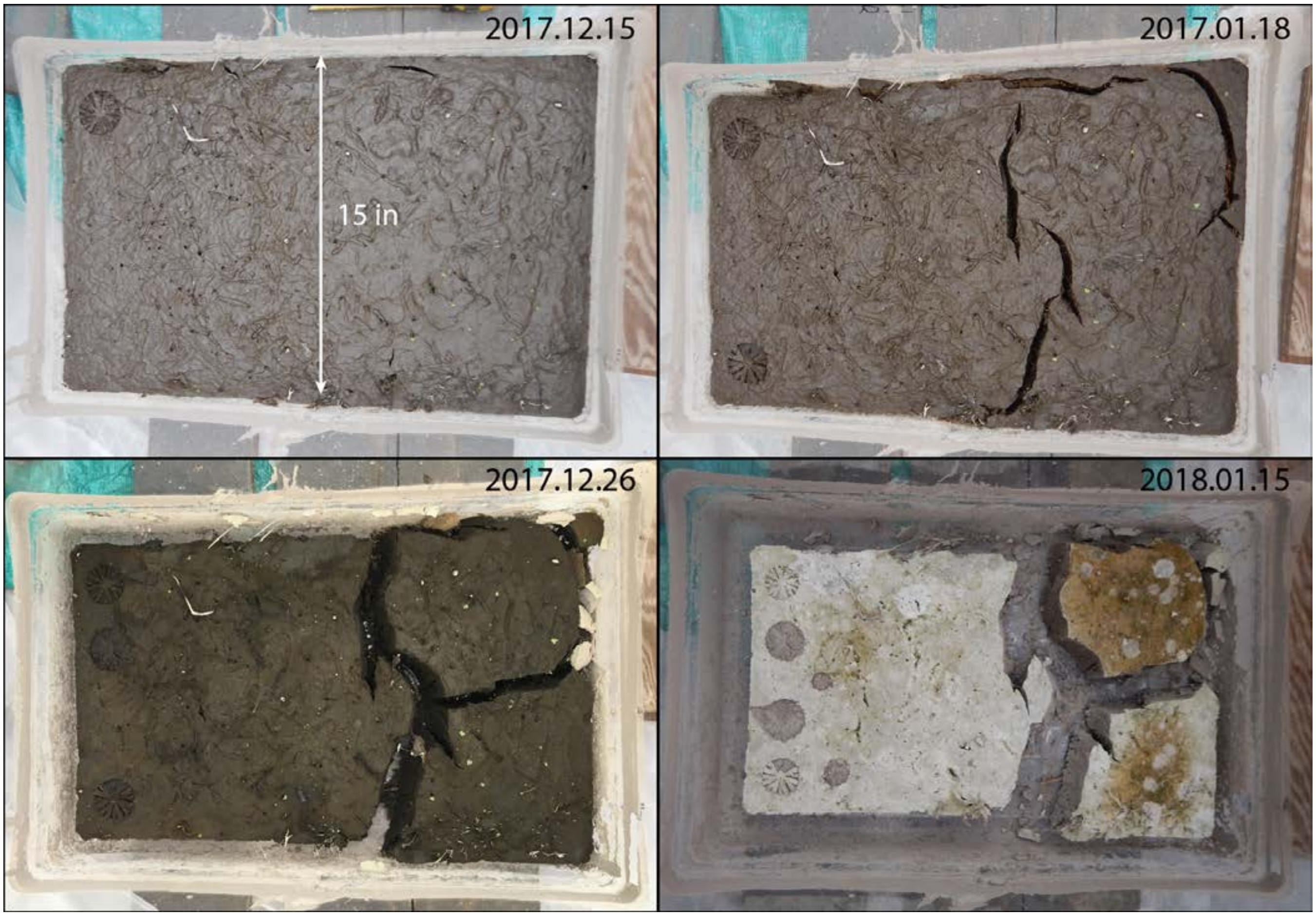
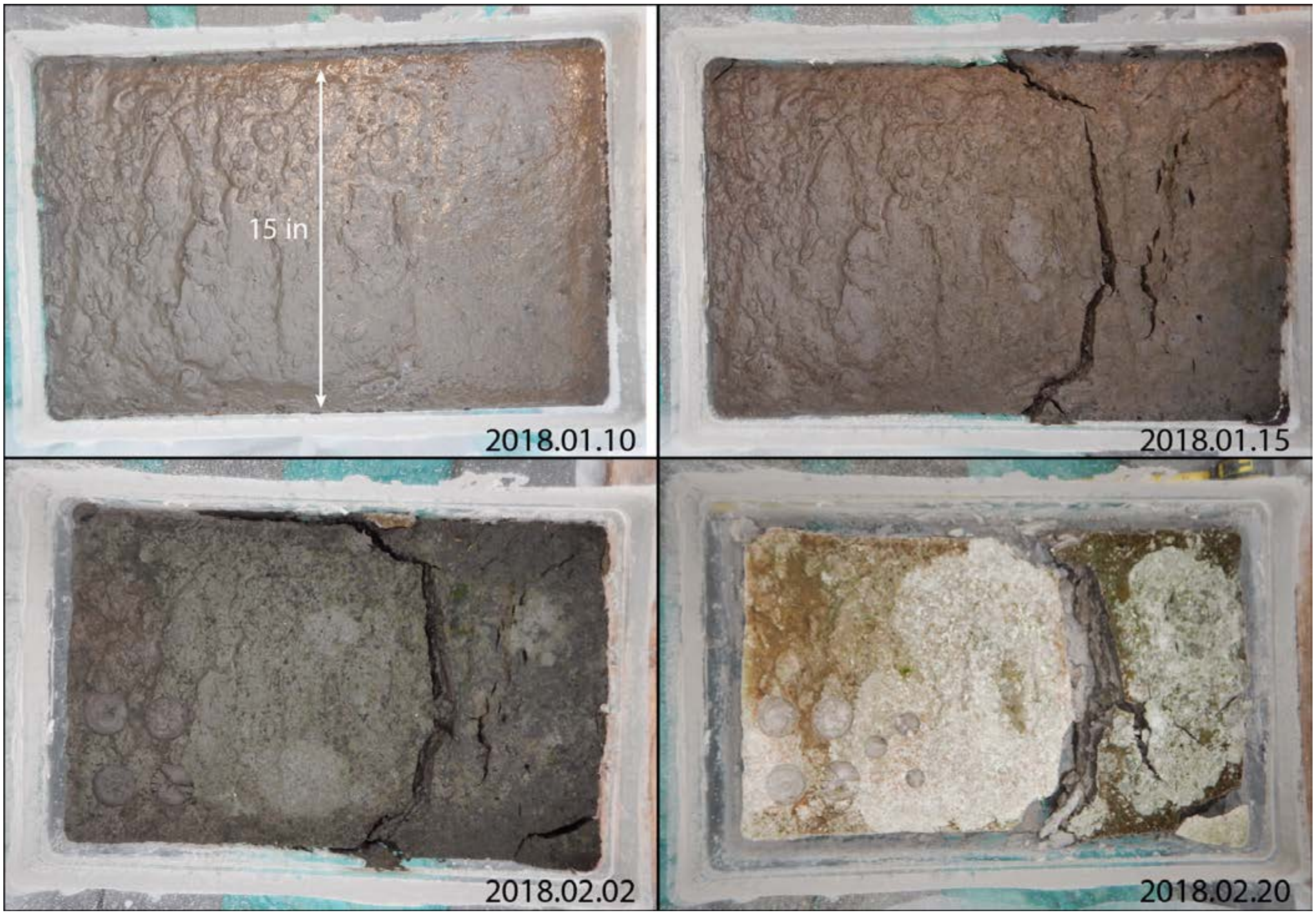


Figure 8-3 Sediment sampling locations at Iron Gate for wetting-drying, grow tests, and plant nutrient availability analysis.



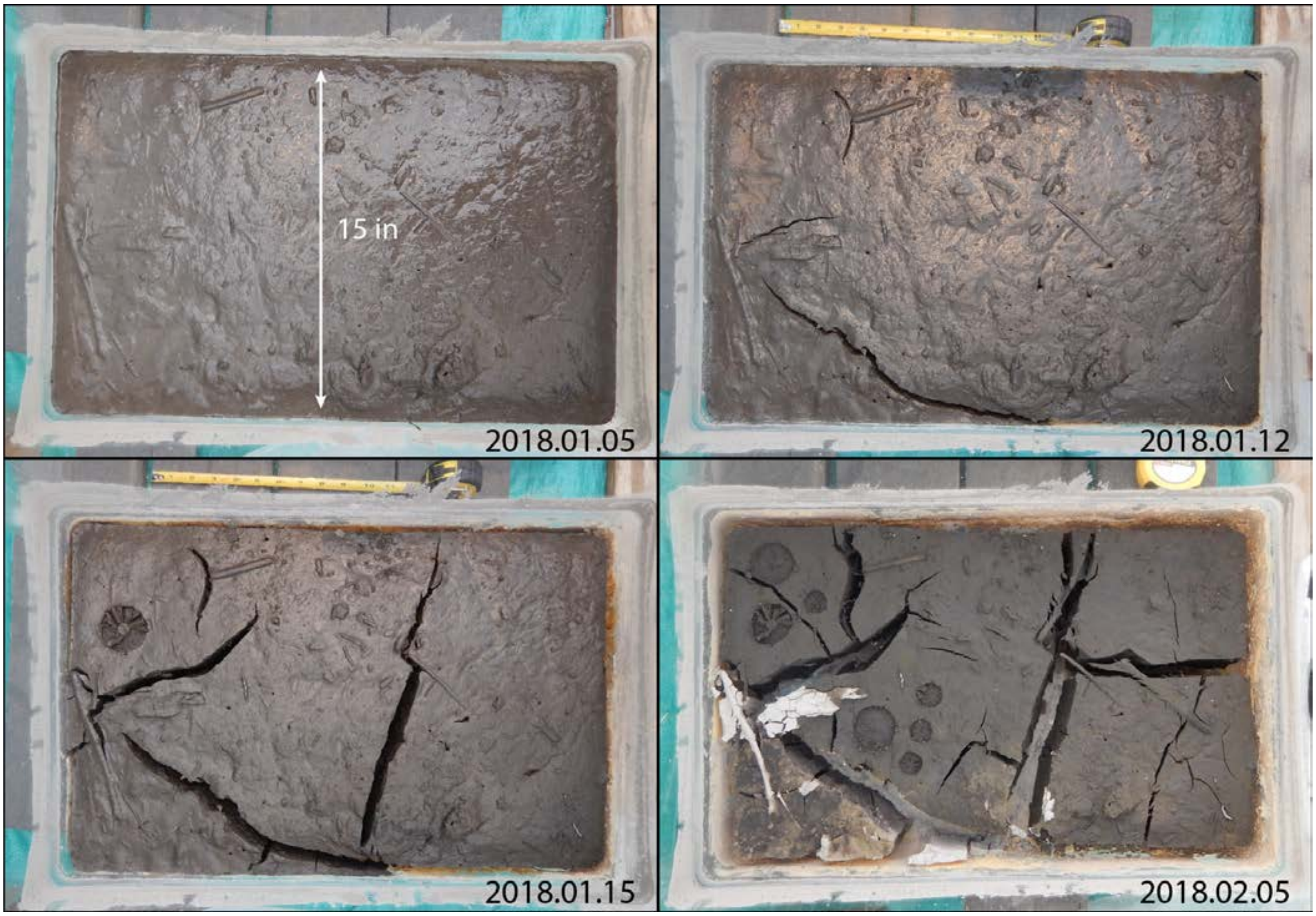
Locations of Torvane measurements are visible on the left side of the deposits.

Figure 8-4 Photos of desiccation and cracking of the J.C. Boyle sediment sample JCB1a.



Locations of Torvane measurements are visible on the left side of the February photos.

Figure 8-5 Photos of desiccation and cracking of the Copco sediment sample CP2a.



Locations of Torvane measurements are visible on the left side of the deposits.

Figure 8-6 Photos of desiccation and cracking of the Iron Gate sediment sample IG1a.

Table 8-2 Summary of physical changes during desiccation for J.C. Boyle samples.

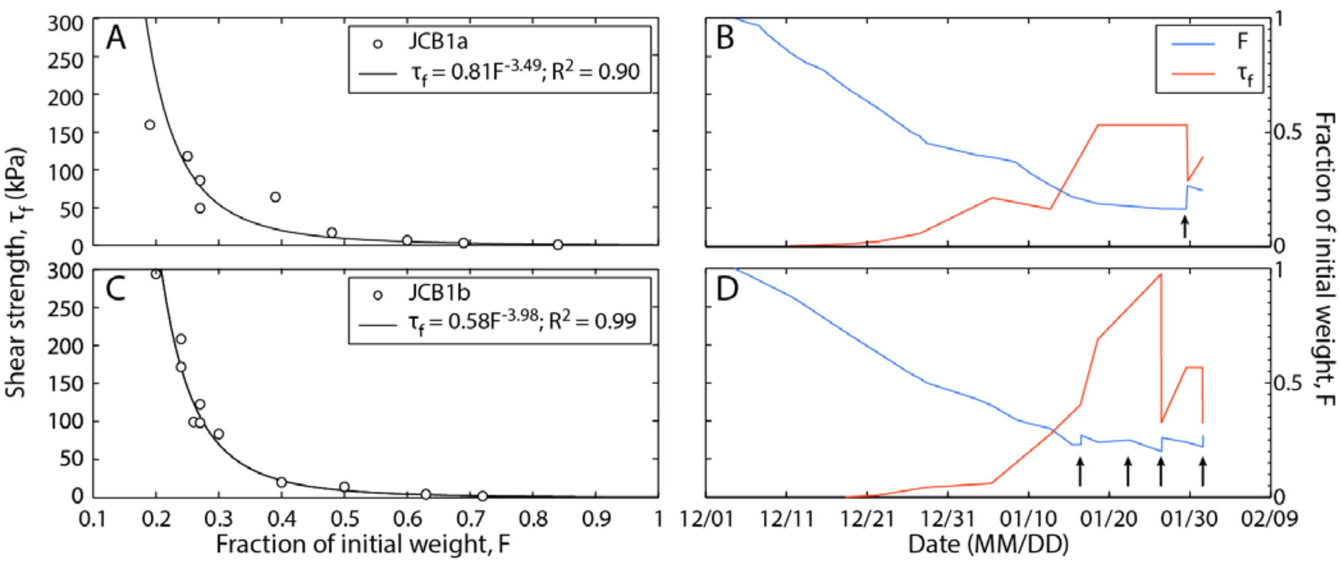
Quantity	JCB1a			JCB1b		
	Moist	Dry	% of Initial	Moist	Dry	% of Initial
Volume (cu. ft)	0.8	0.22	28	0.90	0.22	25
Thickness (in)	3.9	2.0	51	4.0	2.0	50
Weight (lbs)	46	8	17	47	10	21
Max crack width (in)		3			2.25	

Table 8-3 Summary of physical changes during desiccation for Copco samples.

Quantity	CP2a			CP2b		
	Moist	Dry	% of Initial	Moist	Dry	% of Initial
Volume (cu. ft)	0.82	0.32	39	0.82	0.33	40
Thickness (in)	4.1	2.0	49	4.1	2.0	49
Weight (lbs)	51	13	25	51	13	25
Max crack width (in)		2.2			1.3	

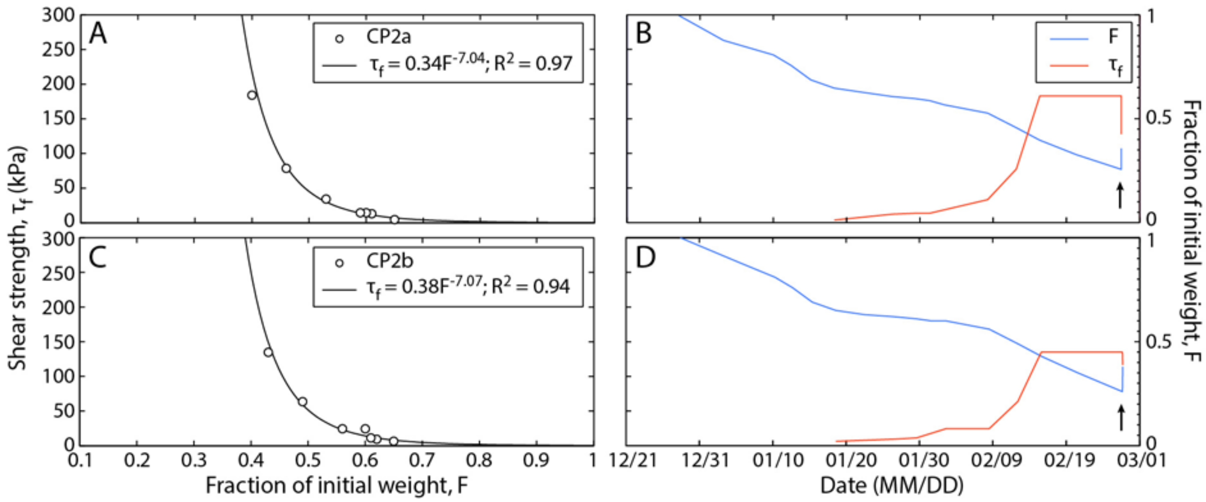
Table 8-4 Summary of physical changes during desiccation for Iron Gate samples.

Quantity	IG1a			IG1b		
	Moist	Dry	% of Initial	Moist	Dry	% of Initial
Volume (cu. ft)	0.95	0.31	33	0.92	0.28	30
Thickness (in)	4.1	2.3	56	3.9	2.0	51
Weight (lbs)	51	15	29	51	13	25
Max crack width (in)		2.0			2.2	



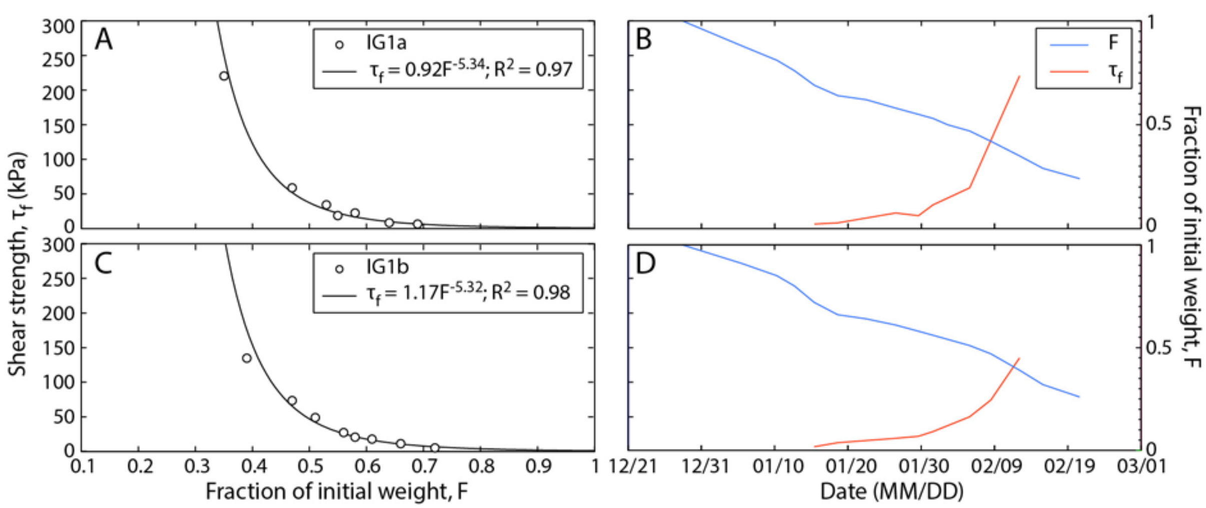
A,C) Shear strength, τf (kPa) vs. fraction of initial weight, F, with power law trendlines. B,D) Changes in τf (red line, left axis) and F (blue line, right axis) vs. time. Vertical arrows mark irrigation events that increased sample weight.

Figure 8-7 Shear strength and drying data for J.C. Boyle samples JCB1a (A,B) and JCB1b (C,D).



A,C) Shear strength, τf (kPa) vs. fraction of initial weight, F, with power law trendlines. B,D) Changes in τf (red line, left axis) and F (blue line, right axis) vs. time. Vertical arrows mark irrigation events that increased sample weight.

Figure 8-8 Shear strength and drying data for Copco samples CP2a (A,B) and CP2b (C,D).



A,C) Shear strength, τf (kPa) vs. fraction of initial weight, F, with power law trendlines. B,D) Changes in τf (red line, left axis) and F (blue line, right axis) vs. time.

Figure 8-9 Shear strength and drying data for Iron Gate samples IG1a (A,B) and IG1b (C,D).

Table 8-5 Results from desiccation of J.C. Boyle sediment samples

Quantity	JCB1a		JCB1b	
	Moist	Dry	Moist	Dry
Shear strength (τ_f, kPa)	0.59	159	1.57	294
Critical shear stress (τ_C, Pa; lbf/ft^2)	0.10 (0.002)	434 (9.06)	0.43 (0.009)	1090 (22.8)
Erodibility (k)	1.04	0.04	0.57	0.02

Shows moist and dry measurements of shear strength (τ_f) in kPa and calculated values of critical shear stress (τ_c) in Pa and lbf/ft^2 and the erodibility coefficient (k) from the Simon et al., (2010) relationships. Moist values are likely maximum values as material was too soft to sample with the Torvane at the outset of the experiments. Dry values are maximum values prior to wetting cycles.

Table 8-6 Results from desiccation of Copco sediment samples

Quantity	CP2a		CP2b	
	Moist	Dry	Moist	Dry
Shear strength (τ_f, kPa)	4.90	184	6.28	184
Critical shear stress (τ_C, Pa; lbf/ft^2)	2.34 (0.049)	538 (11.2)	3.39 (0.071)	538 (11.2)
Erodibility (k)	0.29	0.03	0.25	0.03

Shows moist and dry measurements of shear strength (τ_f) in kPa and calculated values of critical shear stress (τ_c) in Pa and lbf/ft^2 and the erodibility coefficient (k) from the Simon et al., (2010) relationships. Moist values are likely maximum values as material was too soft to sample with the Torvane at the outset of the experiments. Dry values are maximum values prior to wetting cycles.

Table 8-7 Results from desiccation of Iron Gate sediment samples

Quantity	IG1a		IG1b	
	Moist	Dry	Moist	Dry
Shear strength (τ_f, kPa)	6.47	221	5.30	135
Critical shear stress (τ_C, Pa; lbf/ft^2)	3.55 (0.074)	707 (14.8)	2.62 (0.055)	338 (7.05)
Erodibility (k)	0.245	0.029	0.276	0.039

Shows moist and dry measurements of shear strength (τ_f) in kPa and calculated values of critical shear stress (τ_c) in Pa and lbf/ft^2 and the erodibility coefficient (k) from the Simon et al., (2010) relationships. Moist values are likely maximum values as material was too soft to sample with the Torvane at the outset of the experiments. Dry values are maximum values prior to wetting cycles.

Table 8-8 Summary results from desiccation of sediment samples

Sample	$\Delta\tau_f$ (kPa)	$\Delta\tau_c$ (Pa)	Max(k)/min(k)
JCB1a	159	434	29.2
JCB1b	294	1089	23.4
CP2a	184	536	9.7
CP2b	135	334	6.3
IG1a	221	704	8.4

Sample	$\Delta\tau_f$ (kPa)	$\Delta\tau_c$ (Pa)	Max(k)/min(k)
IG1b	135	335	7.0

Shows maximum increases in shear strength ($\Delta\tau_f$, kPa) and in critical shear stress ($\Delta\tau_c$, Pa), and proportional decrease in the erodibility coefficient (max(k)/min(k)) from beginning to end of the experiments.

Table 8-9 Cohesive sediment parameter values for 2D morphodynamic modeling of Copco Reservoir drawdown and evolution under three scenarios

Scenario	Critical shear stress (τ_C, Pa)	Erodibility coefficient (k, cm^3/N-s)
Easy-erode	0.2	20.0
Medium-erode	0.25	2.0
Hard-erode	2.0	0.5

Source: USBR (2011b) using data from Simon et al. (2010).

8.1.2 Reservoir Revegetation and Grow Tests

A primary component of this RAMP is revegetation of the former reservoir areas. Successful revegetation is essential for stabilizing reservoir deposits, establishing critical habitat, and restoring natural ecosystem functions. General long-term revegetation patterns will be influenced by local topographic conditions (e.g., aspect, elevation), subsurface hydrology, and sediment texture. West and south facing slopes receive more solar radiation, have higher evapotranspiration, and will be hotter and drier than north and east facing slopes. South and west facing slopes are more appropriate for juniper woodland or three-leaf sumac scrub habitats while north and east facing slopes will better support ponderosa pine and Douglas fir woodlands. Similarly, areas at the bottom of the valley slopes will be cooler and more mesic than areas higher up or on steeper slopes. Species such as big-leaf maple, California black oak and Oregon ash will be more successful in more mesic and moisture preserving environments while juniper woodland will be more appropriate on steeper, xeric slopes. Areas with lower solar radiation will support species that prefer wetter, cooler environments (e.g., riparian and mesic communities) while areas of higher solar radiation will be more appropriate for species that are more tolerant of hot, dry xeric conditions with high evapotranspiration rates.

On fine substrates, native annual grasses and forbs with shallow root systems tend to be the first pioneers in primary succession (Grubb, 1986). Coarse soils are favored by native perennial grasses (bunch grasses) that grow deep root systems that allow them to persist for years. Large trees and shrubs tend to pioneer newly-formed, coarse-textured substrates (Grubb, 1986). On fine sediments, native annual grasses may provide short-term resistance to invasion by exotic annual grasses, but long-term resistance requires the establishment of woody species. On coarse sediments, trees and shrubs will establish readily. However, riparian deciduous species, such as red alder, willows and cottonwood, will not perform well on deep layers of coarse sediments perched above the water table. These riparian trees are true phraetophytes and require permanent constant contact with the ground water table. Many riparian trees can grow their roots at a rate that maintains pace with normal recession of the ground water table in riparian areas after the peak of the spring snowmelt.

Large areal extents of reservoir sediments are likely to persist after drawdown, and the success of revegetation efforts will be largely determined by the ability to grow plants in the reservoir sediments. Reservoir sediments differ from native soils, so testing has been undertaken to evaluate revegetation options.

Results of Previous Testing

A seedbank study of reservoir sediments was conducted in 2010 (USBR, 2011c) to evaluate the natural availability of viable seed material in the reservoir deposits. Samples from each reservoir were placed in greenhouse with 12 hours of supplemental daylight, temperatures between 70 and 95 deg. F, and irrigated with 0.1 inches daily from a sprinkler system (USBR, 2011c). The seedbank germination study found that most of the extant seeds that successfully germinated were native wetland-type species, and the highest germination densities were from sediment proximal to existing wetlands along reservoir perimeters (USBR, 2011c). Wetland seeds are better adapted to the anoxic conditions in the reservoir substrate than species from other ecogeomorphic areas or “planting zones” (i.e., upland, riparian bank, riparian floodplain). Some existing perimeter wetlands are expected to vanish with the changing hydrologic conditions (e.g., lowering water table) post-drawdown. These results suggest that some natural wetland succession is possible post-drawdown at springs and tributaries historically or currently associated with wetlands, but upland and riparian vegetation will need to be actively revegetated.

Grow Test Experimental Methodology

Revegetation “grow tests” and plant nutrient availability (PNA) lab analyses were undertaken in Winter 2018 to evaluate reservoir sediments as a growth medium and to identify the ideal seed mix for a cover crop and for each planting zone in each unique reservoir setting. Surface grab samples (2 ft^3 per location) of reservoir sediments were collected in the same field effort as the sediments for the wetting drying experiments. In a greenhouse environment, fully saturated reservoir sediment was distributed into four (one for each planting zone) freely draining 10 inch by 10 inch sample containers to a depth of approximately 6 to 7 inches (Figure 8-11Figure 8-10). Seeds were placed on the surface of the moist sediments in a 6 x 6 grid (36 seed locations per container, multiple seeds per location depending on seed species) and supplemented with mycorrhizal inoculant. The species lists for each planting zone is presented in Table 8-6. For the first two weeks, the sediment surface was moisturized daily with a spray bottle, and greenhouse conditions were maintained at approximately 55 deg. F and 55% relative humidity. After two weeks, a greater (0.1 to 0.25 inch) but less frequent (twice per week) irrigation amount was applied to the plants with a sprinkler system, and a greater temperate range mimicking natural diurnal cycles (55 to 70 deg. F) was imposed. After several weeks, temperatures were increased to over 100 deg. F with the same irrigation schedule. Control over environmental conditions was limited in the greenhouse, and the ability to simulate, for example, realistic freezing temperatures and low intensity rainfall was not possible.

Each bin corresponds to a planting zone (clockwise from top left): riparian bank, riparian floodplain, cover, upland. The experimental set up was identical for each of the three grow test reservoir samples.

Figure 8-10 Grow test sample layout for J.C. Boyle sample JCB6 immediately after seed placement (left) and after six weeks (right).

Grow tests were also performed on the fully desiccated sediment from the concluded wetting and drying experiments to evaluate the effectiveness of secondary revegetation in the fall. Attempts were made to till one of the sediment samples by hand using a 1/8 inch screw. The high strength and brittleness made tilling the deposit without fracturing the deposit all the way through a challenge. Instead, the footprints of the Torvane tests (n >= 7 per sample) were considered representative of “tilled” sediment. Samples were irrigated for 5 minutes, and 0.2 to 0.4 ounces of each seed mixture were distributed loosely across each sediment surface. Imbedding seeds was not an experimental option given the high strength of the dried sediment. JCB1a, JCB1b, and IG1a were seeded with the Upland seed mixture, IG1b and CP2a were seeded with the Riparian Floodplain seed mixture, and CP2b was seeded with the Riparian Bank seed mixture. Samples were irrigated daily with approximately 0.4 to 0.5 inches of rainfall with an average intensity of 1.3 to 1.5 inches per hour. This rainfall represents an approximately 10-year event based on climate data from the Copco #1 Dam weather station (Western Regional Climate Center). After 2 weeks, irrigation was applied for 20 to 30 minutes twice per week at a rate of 2.5 inches per hour. After 8 weeks, temperatures in the greenhouse were increased, with daily maximums over 100 degrees, to mimic summer conditions. The irrigation regime was kept constant.

The suitability of the reservoir sediments as a growth medium was also assessed with a plant nutrient availability (PNA) analysis. Physical and chemical characteristics of the reservoir sediment samples were tested by a soils lab to identify any chemical deficiencies or excesses that could inhibit plant growth. Four to six cups of material were extracted from several locations in each surface grab sample and composited into a single sample for the analysis. A first round of samples (JCB4, JCB7, CP4, CP7, CP8, CP9, IG2, IG3, IG6, IG8, IG9) were composited and packaged in Ziploc bags on the research vessel and sent to the lab in December. A second round (JCB2, JCB6, CP1, CP5, CP6, IG4, IG7) was packaged and analyzed in January from sediments that had been stored for several weeks in the sealed polycarbonate sample bins in a storage unit.

Results of Grow Tests

Results from the grow tests demonstrate the ability of the reservoir sediments to support plant growth for species from each planting zone. Successful germination and plant growth occurred in 76%, 71%, 80%, and 81% of the seed locations for riparian bank, riparian floodplain, upland, and cover seed mixtures, respectively. Results (e.g., Table 8-10) allowed for identification of species that were unsuccessful in growing in the reservoir sediments. In general, clustered field sedge, creeping wildrye, chick lupine, western needlegrass, and silverleaf scorpionweed has low growth success.

Most of the seeds germinated in a period of one to two weeks. After four weeks, species growth was healthy, and species mortality was undetectable. The volume of each deposit decreased with time even with the irrigation. Initial deposit surface dimensions were approximately 10 by 10 inches with a thickness of 6 inches. After six weeks, the samples had pulled back from the sides of the container resulting in 7- by 7-inch surface dimensions, and the thickness decreased to 3 inches. Plant growth was initially unaffected by the change in deposit volume. Cracks did not development in the interior of the deposit surfaces and was at most minor along the deposit edges. Presumably the material strength increased considerably with decreases in deposit volume given the patterns observed during wetting-drying experiments. Despite changes in volume and material strength, root development was extensive and visible in the sides of the deposits, in some cases extending through the full deposit thickness. There were no systematic differences in plant growth for the different planting zones or the reservoirs. After eight weeks of plant growth, some of the sample sediments dried out, and the densely packed plants began to die. The porosity and available pore water were expected to steadily drop with desiccation, and the water demand of the growing plants was expected to increase. The irrigation rate was not increased to accommodate the decreasing soil water supply and increased demand. The initial seed density at the start of the experiments was higher than expected in the field, and that density increased as the deposit contracted. Complete mortality occurred in several weeks after temperatures were increased to over 100 deg. F without an increase in irrigation frequency or intensity. A subsequent reduction in temperature to 80 deg. F and reseeding was unsuccessful on these samples.

On the seeded wetting-drying samples, germination and growth were most successful on the fresh sediment surfaces found in narrow cracks and in the footprints of the Torvane tests (Figure 8-11). Germination was less successful for seeds on the majority of the undisturbed sediment surfaces, which had a film of fungus, not introduced experimentally, that caused the discolorations visible in the photos of the dried samples (Figure 8-4 and Figure 8-5). Some germination did occur on the undisturbed surfaces, but it took an extra week or two relative to the disturbed and fresh sediment surfaces. Plant growth was healthy on all samples until the daily maximum temperatures were allowed to increase to over 100 degrees, at which point there was some plant mortality, particularly in the IG1 samples, which had the highest clay content and appeared to desiccate more rapidly between irrigation events.

Plant growth is visible in cracks and the round Torvane scars.

Figure 8-11 Grow test on wetting-drying sample JCB1b taken two weeks after seeding with the upland seed mixture.

The PNA test results were similar amongst samples from the three reservoirs. In general, the samples are moderately acidic, fine-textured, low in calcium, and high in magnesium and organic matter. The average pH of the samples ranged from 6.2 to 6.5, which is slightly more acidic than the optimum range of 6.5 to 7.5. The sediments have been submerged in an anaerobic environment, so they contain high levels of iron, manganese, and vanadium due to microbial respiration (Wallace, 2017).

However, there were some systematic variations in metal concentrations between samples from the first (December 2017) and second (January 2018) rounds of lab analyses. The 2018 sample concentrations were greater than 2017 concentrations by a factor of 2 to 10 depending on the metal. Plant extractable concentrations of most of the analyzed elements (e.g., phosphorus, potassium, iron, manganese, zinc, copper, magnesium, sodium, sulfur, arsenic, barium, cobalt, lead, nickel, and vanadium) depend strongly on the degree of aeration of the sediment, whereby higher concentrations are associated with lower degrees of aeration. This suggests that the 2017, which were stored in Ziploc bags for a period of 2 weeks were more aerated than the samples stored in the storage unit for a period of 5 weeks. This is perhaps because standing water was present in the storage unit samples, so the degree of aeration was lower than those sediments mixed and bagged on the research vessel.

Implications of Grow Test Results for Reservoir Revegetation

The grow test results suggest that the reservoir sediments are a suitable medium for plant growth and that soil supplements, while potentially helpful, are not needed. The majority of the species in each planting zone mixture were successfully able to germinate and grow. The development of root systems will increase infiltration rates in uncracked sediment, stabilize disintegrated sediments, and accelerate soil development.

Planting and growing conditions in the greenhouse were an idealized representation of some of the factors affecting plant growth in the field. Minimum temperatures in the greenhouse were near 50 deg. F and cannot mimic the cold and below-freezing temperatures possible at the reservoirs during the drawdown when many of the seeds will be planted. Colder conditions in the field, particularly at J.C. Boyle, are harsh on young plants, and germination rates will potentially be lower. Summers around the reservoirs are hot and dry. At the Copco #1 Dam weather station, average maximum monthly temperatures exceed 89 deg. F and average total monthly precipitation less than 0.6 inches for July, August, and September (Figure 3-10). In similar simulated conditions in the greenhouse, plant growth in the wetting-drying samples, which received greater irrigation, was successful, whereas the grow test samples, which received less irrigation were not. Furthermore, the drastic changes in the sediment when desiccated (e.g., increase in sediment shear strength, reduction in porosity, reduction in concentrations of certain essential plant extractable elements) will be concurrent with high temperatures and dry conditions. The twice-per-week lower intensity irrigation failed to resaturate the grow test samples once they had been fully desiccated desiccated, and reseeded plant growth was unsuccessful, even with temperatures reduced to 80 deg. F. These environmental conditions and their effect on the reservoir sediments will severely limit the survival of plants established in the reservoir sediments in the spring after drawdown.

Revegetation will resume with cooler conditions and return of rainfall in the fall. The decrease in sediment strength observed after wetting should help with seed germination but to what degree is unknown. Root development during the spring may improve infiltration rates in the unfractured sediments, relative to the wetting-drying experimental samples, and help initiate soil development and increase soil moisture in the shallow subsurface. Plant growth was possible in the wetting-drying grow tests, but rainfall amounts were similar to 10-year events for that time duration and were applied daily. As such, they represent considerably more water than expected from natural precipitation. However, most the rainfall was lost as run-off, so infiltration is perhaps more similar to lower intensity, longer duration events that may occur in fall. Where feasible, irrigation will be a beneficial supplement to natural precipitation.

The wetting-drying grow test results suggest that fresh and disrupted (e.g., tilled) surfaces are more favorable for plant germination and growth. The initial sediment surface morphology of both types of grow tests was more uniform than expected in the reservoirs, where sediments will have experienced some degree of slumping and erosion. Microtopography may be more prone to desiccation between rainfall events than smooth surfaces, but the grow tests results suggest that microtopography on the reservoir sediment surfaces may create small depressions and surface roughness that can catch seeds and increase the soil surface area to which the seeds are exposed. Germination may be more successful as a result. Crack density and microtopography as a result of slumping should be sufficient in the post-reservoir surface to not require tilling of the sediment surface.

Subsurface conditions and hydrology will be more favorable for plant growth in the field than in the experimental set up. The thickness of the experimental sediment deposits varied from 2 to 3 inches in the dried wetting-drying samples and 3 to 7 inches in the dry and moist grow test samples, respectively. Roots for the planted species are capable of penetrating deeper than the sample thicknesses to access moisture that is not present in near-surface sediments during dry periods. The degree to which this effect will compensate for certain more idealized environmental conditions in the greenhouse is unknown.

The PNA analysis did not reveal any major chemical deficiencies or excesses that would inhibit germination and plant growth in the reservoir sediments. The high iron, manganese, and vanadium concentrations are more suitable for aquatic, rather than upland, species growth. Plant-available arsenic concentrations at J.C. Boyle are comparable to the arsenic limits for herbaceous and woody plants but should not impact grassy species and other arsenic-tolerant plants. Plant extractable chemical concentrations, as opposed to total concentrations, of these metals are expected to decrease following drawdown with exposure to the atmosphere. The desiccated reservoir sediments will have lower concentrations of these potentially problematic elements than the fresh reservoir sediments, but germination will be more difficult in the dried sediments, which will be considerably firmer and have less available pore water. Therefore, seeding moist, rather than dried, sediment should have greater success, with the caveat that growth will be sensitive to colder air temperatures. The grow test results support this approach and suggest that the high metal concentrations do not have a noticeable impact on plant growth.

Grow Test Data and Figures

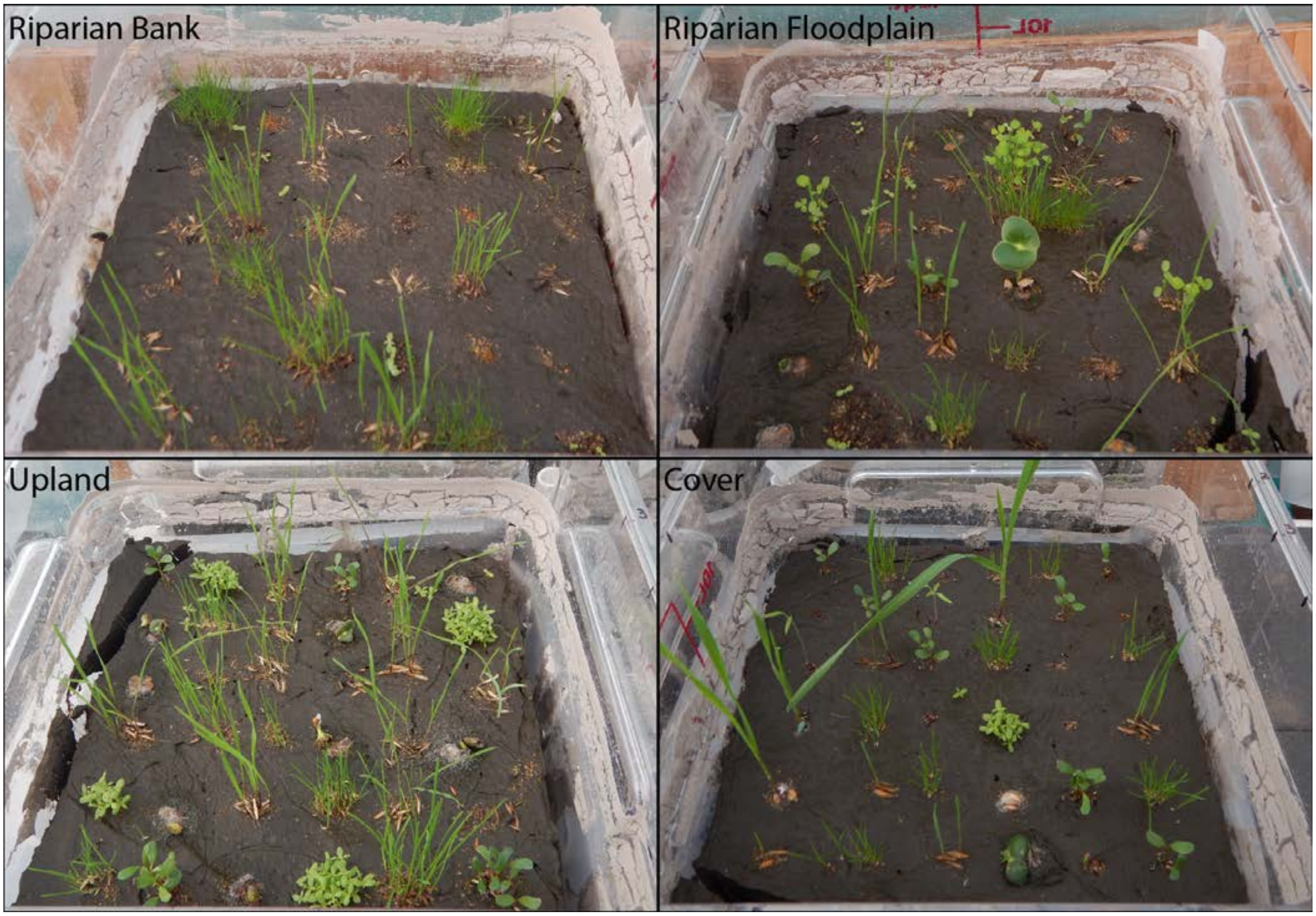
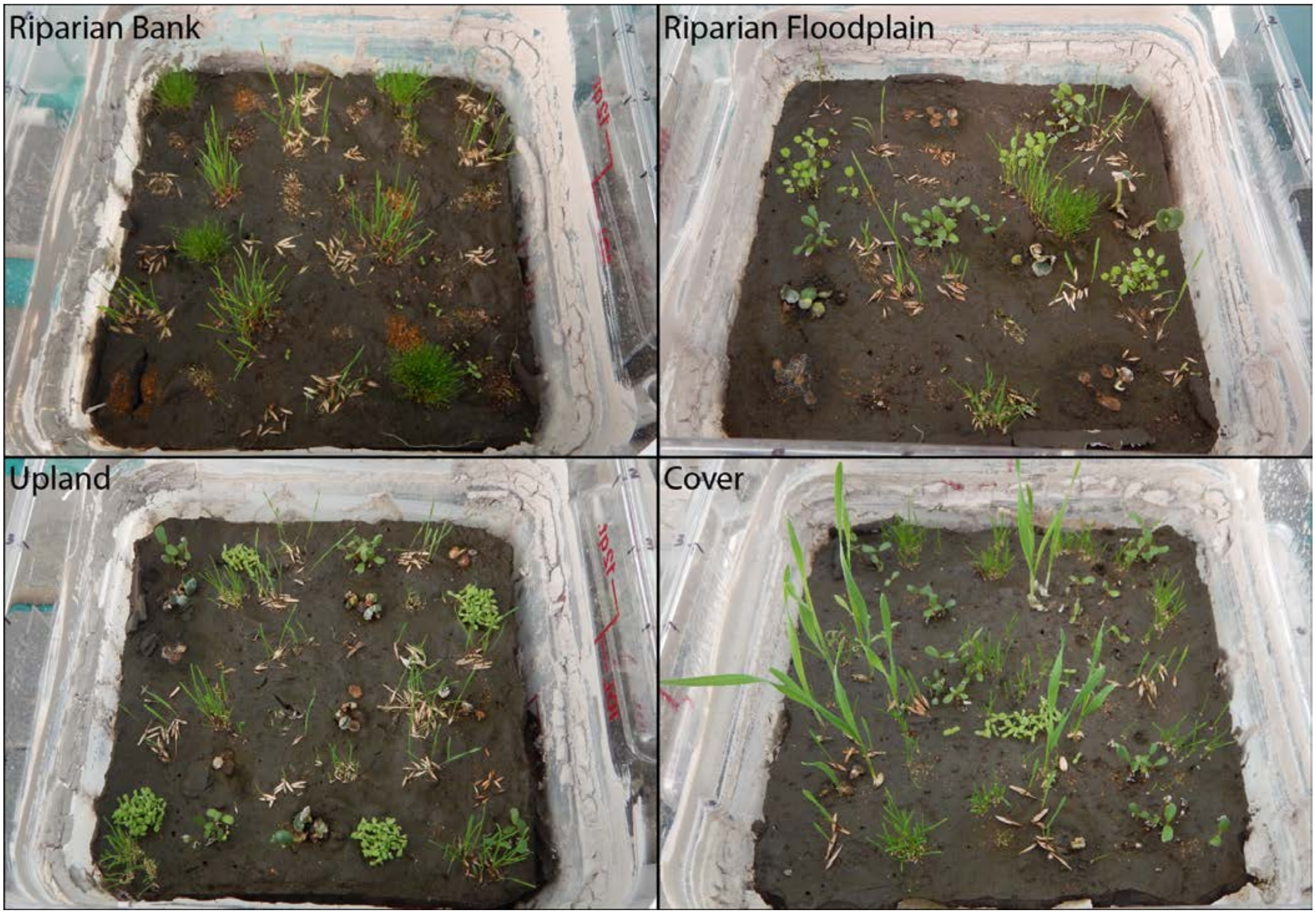
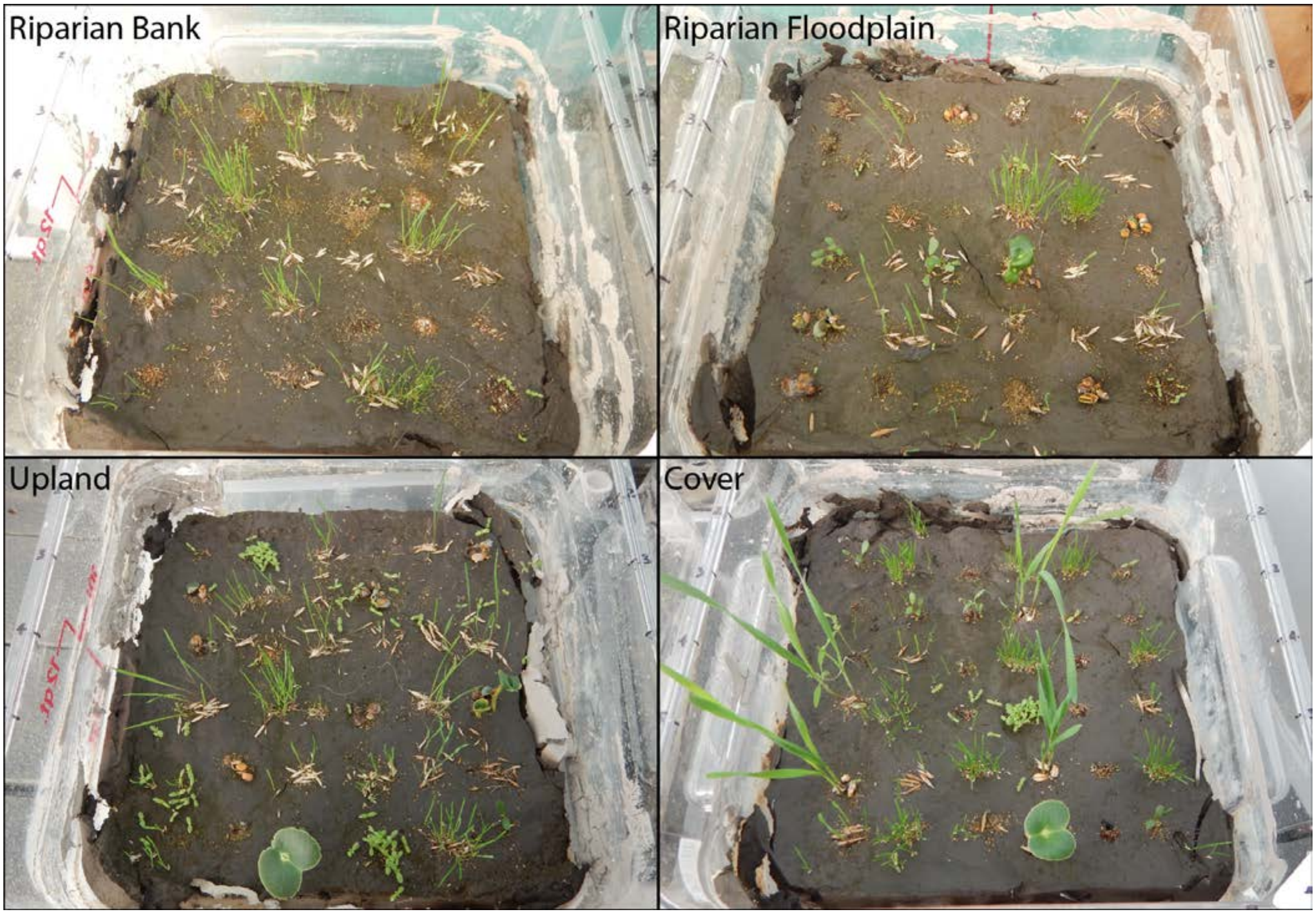


Figure 8-12 Photos of grow tests for J.C. Boyle sediment sample JCB6 taken three weeks after seed placement.



Species in the seed mixtures correspond to post-removal vegetation zones (riparian bank, riparian floodplain, and upland) and a cover crop mixture. Inside length of sample containers is approximately 10 inches.

Figure 8-13 Photos of grow tests for Copco sediment sample CP6 taken three weeks after seed placement.



Species in the seed mixtures correspond to post-removal vegetation zones (riparian bank, riparian floodplain, and upland) and a cover crop mixture. Inside length of sample containers is approximately 10 inches.

Figure 8-14 Photos of grow tests for Iron Gate sediment sample IG4 taken three weeks after seed placement.

Table 8-10 Species list and grow test results for each planting zone.

Species	Seed locations per sample	Plant count - J.C. Boyle JCB6	Plant count - Copco CP6	Plant count - Iron Gate IG4	Average number of plants per location
Riparian Bank					
Agrostis exarata	4	130	150	80	30
Carex praegracilis	4	0	0	21	2
Deschampsia danthonioides	4	7	24	23	5
Elymus [Leymus] triticoides	4	2	0	3	0

Species	Seed locations per sample	Plant count - J.C. Boyle JCB6	Plant count - Copco CP6	Plant count - Iron Gate IG4	Average number of plants per location
Hordeum brachyantherum ssp. *brachyantherum*	4	16	38	23	6
Juncus bufonius	4	30	15	26	6
Artemisia douglasiana	4	17	18	24	5
Festuca [Vulpia] microstachys	3	28	35	32	11
Deschampsia caespitosa	4	29	37	15	7
Elymus glaucus	1	3	3	2	3
Riparian Floodplain					
Leymus triticoides	4	7	3	0	1
Artemisia douglasiana	4	25	12	32	6
Trifolium willdenovii	3	17	30	3	6
Acmispon americanus [Lotus purshianus]	3	14	21	10	5
Lupinus microcarpus var. *densiflorus*	3	1	2	6	1
Lupinus microcarpus var. *microcarpus*	3	0	0	2	0
Stipa [Achnatherum] occidentalis var. *occidentalis*	4	6	0	0	1
Elymus [Pseudoroegneria] spicatus	1	5	3	5	4
Elymus glaucus	2	8	10	8	4
Hordeum brachyantherum sspp. *Brach*	1	5	6	6	6
Bromus carinatus	1	3	5	3	4
Poa secunda	1	15	15	6	12
Festuca [Vulpia] microstachys	1	20	15	15	17
Koeleria macrantha	1	10	8	5	8
Leymus cinereus	1	3	3	6	4
Agrostis exarata	1	20	35	40	32
Elymus elymoides	1	4	5	3	4
Hordeum brachyantherum ssp. *californicum*	1	5	3	6	5
Upland					
Acmispon americanus [Lotus purshianus]	4	23	22	4	4
Lupinus microcarpus var. *densiflorus*	4	2	3	6	1
Lupinus microcarpus var. *microcarpus*	4	1	0	7	1
Elymus [Pseudoroegneria] spicatus	4	21	25	25	6
Achillea millefolium var. *lanulosa*	4	50	85	60	16
Poa secunda	3	45	60	29	15
Stipa [Achnatherum] occidentalis var. *occidentalis*	3	0	1	2	0
Festuca [Vulpia] microstachys	2	18	30	20	11

Species	Seed locations per sample	Plant count - J.C. Boyle JCB6	Plant count - Copco CP6	Plant count - Iron Gate IG4	Average number of plants per location
Elymus elymoides	2	12	11	11	6
Hordeum brachyantherum ssp. *californicum*	2	10	18	9	6
Koeleria macrantha	2	16	11	4	5
Elymus glaucus	1	5	3	5	4
Bromus carinatus	1	4	3	0	2
Cover					
Acmispon americanus	7	21	41	11	3
Phacelia hastata	5	0	1	5	0
Phacelia tanacetifolia	4	3	6	7	1
Triticale sterile	2	2	7	4	2
Elymus x Triticum	2	1	5	5	2
Bromus carinatus	5	10	16	21	3
Deschampsia elongata	8	75	145	140	15
Achillea millefolium	1	10	20	25	18
Lupinus microcarpus var. *densiflorus*	1	1	0	1	1

Notes: Data were collected three weeks after seed placement. The seed locations per sample are out of a potential 36 locations available in each sample bin.

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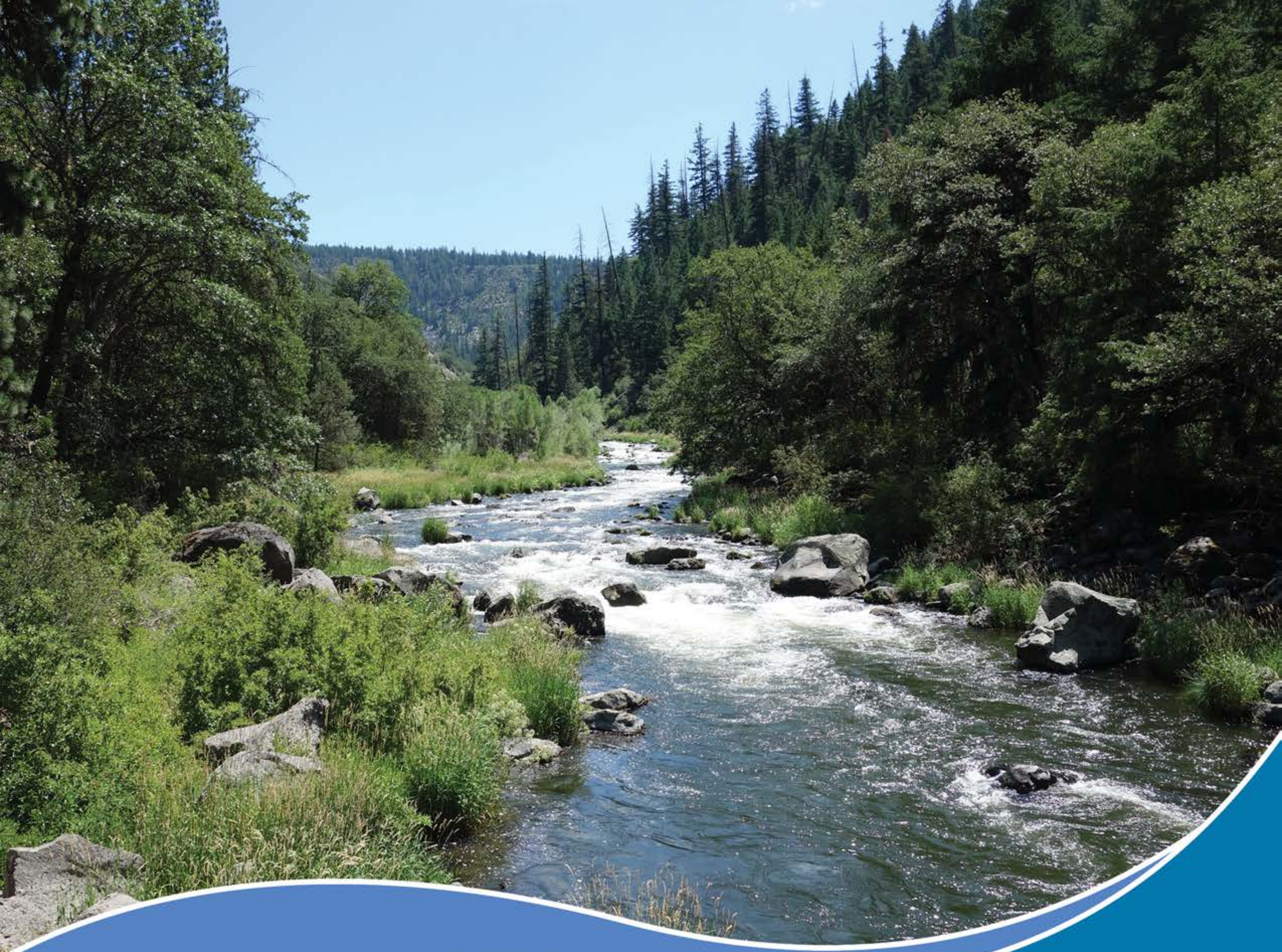

Definite Plan for the Lower Klamath Project

Appendix I - Aquatic Resources Measures

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Acronyms

AR	aquatic resource
ATWG	Aquatic Technical Work Group
CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
DPS	distinct population segment
EIS/R	Environmental Impact Statement/ Environmental Impact Report
ESU	evolutionary significant unit
km	kilometers
KRRC	Klamath River Renewal Corporation
mi	miles
NMFS	National Oceanic and Atmospheric Administration
ODFW	Oregon Department of Fish and Wildlife
PIT	passive integrated transponder
Rkm	river kilometer
RM	river mile
SONCC	Southern Oregon/Northern California Coastal
USBR	U.S. Bureau of Reclamation
USFWS	U.S. Fish and Wildlife Service ,
USGS	U.S. Geological Survey
yd^2	square yards

Executive Summary

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Executive Summary

The Klamath River Renewal Corporation (KRRC) convened an Aquatic Technical Work Group (ATWG) comprised of agency and tribal fisheries scientists to review the aquatic resource (AR) mitigation measures included in the Klamath Facilities Removal Final Environmental Impact Statement/ Environmental Impact Report (2012 EIS/R; U.S. Bureau of Reclamation (USBR) and California Department of Fish and Game (CDFW) 2012), determine the appropriateness of the 2012 AR measures, and develop updated AR measures in accordance with ATWG input.

Through a series of nine meetings with the ATWG between April 28 and August 15, 2017, review of recent similar dam removal projects, and new scientific information that has been developed since the 2012 EIS/R, updated AR measures are proposed to be implemented as part of the removal of four dams on the Lower Klamath River (Project). The three key periods of time during the reservoir drawdown year include: (1) reservoir drawdown completed by the end of March, (2) volitional fish passage by October 1, and (3) free-flowing river conditions at all four facilities by December 31. While these time periods are referenced throughout Appendix I, the term “the Project” refers to these three time periods and is used more generally in the document to describe the Project and Project effects.

The proposed AR measures are adapted from the AR measures included in the 2012 EIS/R. The AR measures are now proposed as part of the Project include:

Mainstem Spawning

KRRC will develop and implement a monitoring and adaptive management plan to offset reservoir drawdown effects on mainstem spawning of anadromous salmonids and Pacific lamprey. Tributary-Klamath River confluences in the Hydroelectric Reach (i.e., the Klamath River and tributaries from Iron Gate Dam [river mile (RM) 193.1] to the upstream extent of J.C. Boyle Reservoir [RM 234.1]) and in the Iron Gate Dam to Cottonwood Creek (RM 185.1) reach will be monitored by KRRC for 2 years following the start of reservoir drawdown to ensure fish passage between tributaries and the Klamath River. KRRC-led monitoring of the four tributary confluences in the Hydroelectric Reach will occur from April 1 in the year of reservoir drawdown through March 31 in the year that is two years post-drawdown. KRRC-led monitoring of the five tributary confluences in the 8-mile reach from Iron Gate Dam to Cottonwood Creek will occur from January 1 of the year of reservoir drawdown, through December 31 in the year following the drawdown year. Tributary confluences in both reaches will be monitored by KRRC at variable frequencies depending on the season and the drawdown year (see Section 3.1.1). Monitoring will also be triggered in response to a 5-year or greater flow event on the Klamath River at the USGS Klamath River Below Iron Gate Dam CA gage (#11516530). KRRC and the ATWG will also convene periodically during the 2-year monitoring period to review monitoring frequency to ensure volitional passage is maintained between the Klamath River and select tributaries. If present, confluence obstructions will be actively removed by KRRC during the 2-year monitoring period to ensure volitional passage for adult Chinook salmon, coho salmon, steelhead, and Pacific lamprey.

KRRC will complete a spawning habitat evaluation on the Klamath River and four tributaries in the Hydroelectric Reach. If spawning habitat post-reservoir drawdown does not meet target metrics, KRRC will convene with ATWG to determine appropriate spawning gravel augmentation locations and methods on the mainstem Klamath River in the Hydroelectric Reach. If tributary spawning gravel habitat is less than the target values following reservoir drawdown, KRRC and the ATWG will convene to prioritize additional habitat restoration actions (e.g., gravel augmentation, gravel retention treatments) that KRRC will undertake to increase the amount of tributary habitat available to compensate for the loss of steelhead redds.

Outmigrating Juveniles

KRRC has planned three actions to offset reservoir drawdown effects on outmigrating juvenile anadromous salmonids and Pacific lamprey. First, KRRC will complete a sampling, salvage, and relocation effort to relocate juvenile salmonids, particularly yearling coho salmon, from the Klamath River between Iron Gate Dam and the Trinity River confluence during the late-fall or winter prior to reservoir drawdown.

Secondly, KRRC will develop an adaptive management plan to assess and restore tributary-mainstem connectivity in the Hydroelectric Reach and the 8-mile reach from Iron Gate Dam downstream to Cottonwood Creek (same task as described above in Mainstem Spawning). KRRC monitoring of the of the four tributary confluences in the Hydroelectric Reach will occur from April 1 in the year of reservoir drawdown through March 31 in the year that is two years post-drawdown. KRRC monitoring of the five tributary confluences in the 8-mile reach from Iron Gate Dam to Cottonwood Creek will occur from January 1 of the year of reservoir drawdown, through December 31 in the year following the drawdown year. KRRC will monitor tributary confluences in both reaches at variable frequencies depending on the season and the drawdown year (see Section 4.1.2). Monitoring will also be triggered in response to a 5-year or greater flow event on the Klamath River at the USGS Klamath River Below Iron Gate Dam CA gage (#11516530). KRRC and the ATWG will also convene periodically during the 2-year monitoring period to review monitoring frequency to ensure volitional passage is maintained between the Klamath River and select tributaries. If present, KRRC will actively remove confluence obstructions during the 2-year evaluation period to ensure volitional passage for juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey.

The third component of the outmigrating juveniles measure will include KRRC monitoring water quality conditions at 13 key tributary confluences downstream from Iron Gate Dam. KRRC and the ATWG will coordinate on a weekly basis from January through June in the year of reservoir drawdown and will convene during that time period if tributary water temperatures reach 17°C (7-day average of the daily maximum values) and Klamath River suspended sediment concentration exceeds 1,000 mg/L, or if observed behaviors of juvenile salmonids inhabiting tributary confluences necessitate salvage. If the tributary water temperature trigger of 19°C (7-day average of the daily maximum values) and Klamath River suspended sediment concentration trigger of 1,000 mg/L (7-day sustained daily maximum) are met, or if juvenile salmonids inhabiting tributary confluences exhibit stressed behavior, a salvage effort will be completed. Based on ATWG guidance, KRRC may conduct a multi-day salvage effort for juvenile fish at the Shasta and Scott rivers and single day salvage efforts at each other tributary confluence area by a 4-person crew and 2 transport trucks. The KRRC salvage effort will be coordinated with the ATWG and will reflect water quality conditions in the tributary confluences, outmigrating juvenile salmonid numbers and observed behavior, and other environmental conditions (e.g., weather and streamflow forecast) as necessary.

Iron Gate Fish Hatchery

To reduce the number of hatchery-reared juvenile coho salmon exposed to high suspended sediment levels, coho salmon will be released from Iron Gate Hatchery (CDFW) into the Klamath River later than the typical release schedule. Water quality monitoring stations established by KRRC prior to reservoir drawdown will be used by KRRC to determine when conditions in the mainstem Klamath River are suitable for the release of hatchery-reared coho salmon.

Suckers

The Project will result in lethal effects to Lost River and shortnose suckers inhabiting the Klamath River reservoirs. Since the two sucker species are lake-type suckers, suckers inhabiting the Hydroelectric Reach reservoirs will not persist following the Project. KRRC will conduct an adaptive management plan that includes sampling, salvage, and relocation of Lost River and shortnose suckers in the Hydroelectric Reach reservoirs. KRRC will translocate suckers to appropriate recipient waterbodies that will ensure the translocated suckers, which are of unknown genetic composition, will not mix with Lost River and shortnose sucker recovery populations in Upper Klamath Lake. KRRC will salvage and relocate up to a maximum of 3,000 suckers to the receiving waters. During the course of these actions, KRRC does not anticipated that the entire populations of suckers residing in the Hydroelectric Reach reservoirs will be recovered.

Freshwater Mussels

Freshwater mussels located in the 8-mile long reach from Iron Gate Dam downstream to the Cottonwood Creek confluence, are anticipated to experience high mortality due to suspended sediment concentrations and bedload deposition. The KRRC will prepare a reconnaissance, salvage, and translocation plan for up to 20,000 mussels located in the deposition reach. During the course of these actions, KRRC does not anticipate that the entire population of mussels residing below Iron Gate Dam will be recovered.

AR measures that were included in the 2012 EIS/R that are not proposed as part of the Project based on consultation with the ATWG and additional information gained from recent dam removal projects include:

AR-3 Fall Pulse Flows – Increasing flows during the fall prior to reservoir drawdown was intended to promote Chinook salmon and coho salmon migration into spawning tributaries to reduce the effect of reservoir drawdown on spawning grounds. Due to water availability uncertainty and typical fall flows, the use of fall pulse flows would likely be ineffective in reducing the effects of suspended sediment on migrating and spawning salmon, steelhead, and green sturgeon.

AR-5 Pacific Lamprey – The 3-km reach of the Klamath River downstream from Iron Gate Dam was proposed for Pacific lamprey ammocoete salvage and relocation in the 2012 EIS/R. Recent surveys have found very low ammocoete abundances between Iron Gate Dam (RM 192.9) and the Shasta River confluence (RM

179.3). Based on the assessment completed by KRRC and reviewed by ATWG, project effects to Pacific lamprey ammocoetes in the 3 km reach downstream from Iron Gate Dam are anticipated to be minimal, and therefore, no action is recommended for Pacific lamprey ammocoetes.

Chapter 1: Introduction

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1. INTRODUCTION

In 2012, the Department of the Interior developed the 2012 EIS/R (USBR and CDFG 2012) to disclose the potential effects of the Project. The 2012 EIS/R identified significant short-term effects to the aquatic biological community. The 2012 EIS/R included AR plans to attempt to mitigate the possible short-term adverse effects of the Project. In 2017, KRRC assembled the Aquatic Technical Work Group (ATWG) comprised of resource agencies, and tribal fisheries scientists in 2017 to review the previous AR measures, determine the feasibility and effectiveness of those plans, and to provide input on refined proposed actions that will best meet the intent of the previous AR mitigation measures. The ATWG included fisheries scientists representing CDFW, Oregon Department of Fish and Wildlife (ODFW), U.S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NMFS), Yurok Tribe, Hoopa Valley Tribe, Karuk Tribe, and The Klamath Tribes.

Through a series of nine meetings between April 28 and October 26, 2017, KRRC and the ATWG reviewed recent similar dam removal projects and new scientific information that has been developed since the 2012 EIS/R to update the 2012 AR measures. Updated AR measures are proposed to be implemented as part of the removal of four dam developments located on the Klamath River (Project). These measures are subject to consultation with aquatic resource agencies and negotiation of the final Biological Opinions for the Project.

During the reservoir drawdown year, reservoirs will be drawn down by the end of March, followed by volitional fish passage by October 1, and free-flowing river conditions at all four facilities by December 31. project effects are anticipated to be short-term in nature, with long-term benefits ultimately outweighing the Project's impacts to the aquatic biological community. The aquatic effects of the Project will primarily occur from the release of reservoir sediment during reservoir drawdown. The purpose of Appendix I is to provide background on the 2012 EIS/R AR measures, information gained from other large dam removal projects, and provide KRRC's and the ATWG's rationale for the revised AR measures included in the Definite Plan.

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Chapter 2: Dam Removal Benefits and Effects

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2. DAM REMOVAL BENEFITS AND EFFECTS

This section identifies benefits that have been observed after other dam removal projects in the Pacific Northwest and the Project's anticipated long-term benefits to the Klamath River ecosystem.

2.1 Fisheries Benefits of Recent Dam Removals in the Pacific Northwest

Removal of large dams from rivers in the western United States, has been completed to, among other things, restore access and connectivity to historical habitats which can provide a multitude of benefits to native fish communities including increases in species richness (Catalano et al. 2007; Burroughs et al. 2010; Kornis et al. 2015) and life-history diversity (Hitt et al. 2012; Pess et al. 2014).

Several recent studies from the Pacific Northwest that provide an overview of the fish passage benefits associated with restoring access to historical habitat through dam removal efforts are summarized below.

Following the installation of a fish ladder at Landsburg Dam in 2003, both Chinook salmon and coho salmon voluntarily recolonized 33 kilometers (km) of upstream habitat in the Cedar River, Washington, after more than 100 years of extirpation. The total density of salmonids roughly doubled in the mainstem closest to the dam 3 years after ladder installation (Kiffney et al. 2009), while dispersal of anadromous fish into tributary habitats occurred more slowly over the next 5 years (Burton et al. 2013). Both the proportion of all redds found in upstream reaches and the proportion of upstream spawners that were born in those reaches increased over time, demonstrating the successful transition from recolonization to self-sustaining upstream populations (Anderson et al. 2015).

Tule fall Chinook salmon were translocated to upstream reaches of the White Salmon River, Washington in the same year as the removal of the Condit Dam in 2011. Translocations were intended to circumvent the disruption of downstream spawning habitat by temporary sediment flows resulting from dam breaching, while natural migration was allowed in subsequent years. Roughly 10 percent of the Chinook population spawned upstream of the former dam site in the year following removal and both total escapement in the river and the proportion of returning fish born in upstream reaches is increasing over time (Engle et al. 2013; Hatten et al. 2015; Allen et al. 2016).

In the Elwha River, Washington, the Elwha Dam and Glines Canyon Dam limited anadromy to the lower Elwha River. Removing the Elwha and Glines Canyon dams provided access to an additional 40 miles of mainstem river habitat as well as tributaries. In 2012, Chinook salmon had access to the area above Elwha Dam for the first time in a century. A total of 203 Chinook redds (396 live and dead adults) were documented upstream of Elwha Dam, with the former Aldwell Reservoir (river kilometer [Rkm] 7.9-12.4) and the main stem Middle Elwha from Rkm 17.2-18.1 (above the former Elwha Dam site) accounting for 44 percent of the redd locations, respectively, in 2012. In 2013, based on SONAR estimates (Denton et al. 2014), the total escapement of Chinook salmon (4,243 adults) approximately doubled over the 20-year average. This doubling resulted in observations of Chinook salmon spawning in all habitats, including the Middle Elwha, with the majority of redds (73 percent) located above the former Elwha Dam (McHenry et al. 2017; Liermann et al. 2017).

At two dam removal sites on the Rogue River in southern Oregon, fall run Chinook salmon used spawning habitat that was formerly inaccessible under reservoirs in the first fall following dam removal. The conversion of former reservoir habitat to riverine habitat, and associated bedload/gravel movement, improved spawning habitat quality in the former reservoir sites. At the former Savage Rapids Dam site, 91 redds were documented within the extent of the former reservoir the first full fall after dam removal. At the former Gold Ray Dam site, 37 redds were documented within the bounds of the former reservoir in 2010, and over twice that many redds were identified within the former reservoir in 2011 (ODFW 2011).

From these previous studies, scientists have found that Chinook and coho salmon exploration of new habitat is an innate component of salmon breeding behavior. Coho salmon movement upstream of a former passage barrier on the Cedar River led to juvenile movement and dispersal which was recognized as an important component of the colonization process (Anderson et al. 2013). Ensuring juvenile passage in the watershed is necessary for juvenile imprinting and the future broadening of adult spawner returns throughout reconnected historical habitats. Additionally, hatchery-origin Chinook salmon have been found to have higher stray rates relative to their wild counterparts (Burton et al. 2013) and as the concept applies to the Klamath River, Iron Gate Hatchery-influenced fall Chinook salmon may rapidly recolonize the Klamath River upstream of Iron Gate Dam. In short, restoring access to lost habitat is a critical conservation strategy (Anderson and Quinn 2007 cited in T. Williams, NMFS, and personal communication 2017).

Beyond the benefits of recolonization for fish populations themselves, recolonization of previously inaccessible reaches also restores the flow of marine-derived nutrients to upstream portions of the watershed resulting in an overall boost to ecosystem nutrient budgets and productivity (Tonra et al. 2015).

2.2 Anticipated Project Benefits on the Klamath River Basin Aquatic Resources

The Project will provide long-term ecosystem benefits to the Klamath River Basin. The following anticipated long-term benefits discussion is based on the 2012 EIS/R and *the Klamath Dam Removal Overview Report for the Secretary of the Interior: An Assessment of Science and Technical Information* (NMFS 2013).

2.2.1 Access to Historical Habitat

Iron Gate Dam located at RM 193.1 blocks access to the Upper Klamath Basin for three anadromous salmonid species, Pacific lamprey, and freshwater mussels. Facilities removal will restore access to approximately 81 miles of suitable riverine, side channel, and tributary habitat in the Klamath River Hydroelectric Reach (i.e., the Klamath River and tributaries from Iron Gate Dam (RM 193.1) to the upstream extent of J.C. Boyle Reservoir (RM 234.1), and 49 tributaries accounting for over 420 miles of historical aquatic habitat throughout the basin upstream of Iron Gate Dam. More specifically, the Project will allow access to historical habitat (Table 2-1) totaling approximately 76 miles for coho salmon, 300 miles for Chinook salmon (Huntington 2004), and 420 miles for steelhead (Huntington 2004; 2006). In addition to increasing the quantity of available habitat, unique habitats will also be accessible with the Project. Groundwater-fed areas throughout the Upper Klamath Basin (Table 2-2) are resistant to water temperature increases caused by changes in climate (Hamilton et al. 2011), potentially buffering climate change effects to coldwater salmonids.

Table 2-1 Potential historical habitat availability by species with removal of the Klamath River Hydroelectric Reach dams

Species	Potential Historical Habitat Availability (mi)
Chinook salmon	300
Coho salmon	76
Steelhead	420
Pacific lamprey	>420

Table 2-2 Estimated volume of groundwater discharge (springs) into upper Klamath River systems

River System	Section	Groundwater Flow (cfs)
Lower Williamson River and Tributaries	Mouth of Williamson River up to Kirks Reef	350
Wood River and Tributaries	Crooked Creek Confluence to Headwaters	490
Sevenmile Creek and Tributaries	Crane Creek Confluence to Headwaters	90
Sprague River	South Fork Sprague River to Sprague River	202
Upper Klamath Lake	Spring in Upper Klamath Lake Including Malone, Crystal, Sucker, and Barclay	350
Klamath River	Keno Dam to J.C. Boyle Powerhouse	285
Klamath River and Fall Creek	J.C. Boyle Powerhouse to Iron Gate Dam	128
Total		1,895

NMFS 2013
cfs – cubic feet per second

Historical anadromous fish population estimates suggest the potential productivity of the Klamath Basin upstream from Iron Gate Dam (RM 193.1). Hamilton et al. (2011) summarized previous spawning surveys and population estimates. The Klamath River and tributaries upstream from Iron Gate Dam historically supported up to 149,000 spawning fall Chinook salmon and up to 30,000 spawning steelhead (Table 2-3).

Table 2-3 Historical and potential production estimates for fall Chinook salmon, coho salmon, and steelhead in the Klamath River Basin

Reach	Species	Median Estimate	Estimate Range	Note
Lower Klamath Basin to Copco Dam	Fall Chinook Salmon		168,000[4] – 175,000[5]	Estimates based on historical spawning escapement and spawning surveys.
	Coho	15,400[4]	20,000[5] – 70,000[5]	
	Steelhead	300,000[5]	221,000[4] – 750,000[5]	
Iron Gate Dam to Copco Dam	Fall Chinook Salmon	2,301[3]	1,113[6] – 18,925[5]	Based on historical spawning data and spawning habitat potential.
	Steelhead	1,144[3]		
Copco Dam to Upper Klamath Lake	Fall Chinook Salmon	10,000[1]	2,2920[2] – 19,207[3]	Based on historical spawning data and spawning habitat potential.
	Steelhead	9,550[3]		

1. FERC 2007
2. Fortune et al. 1966
3. Chapman 1981
4. CDFG 1965
5. Coots 1977
6. FERC 1963

Chinook Salmon

The Project will benefit fall Chinook salmon by restoring access to over 300 miles of historical habitat (Table 2-1) in the Klamath Basin upstream from Iron Gate Dam (e.g., improving water quality, increasing flow variability downstream from Iron Gate Dam, and reducing disease). Over time, Chinook salmon returns upstream of Keno Dam could be substantial, although fish passage at Keno Dam and habitat quality improvements in the Upper Klamath Basin will be necessary to realize recovery potential.

Table 2-4 Estimated Klamath River mainstem, side channel, and tributary habitat under the Hydroelectric Reach reservoirs

Reservoir	Mainstem Habitat (mi)	Side Channel Habitat (mi)	Tributary Habitat (mi)
Iron Gate	6.81	-	2.49
Copco	6.87	1.24	1.51
J.C. Boyle	3.32	-	0.19
Total	17.00	1.24	4.18

Source: Cunanan 2009

mi - miles

Coho Salmon

After implementation of the Project, coho salmon are expected to rapidly recolonize habitat upstream of Iron Gate Dam, as observed after barrier removal at Landsburg Dam in Washington (Kiffney et al. 2009) and the Elwha River dams in Washington (Liermann et al. 2017). Assuming coho salmon distribution will extend up to Spencer Creek after dam removal; coho salmon from the upper Klamath River population will reclaim approximately 76 miles of habitat: approximately 53 miles in the mainstem Klamath River and tributaries (DOI 2007; NMFS 2007) and approximately 22.4 miles currently inundated by the reservoirs (Cunanan 2009).

Coho salmon colonization of the Klamath River between Keno and Iron Gate dams by the upper Klamath coho salmon population would likely improve the viability of SONCC coho salmon by increasing abundance, diversity, productivity and spatial distribution.

Steelhead

The Project will restore access to over 420 miles of historical steelhead habitat upstream of Iron Gate Dam (Huntington 2004; 2006). Because of their ability to navigate steeper gradient channels and spawn in smaller, intermittent streams (Platts and Partridge 1978), and their ability to withstand a wide range of water temperatures (Cech and Myrick 1999; Spina 2007), steelhead distribution in the basin could expand to a greater degree (over 420 miles; Huntington 2004; 2006) than that of any other anadromous salmonid species. FERC (2007) concluded that restoring fish passage would help to reduce the adverse effects to steelhead associated with lost access to upstream spawning habitats. Hamilton et al. (2011) also concluded that restored access to historical habitat above the dams would benefit steelhead runs.

Lamprey

Pacific lamprey is the only anadromous lamprey species in the Klamath Basin, although five other resident lamprey species are also present in the system. Access to habitat upstream of Iron Gate Dam as a result of the Project, could benefit Pacific lamprey by increasing their range and distribution in the Klamath River Basin, providing additional spawning and rearing habitat upstream and downstream of Iron Gate Dam, and increasing their abundance. The Project is anticipated to expand the current range of Pacific lamprey to areas upstream of Iron Gate Dam (FERC 2007). Restoration of natural hydrologic conditions will improve rearing conditions for lamprey ammocoetes that are currently affected by periodic peaking flows that dewater habitat and strand ammocoetes.

2.2.2 Water Quality and Water Temperature

The Project will decrease residence time from several weeks to less than a day, resulting in improved water quality and a more natural temperature regime. Reservoir removal will also increase the benefits of tributaries and springs such as Fall, Shovel, and Spencer creeks and Big Springs, that will flow directly into the mainstem Klamath River, creating patches of cooler water (see Table 2-2) that could be used as temperature refugia by fish during summer and fall, as well as providing slightly warmer winter water temperatures conducive to the growth of salmonids (Hamilton et al. 2011). The Project would result in a 2-10°C decrease in water temperatures during the fall months and a 1-2.5°C increase in water temperatures during spring months (PacifiCorp 2004a; Dunsmoor and Huntington 2006; NCRWQCB 2010a).

Elimination of the thermal lag currently caused by the existing reservoirs, will result in water temperatures more in sync with historical fish migration and spawning periods for the Klamath River, warming earlier in the spring, and cooling earlier in the fall compared to existing conditions (Hamilton et al. 2011). Warmer springtime temperatures would result in fry emerging earlier (Sykes et al. 2009), encountering favorable temperatures for growth sooner than under existing conditions, which could support higher growth rates and encourage earlier emigration downstream, thereby reducing stress and disease (Bartholow et al. 2005; FERC 2007). In addition, fall Chinook salmon spawning in the mainstem during fall would no longer be delayed (reducing pre-spawn mortality), and adult migration would occur in more favorable water temperatures than under existing conditions. For example, groundwater inputs in the J.C. Boyle Bypass Reach are anticipated to account for 30 to 40 percent of the total summer flow following dam removal. Groundwater inputs will have a positive effect on water temperature, benefiting both anadromous and resident fish and other aquatic organisms in the Klamath River.

In addition to restoring a more natural thermal regime, the Project will result in overall increases in dissolved oxygen, increased diel variability in dissolved oxygen, and lower microbial oxygen demand due to decreased organic load. The conversion of an additional 22.4 miles of reservoir habitat to riverine and riparian habitat will improve water quality by restoring the nutrient cycling and aeration processes provided by a natural channel.

2.2.3 Hydrograph

With the Project, Klamath River flows will mimic the natural hydrograph. Fish migration patterns, riparian plant community processes, and sediment and debris transport mechanisms are anticipated to benefit from a more natural hydrograph.

2.2.4 Disease

Fish diseases are widespread in the mainstem Klamath River during certain time periods, and in certain years disease prevalence has been shown to adversely affect survival and productivity of Chinook and coho salmon. High infection rates by the myxozoan parasite *Ceratonova shasta* (*C. shasta*) have been documented in emigrating juvenile salmon populations during spring and early summer in the Klamath River (True et al. 2016 *cited in* USFWS 2016), which have been linked to population declines in fall Chinook Salmon (Fujiwara et al. 2011; True et al. 2013). Fish infected by *C. shasta* are also prone to mortality caused by other pathogens such as *Parvicapsula minibicornis*, to predation, and compromised osmoregulatory systems that are essential for successful ocean entry (S. Foott personal communication *cited in* USFWS 2016).

C. shasta infection rates of juvenile Chinook salmon are influenced by *C. shasta* spore densities, water temperature, and juvenile salmonid residence time in area of high spore densities. Table 2-5 includes a summary of juvenile Chinook salmon prevalence of infection over 10 years at the Kinsman rotary screw trap location (RM 147.6), located 45 river miles downstream from Iron Gate Dam (RM 193.1). The Kinsman trap is located between the Shasta River and the Scott River, a reach of the Klamath River often referenced as the "infectious zone" (USFWS 2016).

Table 2-5 Summary of estimates of annual-level *C. shasta* infection prevalence for wild and/or unknown origin juvenile Chinook salmon passing the Kinsman rotary screw trap site (RM 147.6).

Year	Origin	Prevalence of Infection	Infected Population Estimate
2005	All	0.41	0.38
2007	All	0.28	0.10
2008	All	0.6	0.51
2009	All	0.5	0.58
2010	Wild/Unknown	0.12/0.15	0.04
2011	Wild	0.2	0.11
2012	Wild/Unknown	0.06/0.00	0.08
2013	Wild	0.18	0.06
2014	Wild	0.67	0.18
2015	Wild/Unknown	0.66/0.96	0.29

Source: USFWS 2016

Prevalence of Infection references annual summaries of weekly collections aimed to monitor weekly disease rates. The Infected Population Estimate references estimates for the prevalence of C. shasta *infections in the population of juvenile Chinook salmon.*

The lower and upper confidence limits account for the estimation uncertainty in abundance and weekly prevalence of infection rates

The Project is expected to reduce fish disease impacts to adult and juvenile salmon especially downstream from Iron Gate Dam. Among the salmon life stages, juvenile salmon tend to be most susceptible to *P.minibicornis* and *C. shasta* (Beeman et al. 2008). The main factors contributing to risk of infection by *C. shasta* and *P. minibicornis* include availability of habitat (pools, eddies, and sediment) and microhabitat characteristics (static flow and low velocities) for the polychaete intermediate host; polychaete proximity to spawning areas; increased planktonic food sources from Hydroelectric Reach reservoirs; water temperatures greater than 15°C (Bartholomew and Foott 2010); and juvenile salmonid residence time in the infectious zone (USFWS 2016).

The Project will restore natural channel processes including channel bed scour and sediment transport. Annual channel bed scour will disturb the habitat of the polychaete worm that hosts *C. shasta* (FERC 2007). Reducing polychaete habitat will likely increase abundance of smolts by increasing outmigration survival, particularly for juvenile coho salmon FERC 2007).

The Project will also broaden the distribution of adult pre-spawn fall Chinook salmon, reducing crowding and the concentration of disease pathogens that currently occurs in the reach between Iron Gate Dam and the Shasta River (USFWS 2016). Lastly, a broader spawning distribution will also influence the distribution of post-spawn adult carcasses that contribute the bulk of the myxospores that enable the *C. shasta* life cycle within the infectious zone. Distributing adult carcasses over a longer reach of the Klamath River corridor will reduce myxospore densities likely leading to lower juvenile salmonid infection rates in the winter and spring rearing period (USFWS 2016).

2.2.5 Nuisance Algae

The Project will eliminate optimal growing conditions for toxin-producing nuisance algal species, alleviating the transport of high seasonal concentrations of algal toxins to the Klamath River downstream from Iron Gate Dam. Nuisance algae reduction will also decrease the associated bioaccumulation of microcystin in fish tissue for species downstream from the Hydroelectric Reach. While some microcystin may be transported downstream from large blooms occurring in Upper Klamath Lake, the levels are anticipated to be lower than those currently experienced due to the prevalence of seasonal in-reservoir blooms. Overall, bioaccumulation of algal toxins in fish tissue are expected to decrease in the Klamath River downstream from Iron Gate Dam and will be beneficial.

2.2.6 Sediment and Debris Transport

In the long term, restoration of sediment and debris transport through the Hydroelectric Reach will decrease substrate size and increase the supply of wood debris, an important structural component that influences aquatic habitat diversity. Bedload sediment movement and transport are vital to create and maintain functional aquatic habitat. The river will eventually drive enhanced habitat complexity due to a more natural flow and reconnected bedload transport regime that will mean the restoration of spawning gravels and early rearing habitat downstream from Iron Gate Dam. Pools will likely return to their pre-sediment release depth within one year (USBR 2012), and the river is predicted to revert to and maintain a pool-riffle morphology providing suitable habitat for fall-run Chinook salmon.

In summary, the Project will have long-term ecosystem benefits. Primary ecosystem benefits that will be realized include restored access to historical habitat upstream of Iron Gate Dam for aquatic organisms (Huntington 2004; 2006); a more natural hydrograph, temperature regime (PacifiCorp 2004; Dunsmoor and Huntington 2006), and nutrient cycling; reduced prevalence of aquatic diseases such as *C. shasta* (Bartholow et al. 2004; Federal Energy Regulatory Commission [FERC] 2007; U.S. Fish and Wildlife Service [USFWS] 2016) and nuisance algae, and restored sediment transport and debris loading (USBR and CDFG 2012).

2.3 Anticipated Short-term Effects of the Project

Short-term effects from the Project to the biological community include high suspended sediment concentrations (Greig et al. 2005, Levasseur et al. 2006; USBR 2011), high bedload transport and deposition, and low dissolved oxygen concentrations (Reclamation and CDFG 2012). The Project's short-term effects are anticipated to impact both mobile and sedentary organisms (e.g., freshwater mussels and lamprey ammocoetes), with the greatest effects on sedentary organisms that are unable to seek refuge from poor water quality. The following sections provide more details on anticipated short-term reservoir drawdown effects presented in the 2012 EIS/R (USBR and CDFG 2012).

2.3.1 Suspended Sediment Effects

The Project could release up to 1.2 - 2.9 million metric tons of fine sediment (sand, silt, and finer) downstream from Iron Gate Dam (RM 193.1) over a two-year period (USBR 2011). Suspended sediment concentrations are expected to exceed 1,000 mg/l for weeks, with the potential for peak concentrations exceeding 5,000 mg/l for hours or days depending on hydrologic conditions during reservoir drawdown (USBR and CDFG 2012). The downstream transport of this sediment, currently stored in reservoir deposits, is anticipated to affect downstream habitats as both suspended sediment and bedload. Biological effects may impact salmonids and Pacific lamprey through gill abrasion and clogging, decreased forage efficiency, and other behavioral effects like delayed migration timing. Deposition of suspended sediments is anticipated to impact salmonid spawning grounds by smothering incubating eggs (Greig et al. 2005; Levasseur et al. 2006), impeding intergravel flow thereby affecting egg and fry development, and impacting fry emergence due to gravel clogging. Fine sediment deposition in slower off-channel habitats may also block connectivity between the Klamath River and off-channel habitats such as mainstem side channels, important habitats for juvenile fish rearing and coho salmon spawning.

2.3.2 Bedload Effects

Bedload mobilized by the Project is anticipated to affect the Klamath River between Iron Gate Dam (RM 193.1) and Cottonwood Creek (RM 185.1). Bedload deposition is anticipated to result in the burial of spawning habitat, freshwater mussel beds, and lamprey ammocoete rearing areas. Dam-released sediment will also increase the proportion of sand in the channel bed, thereby decreasing salmonid fry and lamprey ammocoete survival. The bed material within the reservoirs and from Iron Gate Dam to Cottonwood Creek is expected to have a high content (30 to 50 percent) of sand immediately following reservoir drawdown until a flushing flow moves the sand sized material out of the reach (USBR 2012). A sufficient flushing flow of at least 6,000 cfs and lasting over several days to weeks is expected to be necessary to return the Klamath River bed composition to one dominated by cobble and gravel with a sand content less than 20 percent. After the flushing flow, the river bed is expected to maintain fractions of sand, gravel, and cobble similar to natural conditions, and be sufficient to support biological communities that use the former effected reach.

2.3.3 Dissolved Oxygen Effects

Release of reservoir sediments is also anticipated to result in depressed dissolved oxygen concentrations that will affect the biological community in the affected reach. Due to high organic concentration of the reservoir sediments, dissolved oxygen depletion is anticipated to result from the microbial breakdown of released organics. Direct effects of low dissolved oxygen levels include fish mortality, reduced growth and impaired development, reduced swimming performance, altered behavior, and reduced reproductive potential. Mobile fish will likely seek out areas of higher dissolved oxygen and improved water quality downstream of the affected reach, in tributaries and tributary confluence areas with the Klamath River, and in areas with faster flowing water with a higher rate of oxygen transfer at the water-air interface. Less mobile organisms are unable to move from impaired water quality so are more susceptible to low dissolved oxygen effects.

2.3.4 Effects Analysis

Hydraulic and sediment modeling was completed to predict flow and sediment transport characteristics in part to predict potential biological effects associated with the Project (USBR 2011; Section 8 and 9). Modeling results are very sensitive to watershed hydrology, both in flow magnitude and runoff pattern (USBR 2011). To account for the range of potential effects that could occur during the Project, two scenarios were analyzed with the goal of predicting the potential impacts to fish that have either a 50 percent (effects likely to occur) or 10 percent (unlikely to occur, or worst-case) probability of occurring (USBR and CDFG 2012; Vol. I, Section 3.3).

Due to the uncertainties associated with biological response to the anticipated high suspended sediment concentrations levels and low dissolved oxygen over extended time periods, KRRC evaluated the 2012 EIS/R worst-case scenario effects for developing the updated AR plans. The 2012 EIS/R considered the potential short-term (less than 2 years) and long-term (more than 2 years) effects to Klamath River aquatic species. Short-term effects were determined to be either significant or less-than-significant for the species covered by the AR plans. The 2012 EIS/R anticipated that mitigation would reduce short-term effects for fall Chinook salmon and Lost River and shortnose suckers (from significant to less-than-significant), but mitigation would not reduce effects to less than significant levels for the other species. The Project as analyzed in the 2012 EIS/R was anticipated to have long-term benefits for all aquatic species (except green sturgeon) including those determined to have significant short-term effects (2012 EIS/R Vol. I, pp. 3.3-129 to 3.3-177).

Chapter 3: Mainstem Spawning

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3. MAINSTEM SPAWNING

The objective of the mainstem spawning measure is to address the short-term project effects on anadromous fish that migrate and spawn in the mainstem Klamath River and its tributaries during the two years following drawdown. The 2012 EIS/R AR-1 plan focused on trapping and hauling adult migratory anadromous salmonids and Pacific lamprey and relocating fish to areas of the basin less affected by project effects. The updated measure, based on the 2012 EIS/R AR-1, proposed as part of the Project includes implementation of a monitoring and adaptive management plan to monitor and ensure habitat connectivity and spawning habitat availability. The adaptive plan includes: 1) monitoring and ensuring tributary-mainstem connectivity at select tributaries in the Hydroelectric Reach and in the 8-mile long bedload deposition reach between Iron Gate Dam (RM 193.1) and Cottonwood Creek (RM 185.1); and 2) survey/quantification of spawning habitat in the Klamath River and tributaries in the Hydroelectric Reach from Iron Gate Dam to Keno Dam, and augmenting spawning gravel if existing spawning habitat is less than the area needed to support 2,100 Chinook redds on the mainstem and 179 steelhead redds in Hydroelectric Reach tributary streams. The measure as currently proposed represents the best available actions and opportunities to offset potential impacts to Chinook salmon and coho salmon spawning redds from reservoir drawdown, and to reduce effects to migrating adult steelhead and Pacific lamprey affected by reservoir drawdown.

3.1 Proposed Measure

Based on a review of the 2012 EIS/R AR-1 presented in Section 3.2, input from the ATWG, and recent fisheries literature, the KRRC concluded that an updated measure is necessary to offset the anticipated short-term effects of the Project on mainstem spawning Chinook and coho salmon, as well as migrating adult steelhead and Pacific lamprey. The updated measure requires KRRC to develop and implement a monitoring and adaptive management plan with on-going input from the ATWG. The plan includes monitoring and ensuring tributary-mainstem connectivity and spawning habitat availability. The monitoring and adaptive management plan has two specific actions.

- **Action 1:** KRRC will evaluate tributary-mainstem confluences, four sites in the Hydroelectric Reach and five sites in the 8-mile reach from Iron Gate Dam (RM 193.1) to Cottonwood Creek (185.1), for 2 years (see Table 3-1 for proposed schedule). Monitoring frequency will be variable based on the season and year. Additionally, any 5-year flow event of 10,895 cfs or greater on the Klamath River recorded at the USGS Klamath River Below Iron Gate Dam CA gage (#11516530) within the first two years following reservoir drawdown, will trigger a monitoring effort. If tributary confluence blockages are identified during monitoring, necessary means will be employed to remove the obstructions to ensure volitional passage for adult Chinook salmon, coho salmon, steelhead, and Pacific lamprey. The ATWG will also convene periodically during the 2-year monitoring period to review monitoring frequency to ensure volitional passage is maintained between the Klamath River and select tributaries.

- **Action 2:** KRRC will complete a spawning habitat evaluation of the Hydroelectric Reach and newly accessible tributaries following reservoir drawdown. A target of 44,100 yd^2 of mainstem spawning gravel will be required to offset the effects to 2,100 mainstem-spawning fall Chinook salmon redds. If mainstem spawning gravel availability is less than the target values following reservoir drawdown, KRRC will consult with the ATWG to plan and implement spawning gravel augmentation in the former Klamath River reservoirs and Hydroelectric Reach. A target of 4,700 yd^2 of tributary spawning gravel is required to offset the effects to 179 tributary-spawning steelhead redds. If tributary spawning gravel habitat is less than the target values following reservoir drawdown, KRRC will meet with the ATWG to prioritize additional habitat restoration actions (e.g., gravel augmentation, gravel retention treatments) that will be implemented by KRRC to increase the amount of tributary habitat available to compensate for the loss of steelhead redds.

The proposed actions are intended to ensure adult salmonid and Pacific lamprey access to mainstem and tributary spawning habitat in the Hydroelectric Reach and between Iron Gate Dam and Cottonwood Creek following the Project. The following sections provide additional detail on the proposed actions.

3.1.1 Action 1: Tributary-Mainstem Connectivity

The following sections provide information on the monitoring and adaptive management plan pertaining to tributary-mainstem connectivity.

Tributary-Mainstem Connectivity Monitoring

To ensure that spawning habitat is accessible during and following reservoir drawdown, fish passage monitoring, and adaptive actions will occur at the confluence areas of key Klamath River tributaries and side channels upstream and downstream of Iron Gate Dam (Table 3-1). Tributary confluences in the Hydroelectric Reach may be affected by sediment deposits and debris obstructions as the reservoirs are drawn down. Tributary deltas may create fish passage barriers that will limit upstream migration of anadromous salmonids and Pacific lamprey. Monitoring frequency will be variable based on the season and year (Table 3-1). Additionally, any 5-year flow event or 10,895cfs or greater on the Klamath River recorded at the USGS Klamath River Below Iron Gate Dam CA gage (#11516530) within the first two years following reservoir drawdown will trigger a monitoring effort.

Table 3-1 Mainstem Spawning Measure monitoring frequency for tributaries in the Hydroelectric Reach and Iron Gate Dam (IGD) to Cottonwood Creek reach for the drawdown year and post-drawdown year.

Monitoring Reach	Monitoring Period	Monitoring Frequency
Hydroelectric Reach 4 tributaries	Drawdown Year (2021-2022)	
	April 1 – June 30	Bi-weekly
	July 1 – September 30	Monthly
	October 1 – December 31	Weekly
	2nd Year (2022-2023)	

Monitoring Reach	Monitoring Period	Monitoring Frequency
	January 1 – March 31	Weekly
	April 1 – June 30	Bi-weekly
	July 1 – September 30	Monthly
	October 1 – December 31	Bi-weekly
IGD to Cottonwood Creek 5 tributaries	Drawdown Year (2021-2022)	
	January 1 – March 31	Weekly
	April 1 – June 30	Bi-weekly
	July 1 – September 30	Monthly
	October 1 – December 31	Weekly
	2nd Year (2022-2023)	
	January 1 – March 31	Weekly
	April 1 – June 30	Bi-weekly
	July 1 – September 30	Monthly
	October 1 – December 31	Bi-weekly

Based on hydraulic and sediment transport modeling completed by USBR (Section 9.2.1.4; 2011), sediment deposition during reservoir drawdown is predicted from Bogus Creek (RM 192.6) downstream to Cottonwood Creek (RM 185.1). From Bogus Creek downstream to Willow Creek (RM 188.0), approximately 1.5 feet of sediment deposition is anticipated. From Willow Creek downstream to Cottonwood Creek, deposition of less than 1 foot is expected. Areas downstream of Cottonwood Creek are expected to have only minor deposition with deposits less than 0.25 feet (USBR 2011). No additional deposition is predicted in the Bogus Creek to Cottonwood Creek reach following the Project.

Species that could be potentially affected by obstructed tributary connections include steelhead and Pacific lamprey during the winter and spring of the drawdown year, and Chinook salmon and coho salmon in the fall of the drawdown year. Further, depending on erosion rates of reservoir sediments, tributary confluence areas in the reservoir areas may not have volitional fish passage conditions during and following drawdown.

Tributary confluences to be monitored by KRRC in the 2-year period following reservoir drawdown include Bogus Creek, Dry Creek, Little Bogus Creek, Willow Creek, and Cottonwood Creek. Tributaries in the Bogus Creek to Cottonwood Creek reach were selected as they are recognized as influential tributaries (e.g., historical fisheries importance or important freshwater sources) in the mid-Klamath River (Soto et al. 2008). Hydroelectric Reach tributaries to be monitored include Spencer Creek (RM 233.4), Shovel Creek (RM 212.0), Fall Creek (RM 199.8), and Jenny Creek (RM 197.4). These tributaries were selected based on having historical or potential habitat for adult salmonids (Huntington 2006).

Tributary confluences will be evaluated for 2 years in both reaches to identify project-related tributary confluence obstructions. Obstructions will be actively removed during the 2-year monitoring period to ensure volitional passage for adult Chinook salmon, coho salmon, steelhead, and Pacific lamprey

Tributary Connectivity Maintenance

Tributary confluences in both reaches will be monitored at variable frequencies depending on the season and year (see Table 3-1). Tributary obstructions that limit fish passage will be remedied through appropriate manual or mechanical means necessary to address obstructions. Example removal methods may include removing sediment using hand tools or hydraulic equipment. Removed gravels and large woody debris will be placed in the Klamath River downstream of the tributary confluence. Removed fine sediments will be placed on the adjacent floodplain or outhauled for disposal. The removal effort will be to the extent necessary to ensure volitional passage for adult and juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey.

3.1.2 Action 2: Spawning Habitat Evaluation

The following sections provide information on the monitoring and adaptive management plan pertaining to mainstem and tributary spawning habitat availability.

Spawning Habitat Target Metrics

Spawning gravel area targets for Chinook salmon and steelhead were developed based on typical spawning redd dimensions for the two species and the anticipated loss of Chinook salmon redds and adult steelhead due to reservoir drawdown. Fortune et al. (1966) used 21 square yards (yd^2) and 26 yd^2 of suitable gravel per Chinook salmon redd and steelhead redd, respectively, to calculate spawning potential in areas of the Klamath River and selected tributaries upstream of Iron Gate Dam (Table 3-2). Based on an anticipated loss of 2,100 Chinook salmon redds downstream from Iron Gate Dam and a 21 yd^2 area per redd, 44,100 yd^2 of spawning gravel is necessary to offset the loss of 2,100 Chinook salmon redds. Based on recent winter steelhead counts, an estimated 358 adult steelhead representing 179 spawning redds will be affected by reservoir drawdown and sediment release. Applying Fortune et al. (1966) steelhead redd dimensions, 4,700 yd^2 of tributary spawning habitat will be needed to offset the loss of 358 winter steelhead.

Table 3-2 Anticipated redd loss due to project effects for fall Chinook salmon and winter steelhead, surface area per redd, and the anticipated spawning habitat area needed to address redd loss for fall Chinook salmon and steelhead adult production

Metric	Fall Chinook Salmon	Winter Steelhead
Anticipated redd loss due to reservoir drawdown and sediment release	2,100	179[1]
Surface area per spawning redd (yd^2)	21	26
Spawning habitat area to address redd loss (yd^2)	44,100	4,700

[1] Updated anticipated winter steelhead loss based on peak steelhead return of (631 in 2001) to Iron Gate Hatchery between 2000-2016 (CDFW 2016). Expected mortality calculated using the methodology contained in the 2012 EIS/R (631*0.80*0.71=358). The 358 adult steelhead were converted to 179 redds that would be lost due to adult steelhead mortality.

Spawning Habitat Monitoring

To quantify the available spawning habitat upstream of Iron Gate Dam, KRRC will implement field surveys and remote sensing following reservoir drawdown. Boat or aerial surveys will be conducted on the mainstem Klamath River between Iron Gate Dam (RM 193.1) and Keno Dam (RM 239.2) during the summer following reservoir drawdown to determine the amount of mainstem spawning habitat in the Hydroelectric Reach suitable for immediate spawning.

Tributary streams will be walked from their mouths to the first natural fish passage barrier to estimate amount of available spawning habitat following reservoir drawdown (Table 3-3). The area of available spawning habitat will be estimated from the mouth to the first natural barrier. If artificial (manmade) fish passage barriers are located during the tributary reach reconnaissance, they will be noted as potential restoration actions to increase the availability of tributary spawning habitat.

Table 3-3 Hydroelectric Reach tributaries to be assessed for existing spawning habitat

Tributary	Tributary Confluence Location at the Klamath River (RM)	Tributary Length to First Barrier (mi)
Jenny Creek	197.4	1.0
Fall Creek	199.8	1.2
Shovel Creek	212.0	2.7
Spencer Creek	233.4	9.0

Response to Spawning Habitat Availability

KRCC will prepare a report summarizing the spawning habitat surveys and outline and prioritize actions to augment spawning habitat if the existing spawning habitat amounts to less than the 44,100 yd^2 of mainstem and 4,700 yd^2 of tributary spawning habitat targets in the Hydroelectric Reach. KRRC will consult with the ATWG for input on potential spawning gravel augmentation locations in the mainstem and on other tributary habitat restoration actions in tributaries to increase the availability of spawning habitat. Currently, if existing spawning habitat does not meet targets, spawning gravel augmentation will be completed in the mainstem Klamath River between Shovel Creek (RM 212.0) and the upstream extent of Copco Reservoir (RM 209.0). Mainstem gravel will be added at a rate of 7.0 cy (21 yd^2 x 1 ft depth) per compensatory mainstem redd. KRRC anticipates augmented gravel will to be redistributed with subsequent high flows, broadening potential spawning habitat over larger areas of the treated mainstem reaches. Tributary spawning habitat restoration actions to be completed in Jenny Creek, Shovel Creek, Fall Creek, and/or Spencer Creek could include removal of artificial fish passage barriers, or placement of large woody debris to trap and retain spawning gravels. Spawning gravel augmentation will be prioritized based on anticipated spawning habitat benefits.

In summary, the updated measure includes development and implementation of a monitoring and adaptive management plan overseen by KRRC with consultation by the ATWG. The plan will direct the evaluation of tributary-mainstem connectivity in the Hydroelectric Reach and the Klamath River deposition reach between

Iron Gate Dam and Cottonwood Creek. Tributary confluences will be monitored for 2 years following the start of reservoir drawdown and tributary confluence obstructions that block fish passage will be addressed over the 2-year period. Mainstem and tributary spawning habitat in the Hydroelectric Reach will be monitored post-reservoir drawdown and will be augmented with supplemental spawning gravel or enhanced through additional restoration actions (e.g., large wood placement to retain spawning gravels) if spawning habitat area metrics are not met by existing habitat conditions following reservoir drawdown.

3.2 Summary of the Affected Species, Project Benefits and Effects, Recent Fisheries Literature, the 2012 EIS/R AR-1, and the Proposed Measure

The following sections review the components of the 2012 EIS/R AR-1, anticipated project effects and benefits on measure species, and recent fisheries literature relative to mainstem spawning. This information is presented in support of the updated measure.

3.2.1 Affected Species

Species identified in the measure include:

- Coho salmon *(Oncorhynchus kisutch)* – Southern Oregon/Northern California Coastal (SONCC) evolutionary significant unit (ESU): Federally Threatened; California Threatened; Tribal Trust Species
- Chinook salmon *(O. tshawytscha)* – Upper Klamath-Trinity Rivers ESU - Fall Run: California Species of Special Concern; Tribal Trust Species
- Chinook salmon *(O. tshawytscha)* – Upper Klamath-Trinity Rivers ESU – Spring Run: California Species of Special Concern; Tribal Trust Species
- Steelhead *(O. mykiss)* – Klamath Mountains Province distinct population segment (DPS) – Summer Run: California Species of Special Concern; Tribal Trust Species
- Steelhead *(O. mykiss)* – Klamath Mountains Province DPS – Winter Run: Tribal Trust Species
- Pacific lamprey *(Entosphenus tridentatus)*: California Species of Special Concern; Tribal Trust Species

3.2.2 Anticipated Project Effects on Measure Species

Short-term effects of the project (from both suspended sediment and bedload movement) were predicted to result in high mortality of fall Chinook salmon and coho salmon embryos and pre-emergent alevin within redds that are constructed in the mainstem Klamath River downstream from Iron Gate Dam (RM 193.1) in the fall of prior to reservoir drawdown (USBR and CDFG 2012). Approximately 2,100 fall Chinook salmon redds and approximately 13 SONCC coho salmon redds were predicted to be affected during reservoir drawdown. Additionally, steelhead and Pacific lamprey migrating within the mainstem Klamath River after December 31 prior to the reservoir drawdown year are anticipated to be directly affected by suspended sediment. Table 3-4 includes the likely and worst-case effects to adult anadromous fish species downstream from Iron Gate Dam.

Table 3-4 2012 EIS/R anticipated effects summary for migratory adult salmonids and Pacific lamprey

Species	Life Stage	Likely Effects	Worst Effects
Coho Salmon	Adult Spawning	Loss of 13 redds (0.7-26%)[1]	Loss of 13 redds (0.7-26%)[1]
Chinook Salmon - Fall	Adult Spawning	Loss of 2,100 redds (8%)[1]	Loss of 2,100 redds (8%)[1]
Steelhead - Summer	Migrating Adults	No anticipated mortality	Loss of 0-130 adults (0-9%)[1]
Steelhead - Winter	Migrating Adults	Loss of up to 1,008 adults (14%)[1]	Loss of up to 1,988 adults (28%)[1]
Pacific Lamprey	Adult Migration and Spawning	High mortality (36%)[2]	High mortality (71%)[2]

Source: USBR and CDFG 2012
[1] Range of potential year class loss based on the average number of redds associated with the evaluated population(s).
[2] The 2012 EIS/R predicted Pacific lamprey mortality based on mortality models developed for suspended sediment impacts to salmonids. Model output did not include the number of predicted Pacific lamprey mortalities.

The following sections include descriptions of species-specific effects adapted from the 2012 EIS/R (USBR and CDFG 2012; Vol. I, pp. 3.3-129 to 3.3-168).

Coho Salmon

The wide distribution and use of tributaries by both juvenile and adult coho salmon will likely protect the population from the worst effects of the Project. However, direct mortality is anticipated for redds and smolts from the upper Klamath River, mid-Klamath River, Shasta River, and Scott River population units. No mortality is anticipated for the Salmon River, Trinity River, and Lower Klamath River populations under the most likely or worst-case scenarios. Based on substantial reduction in the abundance of a year class in the short-term, the effect of the Project was found to be significant for the coho salmon from the Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units.

Based on spawning surveys conducted from 2001 to 2005 (Magneson and Gough 2006), 6 to 13 redds could be affected during reservoir drawdown. The anticipated loss of redds from the Upper Klamath River coho salmon population unit was based on the peak count of redds surveyed in all years (13 redds counted in 2001). Mainstem Upper Klamath River coho redd surveys completed between 2001 and 2016 yielded 6 redds on average and no redds in 2009. A total of 38 mainstem redds were documented between 2001-2005, with two-thirds of those redds being found within 12 miles of the dam (NMFS 2010). Many of the redds anticipated to be affected by the Project are thought to be from returning hatchery fish (NOAA 2010). To preserve existing genetic characteristics and to reduce the threat of demographic extinction, under the Iron Gate Hatchery's hatchery genetic management plan (HGMP), all adult coho salmon not used as broodstock have been returned to the Klamath River to spawn naturally since 2010. Many of these hatchery-origin adult coho salmon stray into Bogus Creek and the Shasta River to spawn while the remainder are thought to spawn in the Klamath River below Iron Gate Dam. Therefore, based on the range of escapement estimates in Ackerman et al. (2006), 13 redds could represent anywhere from 0.7 to 26 percent of the naturally returning spawners in the Upper Klamath River Population Unit, and likely much less than 1 percent of the natural and hatchery returns combined (Magneson and Gough 2006; USFWS, unpublished data, 2017).

Chinook Salmon – Fall Run

Fall Chinook salmon use the mainstem Klamath River for spawning, rearing, and as a migratory corridor. Direct mortality is predicted for fall Chinook salmon redds and some smolts. The effect of suspended sediment concentrations on juvenile fall Chinook salmon from the Project is expected to be relatively minor because of variable life histories, the large majority of age-0 juveniles that remain in tributaries until later in the spring and summer, and because many of the fry that out-migrate to the mainstem come from tributaries in the mid-or lower Klamath River, where suspended sediment concentrations resulting from the Project are expected to be lower due to dilution from tributaries.

Suspended sediment is predicted to result in 100 percent mortality of fall Chinook salmon eggs and fry spawned in the mainstem Klamath River during the fall prior to the reservoir drawdown year. Much of the overall effect on fall Chinook salmon will depend on the relative proportion of mainstem spawners during the fall prior to the reservoir drawdown year. Based on redd surveys using a mark and re-sight methodology from 1999 through 2009 (Magneson and Wright 2010), an average of 2,100 redds from hatchery and naturally returning adults are constructed in the mainstem Klamath River from Iron Gate Dam downstream to the Shasta River confluence and represents approximately 8 percent of the total, basin-wide escapement (USBR and CDFG 2012).

Steelhead – Summer and Winter

High suspended sediment concentrations resulting from the Project are anticipated to affect winter steelhead migrating during the winter and spring of the drawdown year, particularly for the portion of the population that spawns in tributaries upstream of the Trinity River (RM 43.4). For that portion of the population, effects are anticipated on adults, run-backs, half-pounders, any juveniles rearing in the mainstem, and out-migrating smolts. However, the broad spatial distribution of steelhead in the Klamath Basin and their flexible life history suggests that some steelhead will avoid the most serious effects of the Project by remaining in tributaries for extended rearing, rearing farther downstream where suspended sediment concentrations should be lower due to dilution, and/or moving out of the mainstem into tributaries and off-channel habitats during winter to avoid periods of high suspended sediment concentrations.

Additionally, the life history variability observed in steelhead means that, although numerous year classes will be affected, not all individuals in any given year class will be exposed to project effects. Some portion of the progeny of those adults that spawn successfully will also rear in tributaries long enough to not only avoid the highest suspended sediment concentrations but may also not return to spawn for up to 2 years, when suspended sediment resulting from the Project should be greatly reduced. The high incidence of repeat spawning among summer steelhead, ranging from 40 to 64 percent (Hopelain 1998) should also increase that population's resilience to project effects. Project modeling results suggest the loss of up to 1,988 winter steelhead redds and up to 130 summer steelhead redds (however, see updated steelhead population data in Section 3.2.3).

Pacific Lamprey

The Project will have short-term effects on Pacific lamprey related to high suspended sediment concentrations, bedload sediment transport and deposition, and impaired water quality (particularly low dissolved oxygen levels). Overall, because multiple year classes of Pacific lamprey rear in the mainstem Klamath River at any given time, and since adults will migrate upstream over the entire year, including the reservoir drawdown period when effects from the Project will be most pronounced, effects on Pacific lamprey adults and ammocoetes are anticipated to be substantial. However, because of their wide spatial distribution and varied life history, most of the population, (which is distributed from at least California along the Pacific Rim to Japan; Goodman and Reid 2012), will not be affected by the Project. In addition, Pacific lamprey are considered to have low fidelity to their natal streams (FERC 2006) and may not enter the mainstem Klamath River if environmental conditions are unfavorable during the reservoir drawdown period. Migration into the Trinity River and other lower Klamath River tributaries may also increase during the reservoir drawdown period because of poor water quality in the upper Klamath River. Low site fidelity and a prevalence of tributary ammocoetes also increases the potential for Pacific lamprey recolonization of mainstem habitats following the Project.

3.2.3 2012 EIS/R AR-1

The 2012 EIS/R AR-1 (Vol. I, pp. 3.3-242 to 3.3-243) directed the capture and relocation of adult spawning condition salmonids and Pacific lamprey to mitigate project effects. A weir and trap system was proposed for installation directly upstream of the Shasta River (RM 179.3), where the mainstem Klamath River is narrow enough to effectively trap migrating salmonids. This location was also specified to ensure that fish returning to key tributaries downstream of, and including the Shasta River, would not be interrupted. The weir was proposed to be installed at the beginning of the fall migration and fished past the initial dam drawdown period until high flows would require the trap be dismantled. Trap operation would occur intermittently to allow volitional passage of fish upstream of the trap location and would coincide with pulses of fish moving through the system. Trapped fish would then be transported and released either into under-seeded tributaries downstream of Iron Gate Dam (e.g., Scott River [RM 145.1]), or into tributaries or the mainstem Klamath River upstream of J.C. Boyle Reservoir (RM 234.1) if consistent with post-Project management goals.

If necessary, additional surveys in the mainstem Klamath River downstream of Shasta River were proposed to locate coho salmon spawning in the mainstem. Any identified adult coho salmon and Chinook salmon, steelhead, or Pacific lamprey could be captured using dip nets, electrofishing, or seines and transported to tributary habitat. Spawning surveys would be conducted in December prior to reservoir drawdown, immediately prior to the first release of sediment associated with the project.

3.2.4 KRRC's and ATWG's Review of AR-1 for Feasibility and Appropriateness

KRRC assessed the feasibility and appropriateness of AR-1 through multiple planning meetings held with the ATWG between May and August 2017. During these meetings, new information on Klamath River fisheries was presented and information on other dam removal projects conducted in the western United States was reviewed to understand how the aquatic ecosystem might respond as discussed above. Major concerns discussed by KRRC and ATWG regarding the 2012 AR-1 included:

- Feasibility of a weir and trap system during high flows and winter conditions.
- High anticipated mortality associated with trapping, handling, hauling, and releasing adult spawning condition fall Chinook salmon and coho salmon.
- Impacts to wild fish populations inhabiting streams used to relocate captured fish.
- Adult coho salmon location at time of the reservoir drawdowns.
- Chinook salmon with a high hatchery influence will be most affected by the reservoir drawdowns.
- 2012 EIS/R baseline population estimates and effects uncertainty.

The following sections provide additional information regarding AR-1 feasibility and appropriateness, based on fisheries literature and ATWG input.

Weir and Trap System Feasibility

The 2012 EIS/R proposed weir and trap location was above the Shasta River confluence (RM 179.3) with the Klamath River. AR-1 guidance anticipated that the weir would be removed periodically to allow for passage of coho salmon and fall Chinook salmon above the weir to the upper Klamath River and its tributaries, and Iron Gate Hatchery (RM 192.6). KRRC and the ATWG concluded that fall rains will increase river flows and will require weir and trap removal from the river. Periods of increasing flow would also likely correspond with the greatest quantities of fish moving into the upper Klamath River. The weir system would likely not be operational during the reservoir drawdown period when winter-spring steelhead and Pacific lamprey migration increases with high flows. Therefore, the weir system would be ineffective at mitigating effects to migrating winter steelhead and Pacific lamprey during periods of high flows.

KRRC and the ATWG concluded that it would likely be infeasible to trap and haul the large number of fish that could be encountered in the upper Klamath River in an efficient, safe, and cost-effective manner, and that if fish were relocated into tributary streams downstream of Iron Gate Dam prior to reservoir drawdown, there was a high probability that many of those fish would re-enter the Klamath River and spawn in the affected area. The number of returning coho salmon and fall Chinook salmon in the fall prior to reservoir drawdown will depend on several factors including year class strength, ocean conditions, ocean and lower river fisheries, and Klamath River water quality conditions during the spawning migration. While the number of fish that return to Iron Gate Hatchery (RM 192.6) vary widely, the average number of fish returning to the Klamath River upstream of the Shasta River confluence (RM 179.3) is substantial (Table 3-5) and would make trapping efforts intensive. For example, to trap the typically small numbers of natural origin coho salmon or winter steelhead upstream of the Shasta River confluence, there would be substantial effort to handle and sort large numbers of spawning condition hatchery fall Chinook salmon that may not be relocated. Given poor water quality conditions typical during the late summer migration, intensive fish handling, sorting, and transport could result in significant stress and mortality of the target species, as described below.

Ultimately, KRRC concluded that trapping using a weir style system, handling, and hauling a substantial portion of the typical returns to the upper Klamath River would be ineffective. There have also not been similar efforts conducted on other large dam removal projects to provide more certainty with this action.

Table 3-5 Fall Chinook salmon, coho salmon, and winter steelhead return metrics for Iron Gate Hatchery from 2000 to 2016

Return Metric	Fall Chinook Salmon	Coho Salmon	Winter Steelhead
Maximum Return	72,474	2,573	631[1]
Average Return	20,229	855	242
Minimum Return	8,176	70	4

Source: CDFW 2016
[1] The peak winter steelhead return to Iron Gate Hatchery from 2000 to 2016 was 631 fish. Using the 2012 EIS/R calculation method, 80 percent of fish returning to Iron Gate Hatchery migrate upstream after December 15th. Under the worst-case scenario, 71 percent of mortality is predicted to occur due to the Project. The 2012 EIS/R used a dataset published in 1994 (Busby et al. 1994) that included larger winter steelhead returns than have occurred over the last 27 years.

Mortality Associated with Trapping, Handling, Hauling, and Releasing Adult Spawning-condition Fall Chinook Salmon and Coho Salmon

KRRC and the ATWG concluded that spawning condition coho salmon and Chinook salmon will begin to reach the proposed weir location at RM 179.3 in late summer and early fall when water quality conditions are generally poor, and fish are susceptible to pre-spawn mortality due to stress and/or disease. Fish would potentially be more susceptible to disease and parasites associated with low flows, high water temperatures, and fish crowding. Given the expected condition of pre-spawn fish and poor water quality, the added stress associated with trapping, handling, hauling, and releasing captured fish is expected to result in high mortality of translocated fish.

Fish condition at the time of trapping influences mortality potential (Keefer et al. 2010). Primary injury and mortality events prior to fish transport are often associated with debris accumulation in the trap box, fish reaction to anesthesia, handling stress, and over-crowding in the trap box. Fish in overcrowded transport tanks may expire due to low oxygen concentrations and warm water temperatures. In a trap and haul study on the San Joaquin River in California, adult fall Chinook salmon were trapped and transported in November. Of the 119 fish that were handled, 4 percent of fish died prior to transport and 8 percent died during transport (Bigelow et al. 2013). A trap and haul study that evaluated effects on adult, sexually mature fall Chinook salmon reported mortality of 19 percent (Geist et al. 2016), substantially higher than a comparison experiment using adult rainbow trout (Mesa et al. 2013 *cited in* Geist et al. 2016). In a study of transport and pre-spawn mortality of adult fall Chinook salmon in the Willamette River, Keefer et al. (2010) found that adult spring Chinook salmon that were captured, transported, and out-planted above barrier dams in the Willamette River, Oregon suffered mean mortality of 48 percent, ranging from 0 to 93 percent for individual release groups. Mortality rates strongly correlated with fish condition and water temperature.

Delayed post-release, pre-spawn mortality has also been detected in other projects, with mortality likely related to transport stress rather than water quality or disease issues which would manifest in more rapid (hours) or longer term (weeks) mortality, respectively (Mann et al. 2011).

In summary, KRRC concluded the potential handling mortality and reduced spawning success associated with an intensive trap and haul program could result in significant losses of fall Chinook salmon and coho salmon and counter the expected benefits of a trap and haul effort.

Impacts to Wild Fish Populations Inhabiting Relocation Streams

KRRC and the ATWG expressed concerns regarding the relocation of fall Chinook salmon and coho salmon that are highly influenced by Iron Gate Hatchery genetics to tributaries potentially inhabited by wild fish with limited hatchery influence. KRRC and the ATWG also concluded that there would be few viable options for recipient tributary streams based on genetics and disease concerns.

The 2012 EIS/R AR-1 was in part intended to assist in the reintroduction of anadromous salmonids upstream of Iron Gate Dam. Contrary to ODFW's draft reintroduction plan (2008), ODFW is currently developing a reintroduction strategy for anadromous fish in the Upper Klamath Basin that is expected to rely primarily on natural recolonization of the Klamath River and associated tributaries upstream of Iron Gate Dam (T. Wise, ODFW, personal communication). CDFW is likewise concerned with introducing coho and Chinook salmon of unknown genetics and disease condition into wild populations that spawn in the Klamath River and tributaries.

Chinook salmon exhibit substantial population genetic structure across the species' geographic range including the Klamath River Basin (Kinziger et al. 2013). Chinook salmon in the Klamath River Basin exhibit a complex genetic structure defined primarily by basin geography. The Iron Gate Hatchery (RM 192.6) has a profound influence on Klamath River fall Chinook salmon in the vicinity of the hatchery. Kinziger et al. (2013) found the proportion of naturally spawning fall Chinook salmon of Iron Gate Hatchery origin decreased with distance from the hatchery. Natural origin Chinook sampled in Bogus Creek (RM 192.6), Shasta River (RM 179.3), and the Scott River (RM 145.1) had decreasing proportions of hatchery genetics with increasing distance from the hatchery. Fall Chinook salmon spawning between Iron Gate Dam (RM 193.1) and the Shasta River (RM 179.3) exhibit the greatest introgression of Iron Gate Hatchery fish genes.

The influence of Iron Gate Hatchery genetics on fall Chinook salmon is greatly diminished by the Scott River (RM 145.1).

In light of these considerations, relocating fall Chinook salmon from downstream of Iron Gate Dam to Klamath River tributaries would have been restricted to tributaries between Iron Gate Dam and the Shasta River to minimize genetic effects to tributary populations. However, moving fish with a higher proportion of hatchery-influenced genetics farther from the hatchery had the potential to extend the hatchery's introgressive influence to downstream fall Chinook salmon populations that are outside of the direct influence of Iron Gate Hatchery (Kinziger et al. 2013). Additionally, streams between Iron Gate Dam (RM 193.1) and the Shasta River (RM 179.3) that support fall Chinook spawning are currently limited by water availability and quality during the fall spawning migration period.

In summary, KRRC and the ATWG concluded that relocating fall Chinook salmon and coho salmon of unknown genetic composition to the Klamath River upstream of Iron Gate Dam or to under-seeded tributaries near Iron Gate Dam presents an unacceptable genetic risk (and possibly disease risk) to other populations potentially dominated by wild fish.

Adult Coho Salmon Location at Time of the Reservoir Drawdowns

KRRC and the ATWG concluded that since coho salmon primarily spawn in Klamath River tributaries, adult coho salmon will largely be unaffected by poor water quality conditions associated with reservoir drawdown in the mainstem Klamath River. Additionally, it is likely that the small numbers of coho that do spawn in the mainstem river are mostly of Iron Gate Hatchery origin (NOAA 2014). Expected mortality associated with trapping, handling, hauling, and releasing adult coho salmon would stress fish that would not be affected by reservoir drawdown if these fish were instead allowed to reach their spawning tributaries (e.g., Bogus Creek). The reservoir drawdown schedule was also in part developed to account for coho salmon entry into tributaries to minimize project effects. Attempting to capture small numbers of mainstem spawning coho salmon would likely impact greater numbers of coho than would be impacted by project activities.

Overall, KRRC and the ATWG concluded a trap and haul program as prescribed in the 2012 EIS/R would negatively affect coho salmon that would otherwise migrate to their native tributary streams in the upper Klamath River.

2012 EIS/R Baseline Population Estimates and Project Effects Uncertainty

Effects to adult fish outlined in the 2012 EIS/R included approximations and assumptions that were based on limited data on Klamath River anadromous salmonids and Pacific lamprey populations; incorporated a conservative analysis of fish avoidance behavior to the anticipated water quality conditions; and in part included a worst-case scenario analysis of project effects on adult salmonids and Pacific lamprey. The following sections provide updated population information for winter steelhead and Pacific lamprey and identifies project effects uncertainties that should be considered in updating the effects determinations.

Steelhead Population Update

Steelhead data for the Klamath River Basin upstream of the Trinity River are limited. Population data for winter steelhead in the 2012 EIS/R were based on Iron Gate Hatchery returns published in 1994 (Busby et al. 1994). In a strong return year based on the 1994 dataset, 3,500 adult winter steelhead returned to Iron Gate Hatchery (USBR and CDFG 2012). The 2012 EIS/R analysis estimated that there would be 71 percent mortality to 80 percent of those fish based on run timing and effects of suspended sediment. Using updated winter steelhead counts for the Iron Gate Hatchery from 2000 to 2016 (Table 3-2), the peak and average numbers of adult winter steelhead returning to Iron Gate Hatchery were 631 and 242 steelhead, respectively Although returns to Iron Gate Hatchery may not be indicative of broader trends in adult winter steelhead returns to the Klamath River, these data do provide an updated metric for estimating anticipated effects of the Project on adult steelhead. Using the same methodology to establish the anticipated mortality to winter steelhead as contained in the 2012 EIS/R, but applied to the 2000-2016 steelhead return data, effects to steelhead would result in a loss of 358 and 138 steelhead on a peak and average year, respectively.

Video monitoring conducted in Bogus Creek and the Shasta River by CDFW between 2007 and 2016 provides additional context to the recent abundance of upper Klamath steelhead populations. Average returns of adult steelhead counted by video were 53 and 102 steelhead for Bogus Creek and the Shasta River, respectively, during the 10-year period. However, many of those years video monitoring was terminated in December or January and did not capture the full steelhead migration period. In years where video monitoring or a combination of video counts and SONAR counts covered the full migration period (2013 and 2016 for Bogus Creek and 2012, 2015, and 2016 for Shasta River) total steelhead counted averaged 94 for Bogus Creek and 194 for the Shasta River (CDFW, unpublished data, 2017). Likewise, no steelhead have been produced at Iron Gate Hatchery since 2012 (K. Pomeroy, CDFW, personal communication, 2017). *Pacific Lamprey Population Update*

Recent genetic analysis of Pacific lamprey suggests no significant population structure exists across populations or regions, indicating a high degree of historical gene flow even across expansive distances of the northern Pacific Rim (Goodman and Reid 2012). Weak population structure and low site fidelity minimize the short-term effects to Pacific lamprey identified in the 2012 EIS/R. Because the metapopulation is now believed to be relatively undifferentiated across the species' range, the percentage of adult and larval Pacific lamprey that will be affected by the Project relative to the population as a whole will be insignificant.

Project Effects Uncertainty

Studies suggest that high suspended sediment concentrations (Newcombe and Jensen 1996; Chapman et al. 2014; Kjelland et al. 2015) and low dissolved oxygen concentrations (Bjorn and Reiser 1991; Washington Department of Ecology [WDOE] 2002; Carter 2005) affect adult salmonid behavior. Adult salmonid behavioral changes to high suspended sediment concentrations include avoidance of turbid waters in homing adult anadromous salmonids. Physiological effects of high turbidity include physiological stress and respiratory impairment, damage to gills, reduced tolerance to disease and toxicants, reduced survival, and direct mortality (Newcombe and Jensen 1996). Concentration and duration of elevated suspended sediment, as well as other factors including water temperature, disease, and river flow, influence the effect of suspended sediment on salmonids.

The effects of low dissolved oxygen levels, eutrophication, or turbidity on natural populations of Pacific lamprey adults and ammocoetes are unknown. Adult steelhead and Pacific lamprey entering the Klamath River during reservoir drawdown and dam removal would encounter poor water conditions and would be expected to avoid poor water quality by either entering tributary streams or using habitats less affected by high suspended sediment concentrations (e.g., tributary confluences or off-channel areas). For instance, in 2012 during dam deconstruction on the Elwha River, a high proportion (44 percent) of Chinook salmon redds were documented in two clear water tributaries (Indian Creek and Little River), while surveys conducted following dam removal activities (2014-2016) resulted in over 95 percent of Chinook redds constructed in the mainstem river. The high proportion of tributary spawning by fall Chinook salmon in 2012 suggests that these streams provided refugia from the effects of dam removal (McHenry et al. 2017). There is increasing evidence that fish will modify their behavior to avoid areas of high suspended sediment concentrations levels immediately following dam removal, thereby reducing the impact of reduced water quality on their populations. This is consistent with ecological and evolutionary theories that predict that fish evolve behaviors to avoid episodic events resulting is poor water quality, such as landslides, fires, and other naturally occurring processes.

The approach presented in the 2012 EIS/R to determine the anticipated effects assumed that fish would not exhibit any of these behavioral responses and instead suffer mortality by voluntarily remaining in areas that had lethal concentrations of suspended sediment for extended periods of time.

Effects to fall Chinook salmon are muted by the fact that any cohort is made up of several age classes of spawners. Grilse and adult returns the year following dam removal will be comprised of age-2, 3, 4, and 5 fish that will be in the ocean during the Project. Benefits of the Project that are expected to be evident the first year following dam removal include increased mainstem and tributary spawning habitat, reduction in disease-induced mortality, and reduction or elimination of redd-superimposition in spawning areas downstream of Iron Gate Dam (N. Hetrick, USFWS, personal communication, 2017). The improved conditions for fall Chinook salmon following the Project will bolster multiple age classes in the short and long-term, producing larger overall adult run sizes even with the anticipated short-term effects of the Project.

3.3 Measure Summary

The Project is anticipated to have significant short-term effects, but long-term benefits for fall Chinook salmon, coho salmon, winter steelhead, and Pacific lamprey. The 2012 EIS/R AR-1 included installing a weir and trap system on the Klamath River immediately upstream from the Shasta River confluence. The trap was proposed to be operated periodically to trap and haul fish for release into under-seeded tributaries upstream and downstream from Iron Gate Dam. The ATWG highlighted several concerns associated with the 2012 EIS/R AR-1, including trapping feasibility, handling mortality, potential genetic and disease effects of relocated fish on wild populations, disruption of adult coho salmon migration to spawning tributaries, and uncertainty of anticipated effects of the Project on adult salmonids and Pacific lamprey. The ATWG stated that these concerns could result in the 2012 EIS/R AR-1 being ineffective at reducing the Project's impacts and potentially introducing additional risks to adult anadromous salmonids and Pacific lamprey populations. Therefore, the ATWG determined that additional options in the proposed measure are warranted.

The proposed measure includes the development and implementation of a monitoring and adaptive management plan to offset Project effects on mainstem spawning. Proposed actions include a 2-year tributary confluence monitoring effort that begins in January of the drawdown year and addressing sediment and debris obstructions that block volitional passage between the Klamath River and key tributaries. The second action includes a spawning habitat evaluation on the Klamath River and tributaries in the Hydroelectric Reach following reservoir drawdown, or approximately March of the drawdown year. If existing spawning habitat conditions do not meet target metrics in the mainstem Klamath River, then spawning gravel augmentation will be completed. If the existing spawning habitat conditions do not meet target metrics in the key tributaries in the Hydroelectric Reach, then the ATWG will be consulted to identify priority restoration activities to increase tributary spawning habitat availability (e.g., large woody debris placement for gravel retention).

Chapter 4: Juvenile Outmigration

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4. JUVENILE OUTMIGRATION

The objective of the measure is to address project effects on juvenile anadromous fish in the Klamath River downstream from Iron Gate Dam. The 2012 EIS/R AR-2 focused on trapping and hauling juvenile anadromous salmonids and Pacific lamprey from 13 key tributaries prior to juvenile entry into the mainstem Klamath River during the Project. Trapped fish would have been trapped, hauled and released into the Klamath River downstream from the Trinity River confluence where suspended sediment concentrations will be diluted by tributary inputs to sublethal concentrations. The proposed measure, based on the 2012 EIS/R AR-2, includes three actions: (1) sampling and salvaging yearling coho salmon from key locations in the Klamath River from Iron Gate Dam (RM 193.1) to the Trinity River confluence (RM 43.4) and relocating captured fish to constructed off-channel ponds prior to reservoir drawdown; (2) monitoring and ensuring tributary-mainstem connectivity; and (3) monitoring juvenile salmonids and water quality conditions at the 13 key tributaries, and salvaging and relocating juvenile salmonids if water quality thresholds are exceeded. The proposed actions are the best opportunities based on available science to offset the effects of reservoir drawdown on juvenile anadromous fish.

4.1 Proposed Measure

Based on a review of the 2012 EIS/R AR-2 presented in Section 4.2, input from the ATWG, and recent fisheries literature, the KRRC concluded AR-2 should be modified to offset the anticipated short-term effects of the Project on outmigrating juvenile fish. The proposed measure includes three actions targeting juvenile salmonids.

- **Action 1:** KRRC will sample and salvage overwintering juvenile coho salmon from the Klamath River between Iron Gate Dam (RM 193.1) and the Trinity River (RM 43.4) confluence prior to reservoir drawdown. Sampling and salvage sites will focus primarily on alcoves, side channels, and backwatered floodplain features adjacent to the mainstem Klamath River. Up to 500 juvenile coho salmon are anticipated to be caught and relocated to off-channel ponds in order to protect this small, but important life history strategy in ESA-listed coho salmon population.
- **Action 2:** KRRC, with input from the ATWG, will prepare a monitoring and adaptive management plan to monitor tributary-mainstem connectivity. Beginning in January of the drawdown year and continuing for 2 years, tributary-mainstem confluences, including four sites in the Hydroelectric Reach and five sites in the 8-mile reach from Iron Gate Dam (RM 193.1) to Cottonwood Creek (RM 185.1), will be monitored with a variable frequency based on the season and year (see Table 4-1 for proposed schedule). Additionally, any 5-year flow event of 10,895 cfs or greater on the Klamath River recorded at the USGS Klamath River Below Iron Gate Dam CA gage (#11516530) within the first two years following reservoir drawdown, will trigger a monitoring effort. If KRRC identifies tributary confluence blockages during monitoring, KRRC will employ necessary means to remove the obstructions to ensure volitional passage for juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey. Juvenile salmonids are expected to benefit from the Project because it will restore

access to at least 13.9 miles of key tributary rearing habitats in the Hydroelectric Reach and several recognized thermal refugia areas including Jenny and Fall creeks.

- **Action 3:** KRRC will prepare and implement a monitoring and adaptive management plan that will include detailed information related to monitoring juvenile salmonids and water quality conditions in 13 key tributary confluences between Iron Gate Dam (RM 193.1) and the Trinity River (RM 43.4). Tributary water temperatures and mainstem suspended sediment concentrations will be monitored by KRRC from March 1 to July 1 of the drawdown year. If water quality triggers are exceeded, KRRC and the ATWG will convene to evaluate the data and determine if juvenile salmonids will be salvaged from the tributary confluences and relocated to cool water tributaries, existing off-channel ponds, and/or to the Klamath River downstream from the Trinity River confluence.

The proposed actions are intended to reduce project effects on juvenile salmonids and Pacific lamprey during reservoir drawdown. The following sections provide additional detail on the proposed actions.

4.1.1 Action 1: Mainstem Salvage of Overwintering Juvenile Salmonids

The following sections provide information pertaining to mainstem salvage of overwintering juvenile salmonids, particularly yearling coho salmon.

Reconnaissance

KRRC will sample up to 15 sites between Iron Gate Dam (RM 193.1) and the Trinity River (RM 43.4) during December one year prior to the start of reservoir drawdown to determine the presence and relative abundance of yearling coho salmon. While low numbers of yearling coho salmon (<500) are expected to be encountered, these fish will be particularly vulnerable to the effects of elevated suspended sediment concentrations from reservoir drawdown and represent a small, but important life history strategy in the ESA-listed coho salmon population (T. Soto, Karuk Tribe, personal communication, 2017). Juvenile coho salmon overwintering downstream of the Trinity River will not be targeted for sampling or salvage efforts as water quality conditions associated with the reservoir drawdown period are expected to be similar to existing conditions (USBR and CDFG 2012). Sites upstream of the Trinity River that will be sampled include alcoves, side channels, and backwatered floodplain areas that do not have sufficient tributary inflows to provide refuge from expected high SSC in the mainstem Klamath River during reservoir drawdown. Priority will be given to sites closer to Iron Gate Dam where SSC are expected to be highest. Final site selection for the reconnaissance effort will be determined in consultation with ATWG.

Overwintering Juvenile Salmonids Salvage and Relocation

Following KRRC's reconnaissance effort, an overwintering yearling coho salmon relocation effort will be conducted by KRRC in December prior to reservoir drawdown. KRRC salvage efforts will take place as close to scheduled drawdown as possible to avoid capturing coho salmon that are migrating to overwintering habitats located in tributary streams or in the lower Klamath River below the Trinity River confluence. The number of sites will be based on the results of the 2019 reconnaissance effort although it is anticipated that up to 15 sites will be seined and trapped. A two-day effort with a 4-person crew and transport truck is anticipated at each site. A minimum of two weeks will be allocated to the salvage and relocation effort. The expected total catch of overwintering juvenile coho salmon in mainstem and off-channel habitats of the Klamath River is expected to be less than 500 individuals based on previous sampling efforts conducted by the Yurok Tribe and Karuk Tribe (Hillemeier et al. 2009). Seined and trapped juvenile coho salmon would be transported to existing off-channel ponds located on Seiad Creek (RM 131.9), West Grider Creek (RM 131.8), Horse Creek/ Middle Creek (RM 116.0), Stanshaw Creek (RM 77.1), and Camp Creek (RM 57.4) or other natural beaver ponds or floodplain channels that are located in close proximity to the salvage sites and that are unaffected by elevated SSCs in the mainstem Klamath River. Coho salmon will be relocated to the off-channel habitat located closest to the salvage site and will be transported by using aerated buckets with lids or by transport truck if necessary. Other native fish captured during the seining and trapping effort, such as juvenile steelhead and juvenile Chinook salmon will be relocated into tributary streams adjacent to the salvage locations. Fish relocated to off-channel ponds will be allowed to volitionally move between ponds and tributary streams. Final relocation sites will be identified after the completion of the reconnaissance effort and in consultation with the ATWG.

4.1.2 Action 2: Tributary-Mainstem Connectivity Monitoring

The following sections provide information on KRRC's monitoring and adaptive management plan pertaining to tributary-mainstem connectivity.

Tributary-Mainstem Connectivity Monitoring

To ensure that rearing habitat is accessible following reservoir drawdown, KRRC will complete fish passage monitoring and adaptive actions at the confluence areas of key Klamath River tributaries and side channels upstream and downstream of Iron Gate Dam for a 2-year period beginning with reservoir drawdown (see Table 4-1 for proposed schedule). Tributary confluences in the Hydroelectric Reach may be affected by sediment deposits and debris obstructions as the reservoirs are drawn down. Tributary deltas may create fish passage barriers that will limit upstream migration of anadromous salmonids and Pacific lamprey.

Based on hydraulic and sediment transport modeling completed by USBR (Section 9.2.1.4; 2011), sediment deposition during reservoir drawdown is predicted from Bogus Creek (RM 192.6) downstream to Cottonwood Creek (RM 185.1). From Bogus Creek (RM 192.6) downstream to Willow Creek (RM 188.0), approximately 1.5 feet of sediment deposition is anticipated. From Willow Creek downstream to Cottonwood Creek, deposition of less than 1 foot is expected. Areas downstream of Cottonwood Creek are expected to have only minor deposition with deposits less than 0.25 feet (USBR 2011). No additional deposition is predicted in the Bogus Creek to Cottonwood Creek reach following the Project.

Species that will be potentially affected by obstructed tributary connections include outmigrating Chinook salmon, coho salmon, steelhead and Pacific lamprey during and following reservoir drawdown. Further, depending on erosion rates of reservoir sediments, tributary confluences in the reservoir areas may not meet fish passage conditions following drawdown.

Tributary confluences to be monitored in the 2-year period following reservoir drawdown include Bogus Creek (RM 192.6), Dry Creek (RM 190.9), Little Bogus Creek (RM 189.8), Willow Creek (RM 188.0), and Cottonwood Creek (185.1). Tributaries in the Bogus Creek to Cottonwood Creek reach were selected as they are recognized as influential tributaries (e.g., historical fisheries importance or important freshwater sources) in the mid-Klamath River (Soto et al. 2008). Hydroelectric Reach tributaries to be monitored include Spencer Creek (RM 233.4), Shovel Creek (RM 212.0), Fall Creek (RM 198.9), and Jenny Creek (RM 197.4). These tributaries were selected based on having historical or potential habitat for adult salmonids (Huntington 2006).

Tributary confluences will be monitored according to the schedule presented in Table 4-1. If present, confluence obstructions will be actively removed by KRRC during the 2-year evaluation period to ensure volitional passage for juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey. In addition to the monitoring effort outlined in Table 4.1, the tributary confluences will also be monitored by KRRC after any flow that is greater than a 5-year flow event that occurs during the first two years following reservoir drawdown.

Table 4-1 Outmigrating Juveniles Measure monitoring frequency for tributaries in the Hydroelectric Reach and Iron Gate Dam (IGD) to Cottonwood Creek reach for the drawdown year and post-drawdown year.

Monitoring Reach	Monitoring Period	Monitoring Frequency
Hydroelectric Reach 4 tributaries	Drawdown Year (2021-2022)	
	April 1 – June 30	Bi-weekly
	July 1 – September 30	Monthly
	October 1 – December 31	Weekly
	2nd Year (2022-2023)	
	January 1 – March 31	Weekly
	April 1 – June 30	Bi-weekly
	July 1 – September 30	Monthly
	October 1 – December 31	Bi-weekly
IGD to Cottonwood Creek 5 tributaries	Drawdown Year (2021-2022)	
	January 1 – March 31	Weekly
	April 1 – June 30	Bi-weekly
	July 1 – September 30	Monthly
	October 1 – December 31	Weekly
	2nd Year (2022-2023)	
	January 1 – March 31	Weekly
	April 1 – June 30	Bi-weekly
	July 1 – September 30	Monthly
	October 1 – December 31	Bi-weekly

Tributary Connectivity Maintenance

KRRC will monitor tributary confluences in both reaches at variable frequencies depending on the season and time period (see Table 4-1). Project-related tributary obstructions that limit fish passage will be remedied by KRRC through appropriate manual or mechanical means necessary to address obstructions. Example removal methods may include removing sediment using hand tools or hydraulic equipment. Removed gravels and large woody debris will be placed in the Klamath River downstream of the tributary confluence. Removed fine sediments will be placed on the adjacent floodplain or outhauled for disposal. The removal effort will be to the extent necessary to ensure volitional passage for adult and juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey.

4.1.3 Action 3: Rescue and Relocation of Juvenile Salmonids and Pacific Lamprey from Tributary Confluence Areas

The following sections provide information on the monitoring and adaptive management plan pertaining to salvage and relocation of juvenile salmonids and lamprey ammocoetes from tributary confluence areas.

Tributary and Mainstem Water Monitoring and Juvenile Fish Salvage

KRRC will develop a monitoring and adaptive management plan that will include monitoring juvenile salmonids and water quality conditions in 13 key tributary confluences between Iron Gate Dam (RM 193.1) and the Trinity River confluence (RM 43.4). Tributaries to be monitored include Bogus Creek (RM 192.6), Dry Creek (RM 190.9), Cottonwood Creek (RM 185.1), Shasta River (RM 179.3), Humbug Creek (RM 173.9), Beaver Creek (RM 163.3), Horse Creek (RM 149.5), Scott River (RM 145.1), Tom Martin Creek (RM 144.6), O'Neil Creek (RM 139.1), Walker Creek (RM 135.2), Grider Creek (RM 132.1), and Seiad Creek (RM 131.9).

Water temperatures in tributary streams will be monitored between March 1 and July 1 of the drawdown year. SSC will be measured continuously following drawdown at water quality stations throughout the mainstem Klamath River including Iron Gate Dam, Seiad Valley, and Orleans. A standing weekly call with the ATWG will be established beginning in January of the year of reservoir drawdown. On a weekly basis, the ATWG will evaluate current water quality conditions in the Klamath River downstream of Iron Gate Dam and tributaries, recent observations of fish behavior from agency and tribal biologists and technicians, and upcoming hydrologic and meteorological forecasts. If key tributary water temperatures reach 17 °C (7-day average of the daily maximum values) and Klamath River SSCs remain elevated above 1,000 mg/L, or if observed behaviors of juvenile salmonids inhabiting tributary confluences necessitate salvage, the ATWG will convene to organize the logistics for juvenile salvage and relocation efforts. The ATWG may also deem that a salvage effort is necessary based on the presence of large numbers of juvenile salmonids at tributary confluence areas if observations of fish behavior indicate that stress coupled with forecasted conditions are likely to lead to high mortality of juvenile fish.

The salvage effort will include capturing fish from confluence areas, loading them to aerated transport trucks, and relocating them to cool water tributaries or off-channel ponds including, but not limited to the Seiad Creek complex (RM 131.9). The Seiad Creek complex includes constructed off-channel ponds and connected cool water tributary channels. The complex provides juvenile salmonids with a variety of habitats that they can choose to use. If the number of salvaged fish exceeds the capacity of the Seiad Creek complex, juvenile salmonids may also be relocated to Beaver Creek (RM 163.3), Cade Creek (RM 110.9), Elk Creek (RM 107.2), Tom Martin Creek (RM 144.6), and Sandy Bar Creek (RM 77.8) as well as constructed off-channel ponds located on West Grider Creek (RM 131.8), Camp Creek (RM 57.4), and Stanshaw Creek (RM 77.1). Juvenile Chinook salmon, steelhead, and Pacific lamprey ammocoetes may be transported to the mainstem Klamath River below the confluence of the Trinity River if suitable tributary habitat is unavailable closer to the salvage sites, or if the estimated carrying capacity of those tributary sites has been reached. A multi-day salvage effort will be conducted at the confluence of the Shasta and Scott rivers and single day salvage efforts will be conducted at other tributary confluence areas by a 4-person crew and 2 transport trucks during the March 1 to July 1 monitoring period. Multiple salvage and transport days may be necessary at the Shasta and Scott River confluences based on juvenile salmonid abundance in the two tributaries.

4.2 Summary of the Affected Species, Project Benefits and Effects, Recent Fisheries Literature, the 2012 EIS/R AR-2, and the Proposed Measure

The following sections review the components of the 2012 EIS/R AR-2, anticipated project effects and benefits on measure species, and recent fisheries literature relative to juvenile salmonid outmigration. This information is presented in support of the proposed measure.

4.2.1 Affected Species

Species identified in the measure include:

- Coho salmon *(Oncorhynchus kisutch)* – Southern Oregon/Northern California Coastal (SONCC) evolutionary significant unit (ESU): Federally Threatened; California Threatened; Tribal Trust Species
- Chinook salmon *(O. tshawytscha)* – Upper Klamath-Trinity Rivers ESU - Fall Run: California Species of Special Concern; Tribal Trust Species
- Chinook salmon *(O. tshawytscha)* – Upper Klamath-Trinity Rivers ESU – Spring Run: California Species of Special Concern; Tribal Trust Species
- Steelhead *(O. mykiss)* – Klamath Mountains Province distinct population segment (DPS) – Summer Run: California Species of Special Concern; Tribal Trust Species
- Steelhead *(O. mykiss)* – Klamath Mountains Province DPS – Winter Run: Tribal Trust Species
- Pacific lamprey *(Entosphenus tridentatus)* - California Species of Special Concern; Tribal Trust Species

4.2.2 Anticipated Project Effects on Measure Species

Short-term effects of the Project are expected to result in mostly sublethal, and in some cases lethal, impacts to a portion of the juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey that are outmigrating from tributary streams to the Klamath River during late winter and early spring of the drawdown year. Deleterious short-term effects are expected to be caused by high suspended sediment concentrations and low dissolved oxygen levels in the Klamath River from Iron Gate Dam (RM 193.1) downstream to Orleans (RM 59.0). Under the worst-case scenario, lost juvenile production in the Upper Klamath River, Middle Klamath River, Shasta River, and Scott River, includes the loss of up to: 669 fall Chinook salmon smolts, 6,536 coho smolts, 11,207 age-1 steelhead, 9,412 age-2 steelhead (USBR and CDFG 2012). Table 4-2 includes the 2012 EIS/R analysis of the likely and worst-case effects to anadromous outmigrating juveniles downstream from Iron Gate Dam.

Table 4-2 2012 EIS/R anticipated effects summary for outmigrating juvenile salmonids and Pacific lamprey ammocoetes

Species	Life Stage	Likely Effects	Worst Effects
Coho Salmon	Outmigrating Smolts	Loss of 2,668 (3%)	Loss of 6,536 (8%)
Chinook Salmon - Fall	Type III Smolts	Loss of 0-189 (<0.02%)	Loss of 0-669 (<0.07%)
Steelhead	Age-1+ Rearing[1]	Loss of up to 8,200 (14%)	Loss of up to 11,207 (19%)
	Age-2+ Rearing	Loss of up to 6,893 (13%)	Loss of up to 9,412 (18%)
Pacific Lamprey	Ammocoetes	High mortality (52%)[2]	High mortality (71%)[2]

Source: USBR and CDFG 2012

[1] Under existing conditions there is 20 percent mortality predicted for Age-1+ rearing.
[2]The 2012 EIS/R predicted Pacific lamprey mortality based on mortality models developed for suspended sediment impacts to salmonids. Model output did not include the number of predicted Pacific lamprey mortalities.

The following sections include descriptions of species-specific effects as analyzed in the 2012 EIS/R (USBR and CDFG 2012; Vol. I, pp. 3.3-129 to 3.3-168).

Coho Salmon

The wide distribution and use of tributaries by both juvenile and adult coho salmon will likely protect the population from the worst effects of the Project. However, direct mortality is anticipated for redds and smolts from the upper Klamath River, mid-Klamath River, Shasta River, and Scott River population units. No mortality is anticipated for the Salmon River, Trinity River, and Lower Klamath River populations under the most likely or worst-case scenarios. Based on substantial reduction in the abundance of a year class in the short-term, the effect of the Project was found to be significant for the coho salmon from the Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units.

Age-1 juveniles that have either successfully over-summered or moved from tributaries into the mainstem in fall could be exposed to much higher suspended sediment concentrations in the mainstem during the winter of facility removal than under existing conditions, and may suffer mortality rates of up to 52 percent under a worst-case scenario (USBR and CDFG 2012). However, many juveniles in the mainstem Klamath River appear to migrate to the lower river to rear and may avoid adverse conditions in the mainstem by using tributary or off-channel habitats during winter, thus reducing their exposure and potential mortality (Hillemeier et al. 2009; Soto et al. 2009), consistent with the observation that juvenile salmonids avoid turbid conditions (Sigler et al. 1984; Servizi and Martens 1992). This strategy may be even more pronounced under elevated suspended sediment concentrations expected as a result of the Project. Overall, it is not known how many juveniles rear in the mainstem during winter, but it is assumed to be a small (<1 percent) proportion of any of the coho salmon populations (USBR and CDFG 2012).

Coho salmon smolts from the cohort prior to reservoir drawdown are expected to outmigrate to the ocean beginning in late February, although the majority of coho smolts typically outmigrate to the mainstem Klamath during April and May (Wallace 2004). During migrant trapping studies from 1997 to 2006 in tributaries upstream of and including Seiad Creek (Horse Creek, Seiad Creek, Shasta River, and Scott River), 44 percent of coho smolts were captured from February 15 to March 31, and 56 percent from April 1 through the end of June (Courter et al. 2008).

Smolts outmigrating from the tributaries described above prior to April 1, are likely to suffer up to 60 percent mortality under the 2012 EIS/R worst-case scenario (USBR and CDFG 2012). Based on modeled population estimates presented in Courter et al. (2008), the anticipated 60 percent mortality would represent a loss of up to 6,536 smolts from the Upper Klamath River, Shasta River, Scott River, and Middle-Klamath River coho populations.

Smolts outmigrating after April 1 would be exposed to lower suspended sediment concentrations and may experience only slightly worse physiological stress and reduced growth rates compared with existing conditions, even under the worst-case scenario (USBR and CDFG 2012).

Chinook Salmon – Fall Run

Fall Chinook salmon use the mainstem Klamath River for spawning, rearing, and as a migratory corridor. Effects of suspended sediment concentrations on juvenile fall Chinook salmon from the Project are expected to be relatively minor because of varied life histories. During juvenile salmonid outmigration trapping conducted at Big Bar (RM 49.7) on the Klamath River between 1997-2000, very few Chinook were captured outmigrating through the lower river before the beginning of June (USFWS 2001). The large majority of age-0 juveniles (Type I outmigrants) remain in tributaries until later in the spring and summer when water quality conditions are expected to be improved relative to late winter and early spring. Type II outmigrants typically rear in tributaries before outmigrating to the mainstem Klamath River and estuary in fall (Sullivan 1989). Additionally, many of the fry that outmigrate to the Klamath River originate in tributaries in the mid or lower Klamath River, where suspended sediment concentrations resulting from the Project are expected to be lower due to dilution from tributaries (USBR and CDFG 2012). Based on trapping data from Big Bar, approximately 63 percent of Chinook smolts are Type I outmigrants and 37 percent are Type II outmigrants (USFWS 2001).

A small proportion of juvenile Chinook salmon typically remain to rear in the spawning tributaries until outmigrating in late winter and early spring as yearlings (Type III outmigrants). Although fish exhibiting this life history trait would be most susceptible to the effects of suspended sediment concentrations, these fish represent a very small proportion (<1 percent of all production) of the Klamath River fall Chinook salmon population (USFWS 2001). Based on outmigrant trapping in the mainstem Klamath River at Big Bar, only 31 Type III outmigrating smolts were captured over 4 years, representing approximately 0.1 percent of the total catch. Based on yearly abundance estimates, this equates to approximately 943 total Type III smolts per year (USFWS 2001). Under the 2012 EIS/R worst-case scenario, mortality rates of up 71 percent are predicted during the Project, equating to 669 smolts, or approximately 0.07 percent of the total fall Chinook salmon smolt production. Type I and Type II juvenile outmigrants are expected to experience only sublethal effects (USBR and CDFG 2012).

Steelhead – Summer and Winter

Juvenile steelhead rear in the mainstem Klamath River, Klamath River tributaries, and the estuary. Since most (>90 percent) juvenile steelhead smolt at age-2, those juveniles leaving tributaries to rear in the mainstem will be exposed to elevated suspended sediment concentrations resulting from the Project through both winter and spring (USBR and CDFG 2012). Based on captures in tributaries and the mainstem, approximately 40 percent of the population rears in tributaries until age-2 (USFWS 2001) and will only be susceptible to mainstem water quality conditions during outmigration. The approximately 60 percent of the rearing population that outmigrates from tributaries as age-0 or age-1 fish, and rears for extended periods in the mainstem upstream of Trinity River, would likely be exposed to much higher suspended sediment concentrations than under existing conditions, with mortality rates up to 100 percent under the worst-case scenario (USBR and CDFG 2012).

Despite these anticipated mortality rates, the broad spatial distribution of steelhead in the Klamath Basin and their flexible life histories suggest that some steelhead will avoid the most serious effects of the Project by remaining in tributaries for extended rearing, rearing farther downstream where suspended sediment concentrations is expected to be lower due to tributary dilution, and/or moving out of the mainstem into tributaries and off-channel habitats to avoid periods of high suspended sediment concentrations. From past studies, many of these juveniles avoid conditions in the mainstem by using tributary and off-channel habitats during winter, which would reduce their exposure to poor water quality during the Project (Hillemeier et al. 2009; Soto et al. 2009), consistent with the observation that juvenile salmonids avoid turbid conditions (Sigler et al. 1984; Servizi and Martens 1992). Most smolts outmigrate in the fall, so many juveniles should already be in the estuary or ocean when initial pulses in sediment occur after December 31 prior to reservoir drawdown, or they may migrate out of the mainstem later in the winter after suspended sediment concentrations decrease.

Life history variability observed in steelhead means that, although numerous year classes will be affected, not all individuals in any given year class will be exposed to project effects. Some portion of the progeny of those adults that spawn successfully in winter and spring of the reservoir drawdown year would also rear in tributaries long enough to not only avoid the highest suspended sediment concentrations but may also not return to spawn for up to 2 years, when suspended sediment resulting from the Project should be greatly reduced. The high incidence of repeat spawning among summer steelhead, ranging from 40 to 64 percent (Hopelain 1998), should also increase that population's resilience to project effects.

Pacific Lamprey

The Project would likely have short-term effects on Pacific lamprey related to suspended sediment concentrations, bedload sediment transport and deposition, and impaired water quality (particularly dissolved oxygen). Overall, because multiple year classes of Pacific lamprey rear in the mainstem Klamath River at any given time, and since adults will migrate upstream over the entire year, including January of the reservoir drawdown year when effects from the Project will be most pronounced, effects on Pacific lamprey adults and ammocoetes are anticipated to be substantial. However, because of their wide spatial distribution and varied life history, most of the population, (which is distributed from at least California along the Pacific Rim to Japan [Goodman and Reid 2012]), would not be affected by the Project. Effects of suspended sediment on lamprey ammocoetes are not well understood and for the 2012 EIS/R analysis were based on using the same anticipated effects for juvenile salmonids. This likely overestimates any effects to lamprey ammocoetes since their preferred rearing strategy is to burrow in fine sediments mixed with organic matter. While some of the actions listed in the proposed measure below have the potential to benefit Pacific lamprey ammocoetes, (i.e., tributary connectivity and habitat restoration) no specific actions have been developed to specifically target Pacific lamprey for relocation from the areas affected by bedload or high suspended sediment concentrations. Additional discussion of Pacific lamprey ammocoetes effects is provided in Pacific Lamprey Ammocoetes.

4.2.3 2012 EIS/R AR-2

The 2012 EIS/R AR-2 (2012 EIS/R, Vol. I, pp 3.3-243 to 3.3-245) included water quality monitoring to evaluate Klamath River suspended sediment concentrations. If pre-determined water quality thresholds were triggered, a network of 17 screw traps located on 13 key tributaries would have been operated to capture downstream migrants prior to their entry into the mainstem Klamath River. Captured juveniles would have been transported and released at sites downstream of the Trinity River or other locations with suitable water quality.

4.2.4 KRRC and the ATWG's Review of AR-2 for Feasibility and Appropriateness

KRRC and the ATWG assessed the feasibility and appropriateness of the 2012 EIS/R AR-2 through multiple planning meetings held between May and August 2017. During these meetings, new information on Klamath River fisheries was presented and information on other dam removal projects conducted in the western United States was reviewed to understand how the aquatic ecosystem might respond as discuss above. Major concerns discussed by KRRC and the ATWG regarding the 2012 AR-2 included:

- Trapping feasibility and efficiency.

- Potential mortality associated with trapping, handling, hauling, and releasing juvenile salmonids.
- Potential imprinting and straying issues.
- 2012 EIS/R baseline population estimates and effects uncertainty.

The following sections provide additional information regarding 2012 EIS/R AR-2 feasibility and appropriateness based on fisheries literature and ATWG input.

Trapping Feasibility and Efficiency

A wet winter season, such as experienced between January and May 2017, could prevent the installation and operation of rotary screw traps in any of the prospective tributaries due to persistent high flows. Additionally, capture efficiencies for juvenile salmonids in rotary screw traps is highly variable and depends on many factors such as stream width, depth, flow conditions, and time of day of operation. Capture efficiencies of juvenile salmonids using rotary screw traps are typically very low, and would result in a small proportion of the downstream migrants being captured for relocation and release. For example, trapping efficiencies on various salmonids calculated by the USGS during monitoring efforts for the recent Condit Dam removal on the White Salmon River in Washington State ranged from 0 - 10.6 percent (Allen and Connolly 2011). Trapping efforts for juvenile Chinook salmon on Blue Creek in the Klamath Basin by the Yurok Tribe resulted in trapping efficiencies ranging from 0.5 - 51.3 percent, but trapping efficiencies of greater than 10 percent were not achieved until stream flows dropped in mid-June (Antonetti and Partee 2013). By mid-June, water quality conditions in the Klamath River following dam removal are expected to have returned to background condition and further remediation actions are not expected to be necessary (USBR and CDFG 2012).

KRRC and the ATWG concluded the level of effort, cost, and likely low capture efficiencies do not support the installation of screw traps for capturing outmigrating juvenile fish during the Project. KRRC and the ATWG also concluded the concurrent operation of 17 screw traps during spring high flows is not feasible or safe given potential flow conditions and the remoteness of some tributaries.

Potential Mortality Associated with Trapping, Handling, Hauling, and Releasing Juvenile Salmonids

KRRC and the ATWG concluded that although mortality on juvenile salmonids associated with trap and haul operations are typically low, these numbers are based on a variety of environmental factors and logistical considerations and can be highly variable (Serl and Morrill 2010). Transporting juvenile salmonids causes stress in smolts (Barton et al. 1980; Specker and Schreck 1980; Matthews et al. 1986), which may reduce survival if fish are directly released into natural environments (Kenaston et al 2001). In some cases, the mortality associated with screw trapping, handling, trucking, and releasing may exceed the expected mortality associated with the Project. For instance, under the worst-case scenario, high suspended sediment concentrations and low total DO could result in the direct mortality of up to 669 fall Chinook salmon smolts, less than 1 percent of production (USBR and CDFG 2012). Mortality associated with trapping, handling, transport, and release efforts could potentially result in a similar or greater loss of fall Chinook salmon smolts. The ATWG suggested that outmigrating juvenile fish are well-adapted to avoid lethal sediment concentrations and will likely employ avoidance behaviors to minimize exposure to lethal suspended sediment concentrations and DO levels. KRRC and the ATWG concluded that large scale efforts aimed at trapping, handling, and releasing juvenile salmonids were likely to cause unnecessary harm to juvenile salmonids.

Potential Imprinting and Straying Issues

KRRC and the ATWG expressed concerns regarding how handling and transport of juvenile salmonids may affect imprinting processes resulting in future straying of returning adults. Juvenile imprinting is influenced by natal stream water chemistry and the juvenile fish's physiological state during rearing and outmigration (Keefer and Caudill 2014). Juvenile fish with extended freshwater residency times, or long-distance migrations, almost certainly experience multiple imprinting events that contribute to homing success of adult spawners. Transporting juvenile fish has been shown to disrupt this 'sequential imprinting' process, and several studies on coho salmon (Solazzi et al. 1991) and Atlantic salmon (Gunnerød et al. 1988; Heggberget et al. 1991) have shown that adult homing success is inversely related to transport distance from rearing sites (Keefer and Caudill 2014).

Therefore, the capture, transport, and release of juvenile fish downstream of the Trinity River could compromise the imprinting process for relocated juvenile fish. Insufficient imprinting to natal streams or the loss of spatially distinct imprinting events during outmigration could potentially increase adult straying rates during future returns and result in the loss of genetic integrity in distinct populations. Future, elevated stray rates could result in a more homogenous distribution of fish returning to the lower Klamath River and also hinder the natural recolonization of areas upstream of Iron Gate Dam.

Overall, the ATWG concluded a screw trap-based trapping program as prescribed in the 2012 EIS/R would be a costly, potentially dangerous effort with uncertain benefits. Tributary trapping could also negatively affect juvenile salmonids by disrupting imprinting processes, causing higher mortality than allowing fish to volitionally leave tributaries, and potentially increasing future returning adult stray rates.

The proposed salvage and transport of juvenile salmonids may experience similar imprinting and straying issues as those outlined for the 2012 EIS/R AR-2. However, the proposed measure is anticipated to address a smaller number of juvenile salmonids and the fish that are transported would otherwise likely perish. Given the potential mortality of juvenile fish remaining in adverse water quality conditions in tributary confluences, the lesser risk of elevated stray rates was deemed an acceptable risk by the ATWG.

2012 EIS/R Baseline Population Estimates and Project Effects Uncertainty

Effects to juvenile fish outlined in the 2012 EIS/R included approximations and assumptions that were based on limited data on Klamath River anadromous salmonids and Pacific lamprey populations; incorporated a conservative analysis of fish avoidance behavior to the anticipated water quality conditions; and in part included a worst-case scenario analysis of project effects on adult salmonids and Pacific lamprey. The following sections provide updated population information for coho salmon and Pacific lamprey, and project effects uncertainty that should be considered in updating the effects determinations.

Coho Salmon Smolt Population Estimates and Outmigration Timing

KRRC reviewed updated smolt trapping data collected by USFWS and CDFG between 2010 and 2015 on the upper mainstem Klamath River and 2010-2016 on the Scott and Shasta Rivers to determine the typical outmigration timing for age-1+ coho salmon smolts. KRRC also reviewed travel time data to see how quickly juvenile fish typically outmigrate in the spring to avoid long exposure to background suspended sediment concentrations effects.

For rotary screw traps and frame nets operated at the Bogus, I-5, and Kinsman sites on the mainstem Klamath River between 2010 and 2015, 63 percent of age-1+ coho migrated after Julian week 13 (last week in March) (Gough et al. 2015; David et al. 2016; and David et al. 2017). Between 2010 and 2016, 93 percent of age-1+ coho salmon captured by rotary screw trap on the Shasta River outmigrated after the end of March, and on the Scott River, 70 percent of age-1+ coho salmon smolts outmigrated after the end of March during the same time period (Jetter and Chesney 2016). Peak outmigration timing beginning in early April on the Shasta River, typically coincides with decreased flows marked by the start of the irrigation season and is consistent with findings from previous studies (Chesney et al. 2009; Adams 2013; Adams and Bean 2016) from CDFW 2016.

Once in the Klamath River, coho salmon smolts appear to move downstream rather quickly. For example, Wallace (2004) reported that numbers of coho salmon smolts in the Klamath River estuary peaked in May, the same month as peak outmigration from the tributaries (Stillwater Sciences 2010). Radio telemetry studies conducted on wild and hatchery coho salmon smolts in the Klamath River between 2006 and 2009 found a wide variety of travel times for coho salmon smolt outmigrating from Iron Gate Dam to the gaging station near the Klamath River estuary (Beeman et al. 2012). The minimum travel time was 3.77 days and the maximum travel time to reach the estuary was 54.44 days with median values over the 4-year study ranging between 15.11 and 25.93 days. However, the longest residence time for any single reach was from the Iron Gate Dam release site to the Shasta River as tagged fish remained near the release site until they were ready to begin the downstream migration to the Pacific Ocean. Once fish passed the Shasta River, travel times in any individual reach were less than 2 days and coho salmon smolts usually took less than 1 week to fully migrate to the gaging station near the Klamath River estuary (Beeman et al. 2012). Courter (2008) assumed that all fish from a given cohort would migrate to the estuary in 2 weeks, and this assumption is also consistent with travel rates documented by Stutzer et al. (2006). Assuming that juvenile fish outmigrating from tributary streams will either outmigrate rapidly to the Klamath River estuary or will move between clean water tributary areas, it is anticipated that no outmigrating smolts will be exposed to suspended sediment for greater than seven contiguous days.

Minimum travel times presented in Beeman et al. (2012) indicate that juvenile coho salmon could migrate downstream of the highest suspended sediment concentrations effects zone fairly quickly. The 2012 EIS/R analysis assumed coho salmon smolts would be exposed to high suspended sediment concentrations for 20 days during the highest suspended sediment concentrations period (prior to April 1). This assumption resulted in a very high mortality estimate for coho salmon smolts (USBR and CDFG 2012).

Further, because smolt abundance data from all tributaries within the Upper Klamath, Middle Klamath, Salmon River, and Lower Klamath River populations were not available for the 2012 EIS/R analysis, smolt production estimates modeled by Courter et al. (2008) were used to predict the number of smolts emigrating to the Klamath River from each population. Modeled smolt production estimates were based on tributary habitat conditions and smolt production data for other populations. Recent trends in adult returns to tributaries, the Klamath River, and Iron Gate Hatchery indicate that coho salmon populations continue to decline, and that these modeled estimates are likely higher than current actual population sizes.

In a study of juvenile coho salmon use of thermal refugia along the Klamath River, juvenile coho began to enter thermal refugia as water temperature reached 19°C, numbers of coho salmon present increased up to about 22°C to 23°C, and then declined dramatically as temperatures exceeded 23°C (Sutton and Soto 2012). These results suggest that 23°C is the upper thermal tolerance limit, with either lethal effects to juvenile coho salmon or temperature- related stress.

By updating the current understanding of coho salmon population estimates and typical juvenile coho salmon outmigration timing from Klamath River, Shasta River, and Scott River coho salmon populations, and by adjusting the potential duration of exposure to reflect typical downstream migration rates, anticipated effects to age-1+ coho salmon smolts may result in substantially lower coho salmon smolt mortality estimates, and in most cases, only result in sub-lethal effects.

Pacific Lamprey Population Update

Recent genetic analysis of Pacific lamprey suggests no significant population structure exists across populations or regions, indicating a high degree of historical gene flow even across expansive distances of the northern Pacific Rim (Goodman and Reid 2012). Weak population structure and low site fidelity may reduce the short-term effects to Pacific lamprey identified in the 2012 EIS/R. Because the metapopulation is now believed to be relatively undifferentiated across the species' range, the percentage of adult and larval Pacific lamprey that will be affected by the Project relative to the population as a whole will be insignificant.

Project Effects Uncertainty

Studies suggest that high suspended sediment concentrations (Newcombe and Jensen 1996; Chapman et al. 2014; Kjelland et al. 2015) and low dissolved oxygen concentrations (Bjorn and Reiser 1991; Washington Department of Ecology 2002; Carter 2005) affect salmonid behavior. Juvenile salmonid response to high suspended sediment concentrations includes behavioral changes such as avoidance of turbid waters, and physiological responses such as stress and respiratory impairment, damage to gills, reduced tolerance to disease and toxicants, reduced survival, and direct mortality (Newcombe and Jensen 1996). Concentration and duration of elevated suspended sediment, as well as other factors including water temperature, disease, and river flow, influence the effect of sediment on salmonids.

The effects of low dissolved oxygen levels, eutrophication, or turbidity on natural populations of Pacific lamprey ammocoetes are unknown. Juvenile salmonids and juvenile Pacific lamprey emigrating from tributaries to the Klamath River that encounter poor water conditions are expected to avoid poor water quality by either remaining in tributary streams or using habitats less affected by high suspended sediment concentrations (e.g., tributary confluences and off-channel areas). Many juveniles in the mainstem Klamath River appear to migrate to the lower river to rear and may avoid adverse conditions in the mainstem by using tributary or off-channel habitats during winter, thus reducing their exposure and potential mortality (Hillemeier et al. 2009; Soto et al. 2009), consistent with the observation that juvenile salmonids avoid turbid conditions (Sigler et al. 1984; Servizi and Martens 1992).

The approach presented in the 2012 EIS/R to determine the anticipated effects to outmigrating juveniles assumed that fish would not exhibit any of these behavioral responses and instead suffer mortality by voluntarily remaining in areas that had lethal suspended sediment concentrations for extended periods of time.

4.3 Additional Information Related to Suspended Sediment Concentration Effects on Outmigrating Juvenile Salmonids

4.3.1 Introduction

The following additional information is on the effects of suspended sediment concentrations on outmigrating juvenile salmonids, which is intended to be addressed through implementation of the proposed measure. This information includes a review of recent juvenile salmonid outmigration data for the Klamath River and select tributaries, comparing outmigration periods to anticipated suspended sediment concentrations from USBR sediment modeling, and assessing potential juvenile salmonid avoidance behaviors related to high suspended sediment concentrations.

Results of KRRC's additional analysis suggest juvenile Chinook salmon, coho salmon, and steelhead generally outmigrate from tributaries to the Klamath River after peak suspended sediment concentrations are anticipated to occur. However, early outmigrating juvenile Chinook salmon and coho salmon from the Shasta River and Scott River are most susceptible to anticipated suspended sediment concentrations associated with reservoir drawdown. Fish may reduce their exposure to high suspended sediment levels by seeking clear water tributary confluences, entering clear water tributaries and off-channel ponds, and expediting their downstream migration. Measures to further reduce suspended sediment impacts to early outmigrating salmonids include implementing an adaptive monitoring and salvage plan.

4.3.2 Klamath River and Tributaries Updated Screw Trap Data and Suspended Sediment Effects

The following section provides an overview of the screw trap and suspended sediment concentration analysis KRRC completed to assess potential reservoir drawdown effects to outmigrating juvenile salmonids.

Screw Trap Data

Screw trap data provided by USFWS, CDFW, Yurok Tribe, and Karuk Tribe (referenced as "acquiring entity") were reviewed and summarized by KRRC. The screw trap data analysis focused on 2008 to 2015, and provides an updated data set extending the period of record for screw trap data reviewed in preparation of the 2012 EIS/R (Reclamation and CDFG 2012). Screw trap data from the Klamath River and tributaries to the Klamath River (Table 4-3) were reviewed to assess juvenile salmonid outmigration timing and relative abundance. Reported data include both juvenile outmigration population estimates and trap catch numbers. Outmigration estimates were generally provided by the acquiring entities for juvenile fall Chinook salmon due to the sufficient abundance and trap catch of individuals in the mainstem and tributaries. Outmigration estimates are computed by multiplying the number of caught fish by a correction factor that approximates trap efficiency. Compared to trap catch numbers, outmigration estimates are a better representation of the potential number of outmigrating juvenile salmonids from the watershed upstream from the trap location.

Trap catch represents the actual number of fish captured during trap operation. Trap catch numbers do not include a correction for stream flow or trap efficiency so trap catch numbers are a less reliable predictor of outmigration timing and population size. Trap catch is reported for Chinook salmon, coho salmon, and steelhead. Coho salmon and steelhead catches were generally insufficient for calculating outmigration population estimates. Trap catch data are reviewed to provide a relative indication of juvenile salmonid outmigration timing and magnitude, but data are less reliable for predicting juvenile abundance compared to population estimates. Population estimates and trap catch data are reported by Julian Week to improve data comparability over time and to also compare trap data with suspended sediment concentrations. Figure 4-1 includes a map with highlighted trap and water and suspended sediment modeling stations.

Table 4-3 Juvenile outmigration trap information and reporting data for Klamath River and Tributary Traps.

Reach	Trap Location	Trap Type	Acquiring Entity	Reporting Data
Upper Klamath River	Mainstem downstream from Bogus Creek[1] (RM 191.2)	Net frame	USFWS	Chinook (age-0) estimates Coho (age-0 and age-1+) catch Steelhead (age-0 and age-1+) catch
	Shasta River[2] (Confluence at RM 179.3)	RST*	CDFW	Chinook (age-0) estimates Coho (age-0 and age-1+) estimates Steelhead (age-0 and age-1+) estimates
	Mainstem at Kinsman Creek (RM 147.6)[1]	RST	USFWS	Chinook (age-0) estimates Coho (age-0 and age-1+) catch Steelhead (age-0 and age-1+) catch
	Scott River[2] (Confluence at RM 145.1)	RST	CDFW	Chinook (age-0) estimates Coho (age-0 and age-1+) estimates Steelhead (age-0 and age-1+) estimates
Middle Klamath River	Salmon River[3] (Confluence at RM 66.4)	RST	Karuk Tribe	Chinook (age-0+) catch Coho (age-0+) catch Steelhead (age-0+) catch

Reach	Trap Location	Trap Type	Acquiring Entity	Reporting Data
	Trinity River[4] (Confluence at RM 43.4)	RST	USFWS	Chinook (age-0+) catch Coho (age-0+) catch Steelhead (age-0+) catch
Lower Klamath River	Blue Creek[5] (Confluence at RM 16.0)	RST	Yurok Tribe	Chinook (age-0) estimates Coho (age-0 and age-1+) catch Steelhead (age-0 and age-1+) catch

*Rotary screw trap
[1]Gough et al. 2015; [2]Jetter et al. 2016; [3]Karuk Tribe, unpublished data, 2017; [4]Harris et al. 2016; [5]Yurok Tribe, unpublished data, 2017

4.3.3 Suspended Sediment Concentration Analysis

Reclamation provided KRRC with the suspended sediment modeling output summarized in Reclamation's (2011) hydrology, hydraulics, and sediment report. KRRC replicated Reclamation's summary suspended sediment concentration graphs associated with sediment modeling for representative dry (2001), median (1976), and wet (1984) years at the four reporting stations: Iron Gate Dam, Seiad Valley, Orleans, and Klamath (see Figure 4-1 and Figure 4-2). Reservoir drawdowns are planned to begin January 1 of the dam removal year. Suspended sediment concentrations rise to an early to mid-February peak and then decline through the fall. Concentrations are generally highest for dry year scenario with other scenarios having lower relative suspended sediment concentration values (Table 4-4). Suspended sediment concentrations generally decrease in a downstream direction as inflows from clear water tributaries dilute suspended sediment concentrations in the Klamath River.

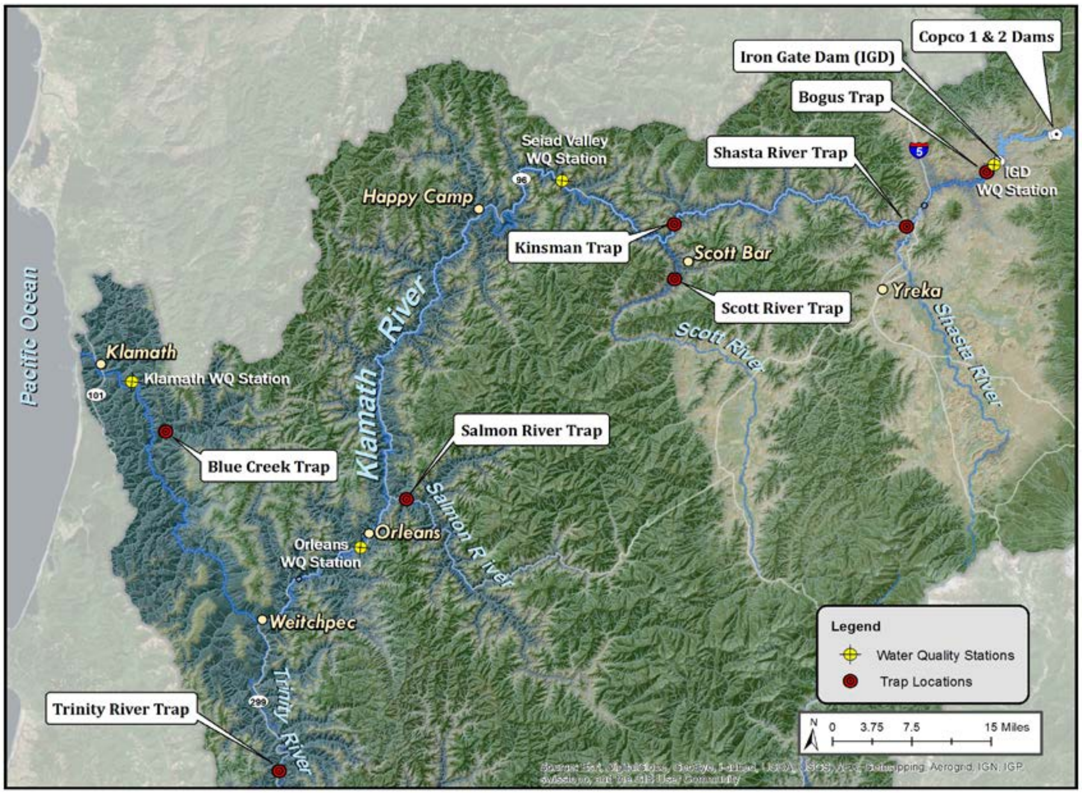


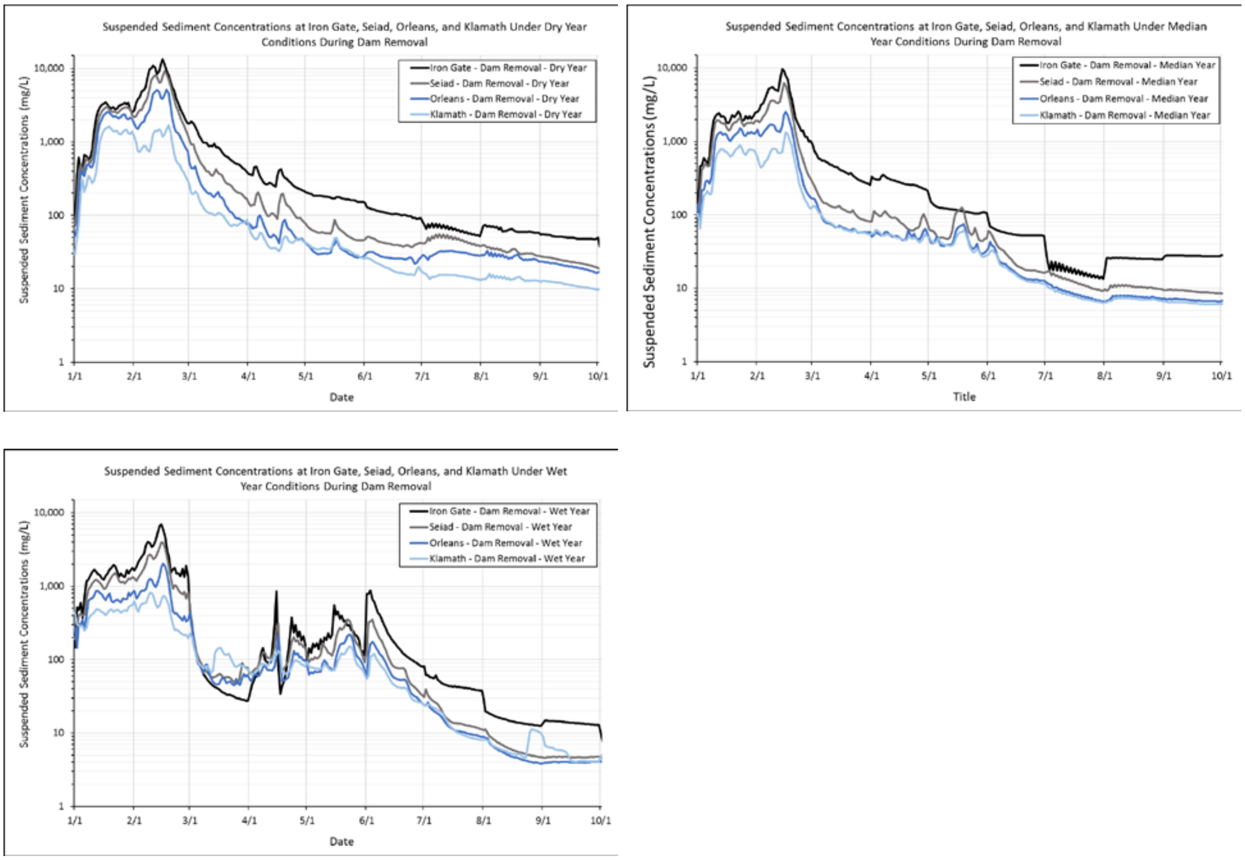
Figure 4-1 Screw trap and suspended sediment modeling stations on the Klamath River.

Juvenile Salmonid Suspended Sediment Exposure

The following sections present information on juvenile salmonid outmigration rates in the Klamath River and suspended sediment exposure effects.

Juvenile Salmonid Outmigration Travel Time

In order to better predict potential effects of elevated suspended sediment concentrations on outmigrating juvenile salmonids, KRRC reviewed past studies and analyzed Klamath River juvenile salmonid outmigration rates and timing. Past Klamath River studies found juvenile salmonid outmigration rates are influenced by tributary and Klamath River water temperatures, smolt growth rates, and other environmental cues.



Modeling output is presented for the Klamath River at Iron Gate, Seiad Valley, Orleans, and Klamath modeling stations. Graphs include dry year (2001, upper left), median year (1976, upper right), and wet year (1984, lower left).

Figure 4-2 Modeled suspended sediment concentrations associated with reservoir drawdown and dam removal.

Table 4-4 Suspended sediment modeling output stations and summary results.

Suspended Sediment Modeling Station	Approximate Location (river mile)	Wet Year / Dry Year Peak SSC (mg/L)	Wet Year / Dry Year Cumulative Days with SSC above 1,000 mg/L	Wet Year / Dry Year Cumulative Days with SSC above 3,000 mg/L
Iron Gate Dam	193.1	6,988 / 13,385	54 / 57	12 / 33
Seiad Valley	131.9	3,999 / 9,223	41 / 50	4 / 19
Orleans	59.0	2,046 / 5,157	11 / 45	0 / 11
Klamath	2.5	819 / 1,670	0 / 28	0 / 0

Note: Suspended sediment concentrations related to juvenile salmonid mortality are also included for reference. A 2-week exposure to 1,000 mg/L concentration is associated with predicted 0-20 percent mortality, and 2-week exposure to 3,000 mg/L is associated with 20-40 percent mortality.

Wallace (2004) reported coho salmon smolts in the Klamath River estuary peaked in May, the same month as peak outmigration from the tributaries (Stillwater Sciences 2010). Radio telemetry studies conducted on wild and hatchery coho salmon smolts in the Klamath River between 2006 and 2009 found a wide range of travel times for coho salmon smolts outmigrating from Iron Gate Dam to the gaging station near the Klamath River estuary (Beeman et al. 2012). The minimum and maximum travel time were 3.8 and 54.4 days, respectively, with median values over the 4-year study ranging between 15.1 and 25.9 days. However, the longest residence time for any single reach was from the Iron Gate Dam release site to the Shasta River as tagged fish remained near the release site until they were ready to begin the downstream migration to the Klamath estuary. Once fish passed the Shasta River, travel times in any individual reach were less than 2 days and coho salmon smolts usually took less than 1 week to fully migrate to Klamath estuary (Beeman et al. 2012). Courter (2008) assumed that all fish from a given cohort would migrate to the estuary in 2-weeks, and this assumption is also consistent with travel rates documented by Stutzer et al. (2006). Based on the literature review, a 2-week outmigration period is believed to be a conservative period for juvenile salmonid exposure to elevated suspended sediment concentrations in the Kamath River. We also anticipate that outmigrating salmonids will have access to, and will choose to use clean water locations such as clear water tributary confluences, off-channel ponds and tributaries, and spring seeps during their outmigration, reducing exposure times. Additionally, suspended sediment concentrations will be substantially diluted by tributary inputs including the Trinity River (RM 43.4).

Juvenile Salmonid Suspended Sediment Exposure Effects

Newcombe and Jensen (1996) created “look-up tables” to predict response severity to suspended sediment exposures of varying durations and concentrations. Predicted severity-of-ill effects scores or indices were developed from empirical data gathered from numerous dose-response studies. Based on review of these data, juvenile salmonids exposed to concentrations of approximately 1,100 mg/L for 2-weeks have a severity-of-ill-effects score of 10, and may experience mortality rates between 0 and 20 percent. Expected mortality rates increase to between 20-40 percent as suspended sediment concentrations approach 3,000 mg/L.

While these predicted severity scores are helpful for evaluating the potential effects to juvenile fish, there is considerable variability between the effects to different species under different conditions as documented in the numerous studies synthesized by Newcombe and Jensen (1996). For instance, the authors reviewed an unpublished study where coho fry that were exposed to suspended sediment at a concentration of 5,471 mg/L for 96 hours in water at 18.7ºC sustained a mortality rate of 10 percent, while similarly exposed steelhead experienced no mortality.

Servizi and Martens (1992) found that a stress response is dependent on a combination of factors including magnitude, frequency, and duration of exposure, as well as environmental factors such as particle size and water temperature. For example, effects to juvenile steelhead and coho salmon held in 18.7ºC water, may have exacerbated the effects of suspended sediment on coho since temperatures of 19ºC are considered suboptimal and juvenile coho salmon typically begin to seek cold water refugia at that threshold (Stenhouse et al. 2012). Likewise, Noggle (1978) found seasonal differences in salmonid tolerance to suspended sediment. In Noggle’s study, bioassays conducted in summer produced lethal concentrations and 50 percent mortality (LC50) of exposed fish at less than 1,500 mg/l, while bioassays in autumn produced LC50 values in excess of 30,000 mg/l. Servizi and Martens (1991) found that underyearling coho salmon survived higher concentrations of suspended sediment at 7ºC (22,700 mg/L) than at either 1ºC or 18ºC.

Based on literature reviewed in Newcombe and Jensen (1996), a 2-week exposure period to suspended sediment concentrations above 1,000 mg/L may result in up to 20 percent mortality of exposed fish, while a 2week exposure to levels over 3,000 mg/L may result in 20-40 percent mortality of exposed fish. For comparison, parasite infection rates of outmigrating juvenile Chinook salmon from the upper Klamath River may be upwards of 60 percent in some years (Som et al. 2016).

Outmigration and Suspended Sediment Concentration Results

The following section presents a review of select screw trap data and suspended sediment concentration results compiled by KRRC. All outmigration and suspended sediment data are presented by Julian week (Table 4-5). Outmigration histograms represent weekly average number of outmigrants based on the sampled time period, generally 2008 to 2015. Salmon River outmigrant data are presented for two representative years rather than as multi-year averages due to limited data availability. Juvenile outmigration variability plots presented in section 4.4, illustrate the plasticity of outmigration timing. Outmigration timing is influenced by flows, water temperature, and other environmental factors.

Table 4-5 Julian week correspondence with months of the year

Julian Week	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1-9	X	X										
9-17			X	X								
17-26					X	X						
26-35							X	X				
35-44									X	X		
44-52											X	X

Upper Klamath River

Outmigration trap data for the Klamath River, Shasta River, and Scott River and suspended sediment concentrations for the Iron Gate Dam and Seiad Valley reporting stations are presented in the following section. Because the outmigration traps are located between Iron Gate Dam and the Seaid Valley reporting stations, juvenile salmonids entering the Klamath River closer to Iron Gate Dam will experience the highest concentrations while fish entering or moving downstream in the Klamath River closer to Seaid Valley will experience suspended sediment concentrations diluted by tributary and spring inputs. Inclusion of both reporting stations provide the range of modeled concentrations anticipated to affect the upper Klamath River reach.

Graphs also include 1,000 mg/L and 3,000 mg/L mortality thresholds outlined in the previous report section. Fish outmigrating when the modeled suspended sediment concentrations exceed the mortality thresholds, may experience mortality likelihoods associated with the respective thresholds.

Klamath River – Bogus Trap Results

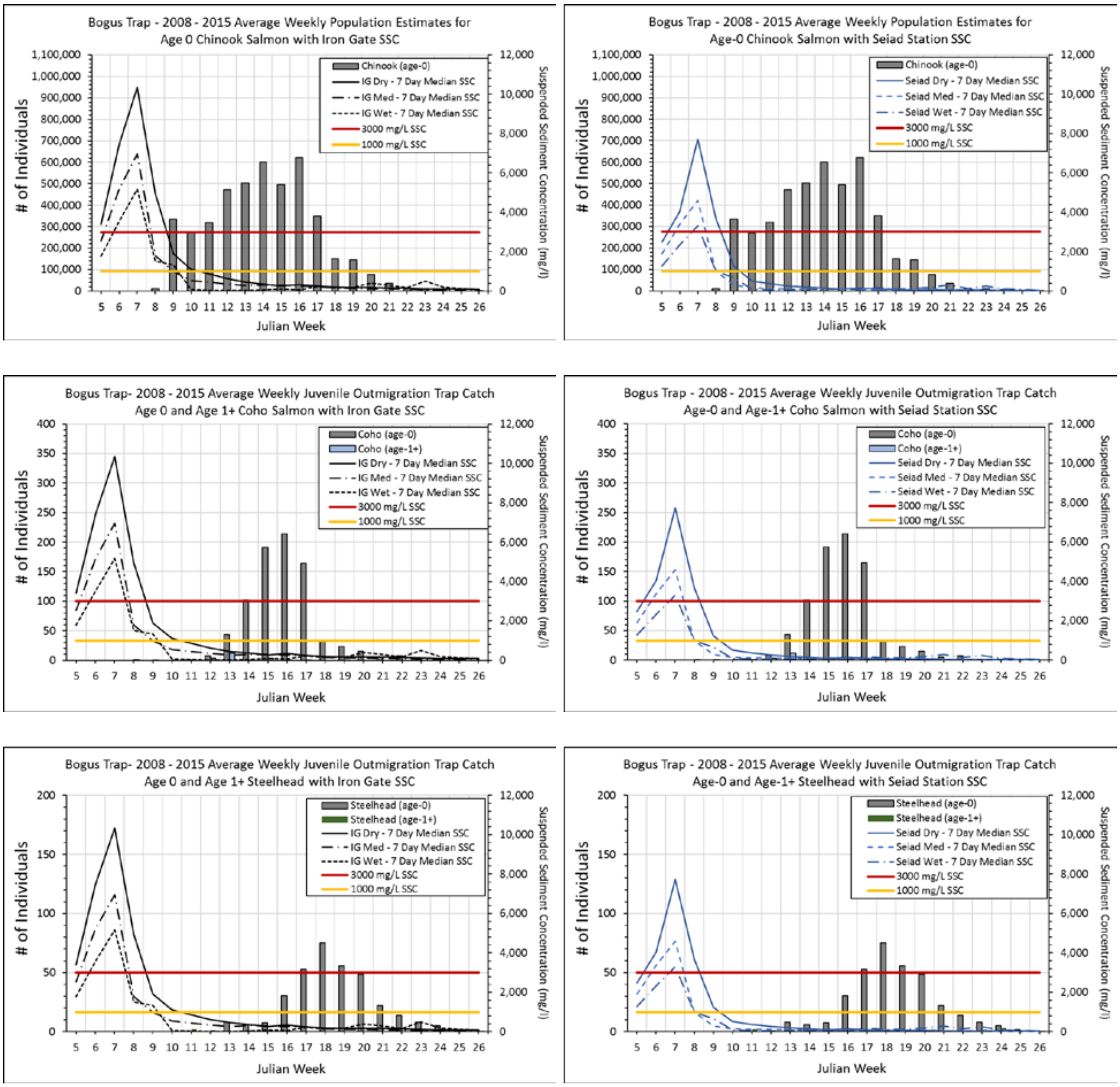
USFWS maintains the Bogus Creek trap located on the Klamath River downstream from Bogus Creek. The net frame trap samples outmigrants from Bogus Creek and the mainstem Klamath River. The Chinook salmon (age-0) outmigration window based on the sample period is from late February through June with an average peak in early to mid-April (Figure 4-3). On average, only the earliest outmigrants would experience suspended sediment concentrations above the 1,000 mg/L and 3,000 mg/L thresholds. Based on the reviewed trap data, most of the outmigrating juvenile Chinook salmon will move past the Bogus Creek trap location after the peak suspended sediment concentrations.

Trap catch results for outmigrating coho salmon and steelhead suggest these species tend to outmigrate from Bogus Creek and the mainstem Klamath River upstream of the Bogus trap later than Chinook salmon juveniles. Peak coho salmon and steelhead outmigrations are from early to mid-April, after suspended sediment concentrations have dropped below 1,000 mg/L.

Shasta River Trap Results

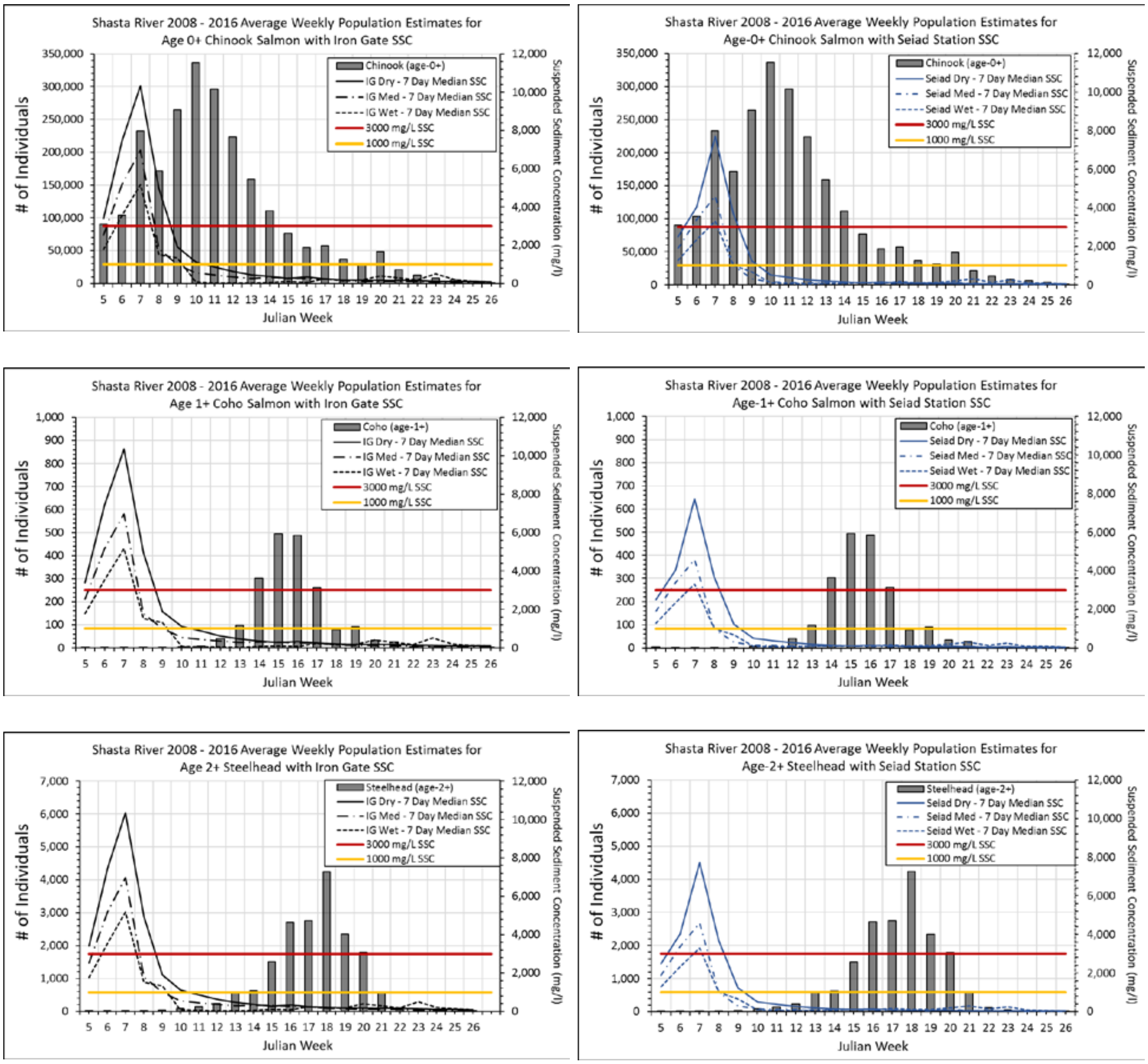
CDFW maintains the Shasta River rotary screw trap located near the Shasta River-Klamath River confluence. Chinook salmon (age-0+) outmigration from the Shasta River tends to occur earlier than in downstream tributaries and the mainstem Klamath River (Figure 4-4). On average, the outmigration begins in January and peaks in early March, overlapping with anticipated declining peak suspended sediment concentrations. Early Chinook salmon outmigrants entering the Klamath River would experience elevated sediment through mid-March. Results suggest the early portion of the Chinook salmon outmigration will be subjected to potentially lethal suspended sediment due to the concentration and exposure duration.

Population estimates for outmigrating coho salmon and steelhead suggest these species tend to outmigrate from the Shasta River later than Chinook salmon juveniles. Peak coho salmon and steelhead outmigrations are from mid to late April and are likely influenced by declining flows and rising water temperatures associated with onset of irrigation season. Coho salmon and steelhead outmigration patterns suggest that most fish outmigrate after suspended sediment concentrations have dropped below 1,000 mg/L.



The left column of plots includes modeled suspended sediment concentrations at the Iron Gate Dam station, the right column includes the modeled suspended sediment concentrations at the Seaid Valley station Outmigrating Chinook salmon appear to be the most vulnerable to peak suspended sediment concentrations. Coho and steelhead outmigrants are expected to outmigrate after peak suspended sediment concentrations.

Figure 4-3 Bogus trap on the Klamath River outmigration plots include Chinook salmon age-0 outmigration estimate (top), coho salmon age-0 and age-1+ trap catch (middle), and steelhead age-0 and age-1+ trap catch (bottom).



The left column of plots includes the modeled suspended sediment concentrations at the Iron Gate Dam station, the right column includes the modeled suspended sediment concentrations at the Seaid Valley station. Outmigrating Chinook salmon appear to be the most vulnerable to peak suspended sediment concentrations in the Klamath River. Coho salmon and steelhead outmigrants are expected to outmigrate after peak suspended sediment concentrations are below 1,000 mg/L.

Figure 4-4 Shasta River trap outmigration plots include Chinook salmon age-0+ outmigration estimate (top), coho salmon age-1+ outmigration estimate (middle), and steelhead age-2+ outmigration estimate (bottom).

Klamath River – Kinsman Trap Results

USFWS maintains the Kinsman Creek trap located on the Klamath River just upstream of the Kinsman Creek-Klamath River confluence and approximately 2.5 miles upstream of the Scott River-Klamath River confluence. The timing and magnitude of juvenile Chinook salmon in the Kinsman trap suggest the influence of early outmigrants from the Shasta River. Over the period of record reviewed by KRRC, the Kinsman trap does not begin operation until the beginning of March and likely misses the early Shasta River outmigrants entering the Klamath River (Figure 4-5). Therefore, early outmigrating Chinook salmon in the Klamath River would be subjected to elevated suspended sediment concentrations. However, the peak of the Chinook salmon migration reaches the Kinsman trap location after peak sediment concentrations.

Trap catch results for outmigrating coho salmon and steelhead suggest these species tend to outmigrate from areas upstream of the Kinsman trap later than Chinook salmon juveniles. Coho salmon and steelhead outmigrate through the summer and mainly outmigrate after suspended sediment concentrations are projected to drop below 1,000 mg/L.

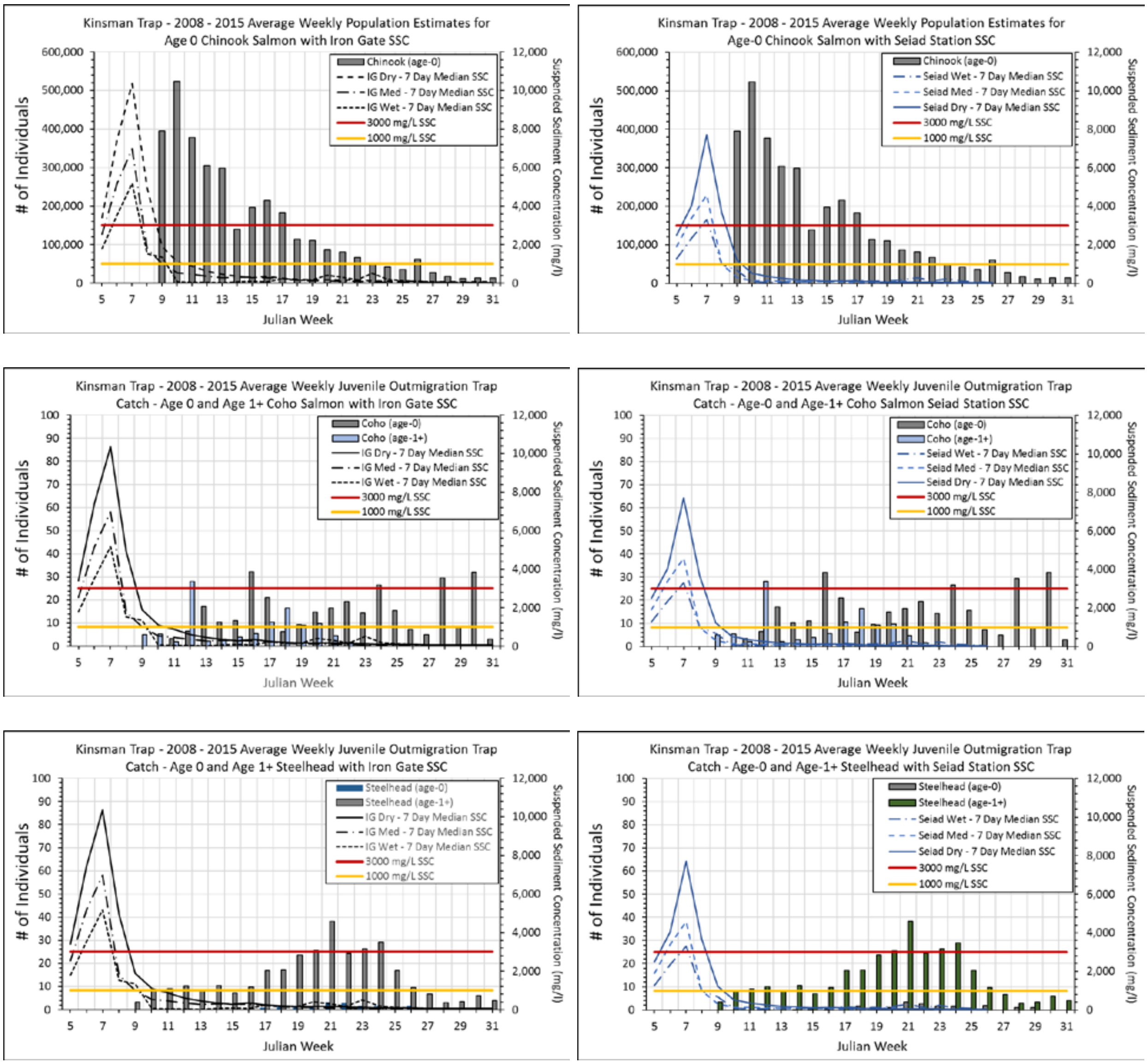
Scott River Trap Results

CDFW maintains the Scott River rotary screw trap located 4.75 miles upstream of the Scott River-Klamath River confluence. Chinook salmon (age-0+) outmigration from the Scott River occurs in mid-April (Figure 4-6) and is more similar to the mainstem Klamath River outmigrants than to the outmigration timing for the Shasta River. The Scott River Chinook salmon outmigration, on average, occurs over a longer period of time with lower abundance relative to the Shasta River Chinook outmigration. Few Chinook salmon outmigrate during the period of peak suspended sediment concentrations.

Population estimate results for outmigrating coho salmon and steelhead suggest these species' outmigration periods overlap with outmigrating Scott River Chinook salmon more so than the level of species overlap in the Shasta River. Although at lower abundance levels relative to Scott River Chinook salmon, Scott River coho and steelhead juvenile outmigration amounts to several thousand fish. The earliest outmigrating fish (late February to early March) will likely be subjected to elevated suspended sediment concentrations as sediment levels taper from the peak. Coho and steelhead outmigration patterns suggest that most fish may outmigrate after suspended sediment concentrations have dropped below 1,000 mg/L.

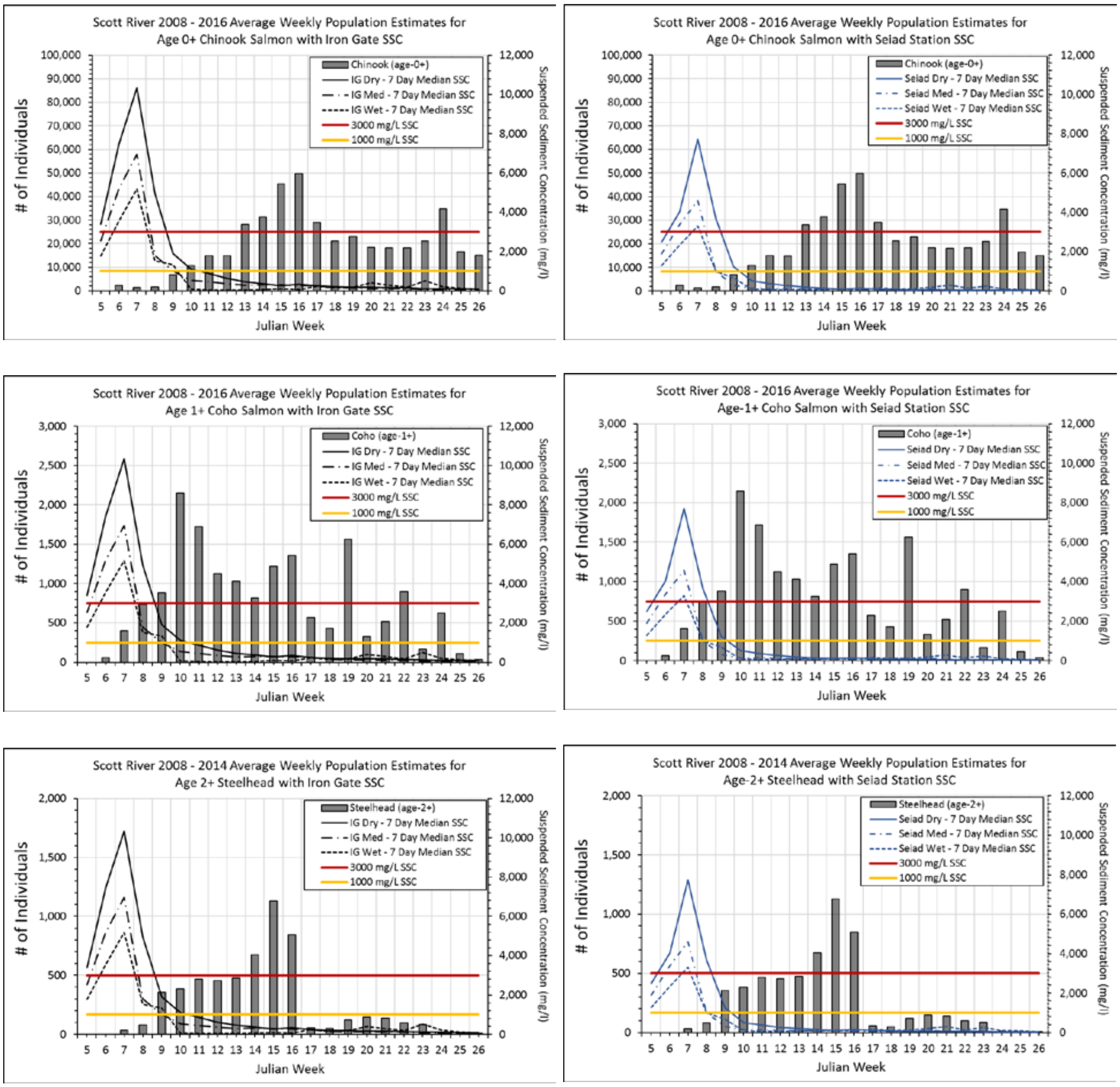
Middle Klamath River

Data are provided for two traps in the middle Klamath River.



The left column of plots includes the modeled suspended sediment concentrations at the Iron Gate Dam suspended station; the right column includes the modeled suspended sediment concentrations at the Seaid Valley station. Outmigrating Chinook salmon appear to be the most vulnerable to peak suspended sediment concentrations. Most coho and steelhead outmigrants are expected to outmigrate after peak suspended sediment concentrations.

Figure 4-5 Kinsman trap on the Klamath River outmigration plots clockwise from upper left include Chinook salmon age-0 outmigration estimate (top), coho salmon age-0 and age-1+ trap catch (middle), and steelhead age-0 and age-1+ trap catch (bottom).



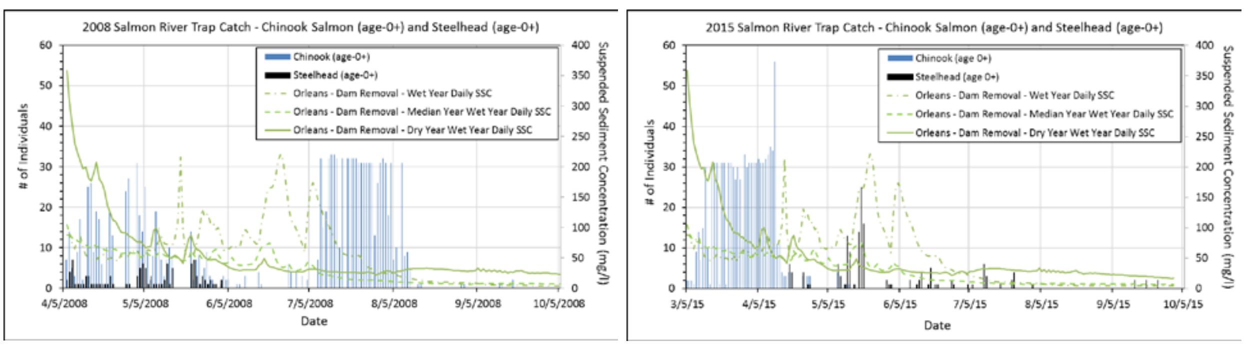
The left column of plots includes the modeled suspended sediment concentrations at the Iron Gate Dam station; the right column includes the modeled suspended sediment concentrations at the Seaid Valley station. Outmigrating coho salmon appear to be proportionally more vulnerable to peak suspended sediment concentrations, with approximately 25 percent of the average outmigrants subjected to concentrations above 1,000 mg/L.

Figure 4-6 Scott River trap outmigration plots clockwise from upper left include Chinook salmon age-0+ outmigration estimate (top), coho salmon age-1+ outmigration estimate (middle), and steelhead age-2+ outmigration estimate (bottom).

Salmon River Trap Results

The Karuk Tribe maintains a screw trap on the Salmon River at RM 0.96. The Salmon River joins the Klamath River at RM 66.4. Suspended sediment concentrations for the Orleans modeling station and Chinook (age-0+) and steelhead (age 0+) trap catch data for 2008 and 2015 are presented in Figure 4-7. The presented years 2008 and 2015 are representative of the outmigration timing for Chinook and steelhead on the Salmon River. The second grouping of Chinook salmon outmigrants from July through September in 2008 is characterized by larger juveniles compared to the earlier April to June outmigration period. The 2015 trap catch data suggest a dominant early juvenile Chinook salmon outmigration and few later outmigrants. There were low numbers of outmigrating juvenile steelhead in both years. Coho salmon outmigrants were not included in the analysis due to low trap catch numbers.

Anticipated suspended sediment concentrations at the Orleans station are below the 1,000 mg/L and 3,000 mg/L mortality thresholds and most Chinook salmon and steelhead juveniles migrate to the lower Salmon River when anticipated suspended sediment concentrations in the Klamath River are less than 500 mg/L. Based on the timing of juvenile Chinook salmon and steelhead entry into the Klamath River and the anticipated suspended sediment concentrations at entry, we do not expect outmigrating fish from the Salmon River to experience lethal conditions. We also anticipate outmigrants will reach the Klamath estuary in less than a week, minimizing their exposure to suspended sediment concentrations.



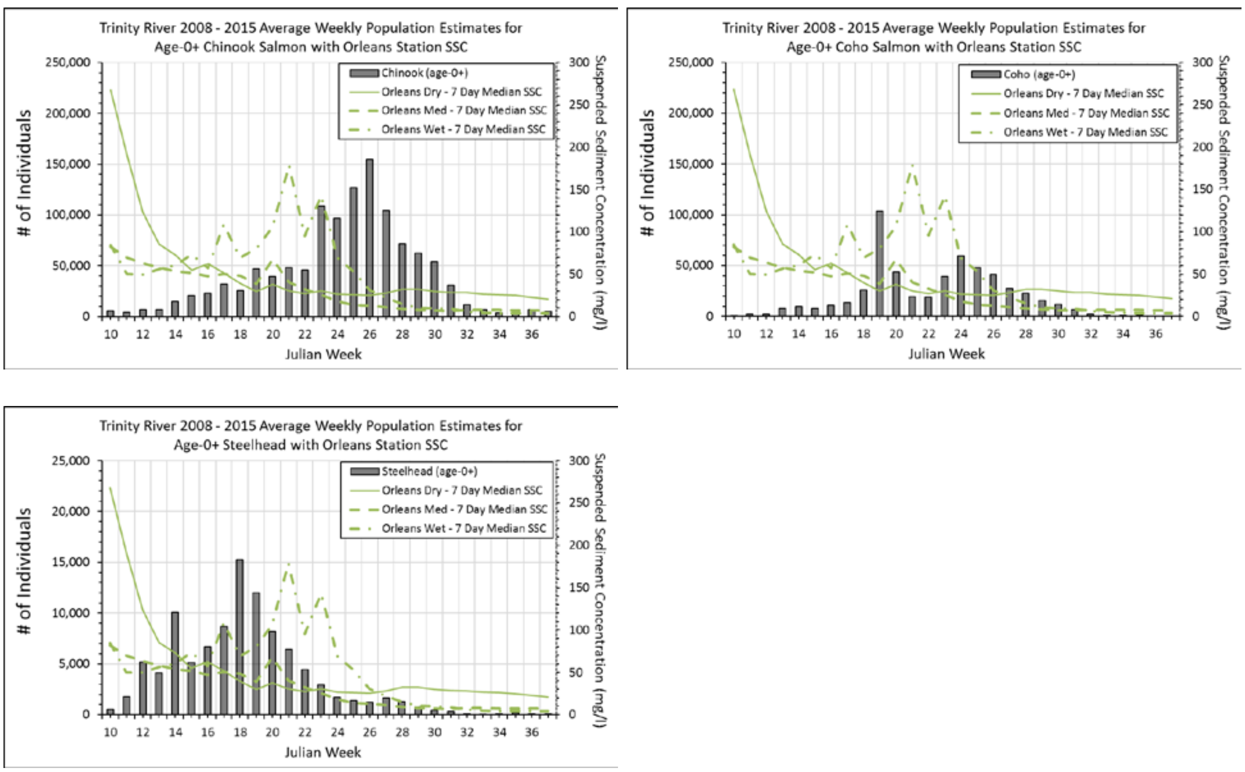
Anticipated suspended sediment concentrations from the Orleans station are also presented. Suspended sediment concentrations during the outmigration period are less than the mortality thresholds of 1,000 mg/L and 3,000 mg/L.

Figure 4-7 Salmon River trap catch outmigration plots for Chinook salmon (age-0+) and steelhead (age-0+) for 2008 (left) and 2015 (right).

Trinity River near Willow Creek Trap Results

USFWS and Yurok Tribe maintain a screw trap on the Trinity River at RM 21.1. The Trinity River joins the Klamath River at RM 43.4. Suspended sediment concentrations for the Orleans modeling station and Chinook salmon (age-0+), coho salmon (age-0+), and steelhead (age 0+) population estimates based on 2008 to 2015 screw trap data are presented in Figure 4-8. Steelhead peak outmigration is earlier than Chinook and coho salmon outmigration timing. The outmigration values include both hatchery and naturally-produced juveniles and age-0 smolts comprise the majority of the sampled outmigrants.

Anticipated suspended sediment concentrations at the Orleans station are below the 1,000 mg/L and 3,000 mg/L mortality thresholds and most fish migrate through the lower Trinity River when Klamath River suspended sediment concentrations are less than 300 mg/L. Based on outmigration timing to the Klamath River (assuming juvenile fish continue to outmigrate to the Klamath River after they bypass the Trinity River trap location) and the anticipated suspended sediment concentrations at entry, we do not expect outmigrating fish from the Trinity River to experience lethal conditions in the Klamath River. We also anticipate outmigrants will reach the Klamath estuary in less than a week, minimizing their exposure to elevated suspended sediment.



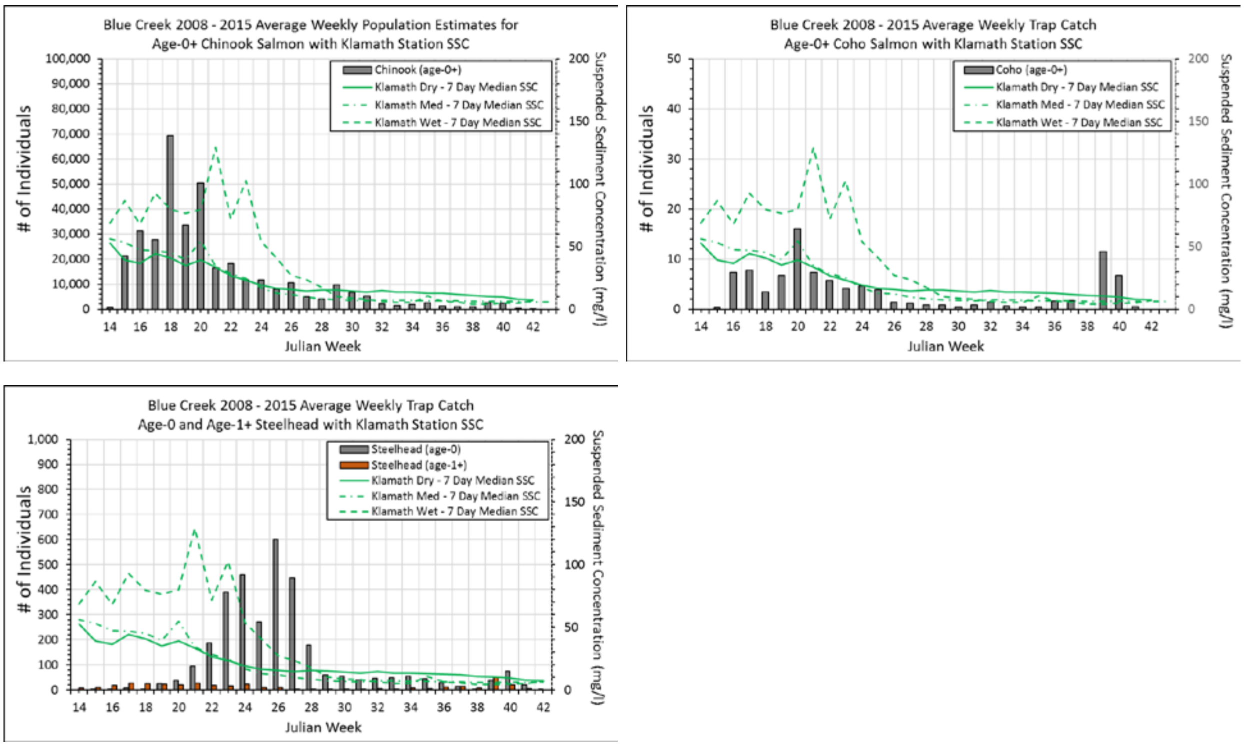
Anticipated suspended sediment concentrations from the Orleans station are also presented. Suspended sediment concentrations during the outmigration period are less than the mortality thresholds of 1,000 mg/L and 3,000 mg/L.

Figure 4-8 Trinity River trap outmigration plots for Chinook salmon age-0+ (upper left), coho salmon age-0+ (upper right), and steelhead age-0+ (lower left).

Lower Klamath River

The Yurok Tribe maintains a screw trap at RM 2.0 on Blue Creek, the largest tributary to the lower Klamath River. Blue Creek supports the largest anadromous fish populations in the lower Klamath River sub-basin, and the tributary is considered to be a salmon stronghold by the Yurok Tribe (Antonetti and Partee 2013). Blue Creek joins the Klamath River at RM 16.0. Suspended sediment concentrations for the Klamath modeling station and population estimates for Chinook salmon (age-0+), and trap catch data for coho salmon (age-0+), and steelhead (age-0 and age-1+) for 2008 through 2015 are presented in Figure 4-9.

Anticipated suspended sediment concentrations at the Klamath station are below the 1,000 mg/L and 3,000 mg/L mortality thresholds. Outmigration timing for juvenile salmonids is generally during anticipated elevated suspended sediment concentrations less than 300 mg/L. We do not anticipate negative effects from suspended sediment concentrations on outmigrating juvenile salmonids in the Lower Klamath River based on low sediment concentrations and the close proximity of Blue Creek to the Klamath estuary.



Anticipated suspended sediment concentrations from the Klamath station are also presented. Suspended sediment concentrations during the outmigration period are less than the mortality thresholds of 1,000 mg/L and 3,000 mg/L.

Figure 4-9 Blue Creek trap outmigration plots include Chinook salmon age-0+ outmigration estimate (upper left), coho salmon age-0+ trap catch (upper right), and steelhead age-0 and age-1+ trap catch (lower left).

Outmigration and Dissolved Oxygen

The release of organic-based sediments during reservoir drawdown is anticipated to affect dissolved oxygen levels in the Klamath River downstream from Iron Gate Dam (Stillwater Sciences 2011). The highest predicted oxygen demand levels will be associated with peak suspended sediment concentrations that are anticipated to occur during February of the drawdown year. Despite the relatively high predicted biological oxygen demand, dissolved oxygen concentrations downstream from Iron Gate Dam are anticipated to generally remain greater than 5 mg/L. Exceptions include predicted concentrations in February of the dam removal year for median (1976) and typical dry year (2001) hydrologic conditions, which exhibit minimum values of 3.5 mg/L and 1.3 mg/L, respectively.

For all water year types (wet, median, dry), the predicted dissolved oxygen minimum values would occur by approximately RM 188-190 (~3-5 miles downstream from Iron Gate Dam) and would return to at least 5 mg/L by approximately RM 175-177 (2 to 4 miles below the Shasta River confluence. The North Coast Basin Plan water quality objective for dissolved oxygen is expressed as percent saturation; at 90 percent saturation, the water quality objective for November through April, assuming average February (2009) water temperatures, would be 9.6-10.6 mg/l. Based on the spreadsheet model results, recovery to the North Coast Basin Plan water quality objective of 90 percent saturation would occur generally within the reach from Seiad Valley (RM 131.9) to the mainstem confluence with Clear Creek, or within a distance of 62-93 miles downstream from Iron Gate Dam, for all water years.

Dissolved oxygen monitoring during dam removal projects is complicated by the harsh in-stream conditions influenced by high suspended sediment concentrations. The U.S. Geological Survey monitored dissolved oxygen levels associated with the drawdown of Fall Creek Reservoir in the Willamette Basin. The Fall Creek monitoring included a water quality monitoring station downstream from the dam, and a second station at Jasper approximately 10 miles downstream from Fall Creek Dam. The Fall Creek Outflow station at the dam detected a decrease in dissolved oxygen concurrent with the sediment release, although the extent of the depletion was unknown due to equipment fouling (Schenk and Bragg 2014). Collected dissolved oxygen data suggested a decline from approximately 12.5 mg/L to between 6 mg/L and 7 mg/L during the first 5 hours following the drawdown. Dissolved oxygen levels trended upward over the course of the of the following 4 days until returning to background levels 6 days after the onset of drawdown (Schenk and Bragg 2014). Dissolved oxygen levels at the downstream Jasper station did not experience a large, rapid decrease in dissolved oxygen during the drawdown, suggesting the drawdown effects on dissolved oxygen were isolated to less than 10 miles of Fall Creek and the Middle Fork Willamette River.

Outmigration and Suspended Sediment Summary

Reservoir drawdown and dam removal sequencing was developed to minimize effects on Klamath River anadromous fish. A review of recent juvenile salmonid outmigration data collected from 2008 to 2015/2016, provides an updated understanding of juvenile salmonid outmigration timing on the Klamath River and select tributaries. Comparing outmigration timing and anticipated reservoir drawdown-influenced suspended sediment concentrations in the Klamath River is informative for predicting potential sediment effects to juvenile salmonids entering the Klamath River during the winter and early spring coincident with reservoir drawdowns. The data review suggests potential sediment effects to early outmigrating juvenile salmonids in the Shasta and Scott rivers. However, juvenile outmigration timing suggests a high degree of plasticity when fish outmigrate from tributaries to the Klamath River. Environmental conditions including stream flow, water temperature, food availability, and other biological and environmental cues influence outmigration timing. The adaptive monitoring and salvage plan included in the measure is also intended to reduce sediment effects on outmigrating salmonids.

4.3.4 Juvenile Salmonid Suspended Sediment Avoidance Behavior Review

KRRC reviewed literature pertaining to juvenile salmonid avoidance behaviors in response to elevated suspended sediment. In summary, the high levels of suspended sediment in the Klamath River during reservoir drawdown are anticipated to be problematic for outmigrating juvenile salmonids during peak concentrations. However, as concentrations decline over time and with distance from Iron Gate Dam, juvenile salmonids are expected to employ behavioral adaptations to reduce exposure effects.

Avoidance Behavior

The reservoir drawdown period will be marked by poor water quality caused by high suspended sediment concentrations. Juvenile salmonids inhabiting the Klamath River are expected to employ coping strategies to survive poor conditions. Juveniles may use clear water tributary junctions, clear water off-channel ponds and tributaries, spring seeps, or increase their use of the benthic zone (Bash et al. 2001; Kjelland et al. 2015), or the upper portion of the water column (Servizi and Martens 1992). We expect juvenile fish to actively seek these areas as they move downstream from natal tributaries into the Klamath River. Factors affecting the ability of juvenile salmonids to find clear water areas include the frequency and output of clear water sources, the magnitude of suspended sediment in the Klamath River, and the developmental stage of juvenile fish (Sedell et al. 1990). Younger fish are generally more susceptible to high suspended sediment concentrations than older fish.

For juvenile salmonids rearing in the mainstem Klamath River at the time of reservoir drawdown, gradually increasing suspended sediment levels may promote more rapid downstream movement of juvenile fish as they seek cleaner water (Berg and Northcote 1985). Redding and Schreck (1987) found juvenile coho and steelhead exposed to 4,000 mg/L exhibited a physiological stress response, but tested fish were able to compensate for the high suspended sediment concentrations within a few days. Fish exposed to 2,000 - 4,000 mg/L of sediment exhibited physiological changes indicative of sublethal stress, but the tested sediment levels also caused modified feeding behavior and lowered the disease resistance of tested fish (Redding and Schreck 1987). Physiological responses were moderate compared to cortisol levels in fish severely stressed by confinement and handling (Redding and Schreck 1983 cited in Redding and Schreck 1987), suggesting that minimizing handling in favor of allowing juvenile fish to make choices on their outmigration may result in lower juvenile salmonid mortality.

Exposure to Organics-based Suspended Sediment

Salmonid suspended sediment studies generally evaluate the effects of mineralized sediment on salmonids. Sockeye smolts were less susceptible to high levels of Frasier River sediments than they were to lower levels of angular ash particles associated with the Mount St. Helens eruption (Newcomb and Flagg cited in Servizi and Martens 1987). Compared to gill abrasion effects caused by mineralized sediment, organic-based suspended sediment may cause problematic effects related to low dissolved oxygen levels (Sorenson et al. 1977 cited in Bash et al. 2001), but organic sediments may be less abrasive compared to suspended mineralized sediments.

4.3.5 Summary of Additional Information on Potential Project Effects on Juvenile Outmigration

Juvenile salmonids exhibit outmigration timing plasticity that reflects their response to instream conditions influenced by stream flow, water temperature, food availability, and other biological and environmental cues. We would anticipate that juveniles will delay entry into the Klamath River when they experience adverse conditions, and fish will choose to outmigrate in response to tributary condition decline and mainstem river condition improvement. Based on the reviewed outmigration data, juveniles outmigrate from tributaries over several weeks from late winter through summer, with juvenile Chinook salmon being the earliest outmigrants from upper Klamath River tributaries. If juvenile fish remain in upper Klamath River tributaries through early to mid-March, they will experience substantially lower suspended sediment concentrations upon entry into the Klamath River. The mid-March time period precedes the start of irrigation season (beginning of April) in the Shasta River, when tributary conditions begin to decline due to reduced instream flows and rising water temperatures (Jetter et al. 2016).

KRRC's data review suggests juvenile salmonids are capable of outmigrating from Iron Gate Dam to the Klamath estuary in less than 2 weeks. Clear water sources in the form of tributary confluences, off-channel ponds, and spring seeps will serve as moderate to high water quality stepping stones in an otherwise harsh aquatic environment. As juveniles migrate downstream, not only will they encounter pockets of improved water quality, but suspended sediment concentrations will also decline with tributary inputs. Water quality conditions downstream of the Trinity River confluence are anticipated to be near background levels as the Trinity River and other tributaries dilute suspended sediment concentrations. It is expected that fish exposed to high suspended sediment concentrations to outmigrate more rapidly, further reducing the exposure duration.

If suspended sediment concentrations remain elevated above 1,000 mg/L for any 2-week period during the outmigration, there may be up to 20 percent mortality of exposed fish. However, this conclusion should be considered in light of documented evidence of juvenile coho and steelhead survival at suspended sediment concentrations exceeding 2,000 mg/L (Redding et al. 1997). Likewise, it is unlikely fish will be continuously exposed to high suspended sediment concentrations over 14 days as they will have access to clear water refuges and will experience improving water quality conditions as they move downstream.

Based on juvenile salmonid outmigration data, anticipated suspended sediment concentrations during reservoir drawdown, and expected juvenile salmonid avoidance behaviors, an adaptive strategy that includes monitoring and salvaging juvenile fish as a last resort, is a prudent approach to reducing sediment effects on juvenile salmonids.

4.4 Juvenile Salmonid Outmigration Variability Plots

4.4.1 Introduction

KRRC prepared outmigration variability plots for trap data from the Klamath River and select tributaries. The plots provide an indication of the variability of outmigration timing by species and trap location. Outmigration variability is related to flow, water temperature, food resources, and other biological and environmental cues. The following sections review outmigration variability based on recent juvenile outmigration data.

4.4.2 Upper Klamath River – Bogus Net Frame and Kinsman Trap Results

Population estimates developed from Bogus net frame and Kinsman rotary screw trap catch data were aggregated for the 2008 to 2015 period. Variability plots were developed to assess outmigrant population variability for each location over the 10-year period (Figure 4-10). Weekly population estimates tended to be the most variable in the middle portion of the outmigration period when years with large population estimates created data outliers. Chinook salmon were the most abundant of the three analyzed species.

4.4.3 Upper Klamath River – Shasta River and Scott River Trap Results

Population estimates developed from Shasta River and Scott River rotary screw trap catch data were aggregated for the 2008 to 2016 period (Shasta River coho analysis from 2009 to 2016). Variability plots were developed to assess outmigrant population variability for each location over the 11-year period (Figure 4-11). Weekly population estimates tended to be the most variable in the middle portion of the outmigration period for age 0+ Chinook salmon. Chinook salmon were the most abundant of the three analyzed species.

4.4.4 Middle Klamath River –Trinity River Trap Results

Population estimates developed from Trinity River rotary screw trap catch data were aggregated for the 2008 to 2015 period. Variability plots were developed to assess outmigrant population variability for the trap location over the 10-year period (Figure 4-12). Weekly population estimates tended to be the most variable for coho salmon due to their overall small population size.

4.4.5 Lower Klamath River – Blue Creek Trap Results

Population estimates developed from Blue Creek rotary screw trap catch data were aggregated for the 2008 to 2015 period. Variability plots were developed to assess outmigrant population variability for the trap location over the 10-year period (Figure 4-13). Population estimates were generated for age 0+ Chinook salmon and age 0+ steelhead. Estimates were not generated for coho due to low catch. Chinook salmon had larger population estimates relative to steelhead.

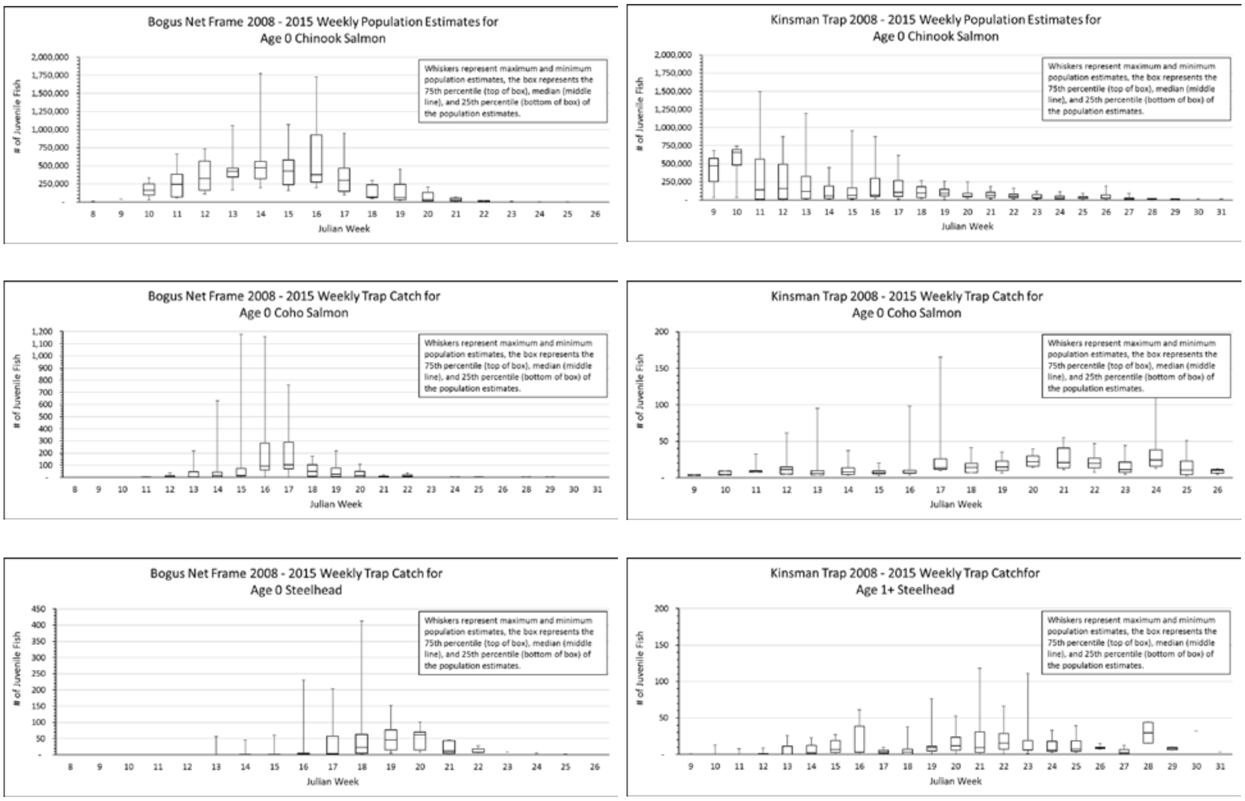


Figure 4-10 Chinook salmon, coho salmon, and steelhead weekly population estimates and trap catch results for the Bogus net frame and Kinsman rotary screw trap on the Klamath River.

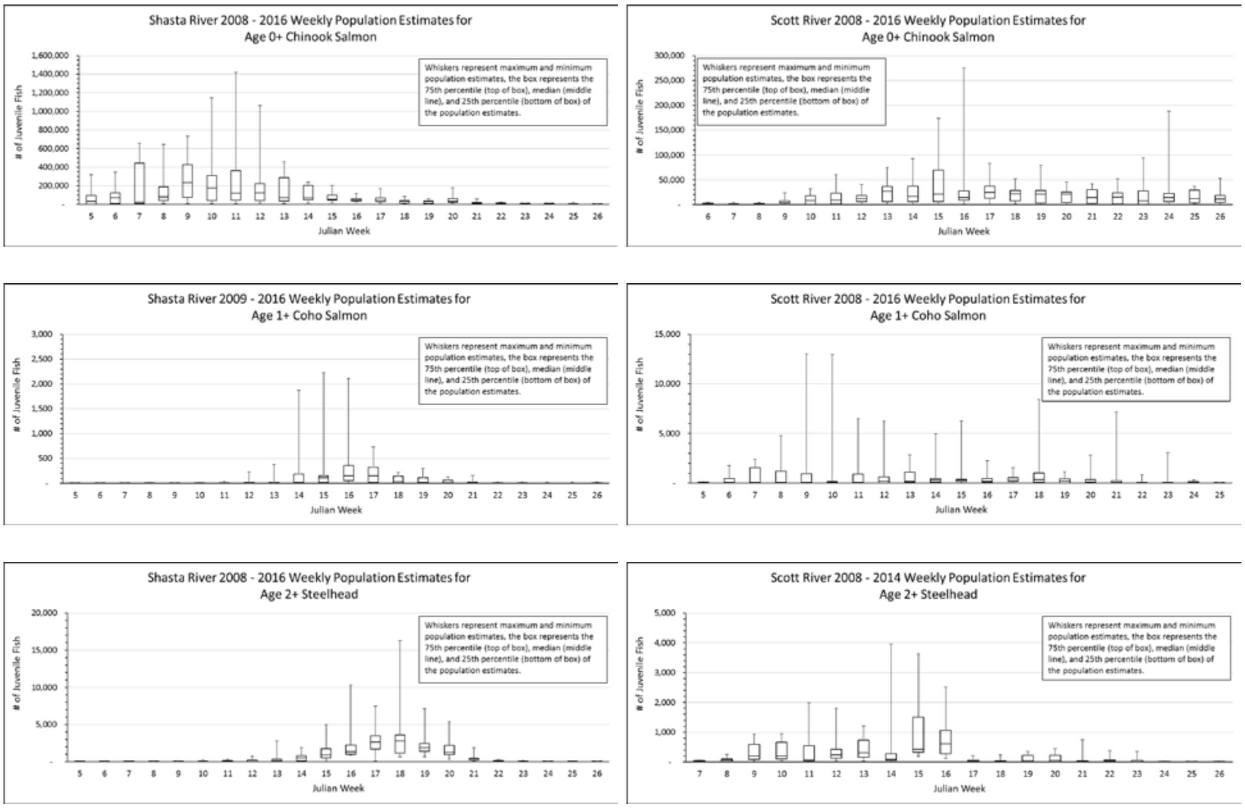


Figure 4-11 Chinook salmon, coho salmon and steelhead weekly population estimates for the Shasta River and Scott River traps.

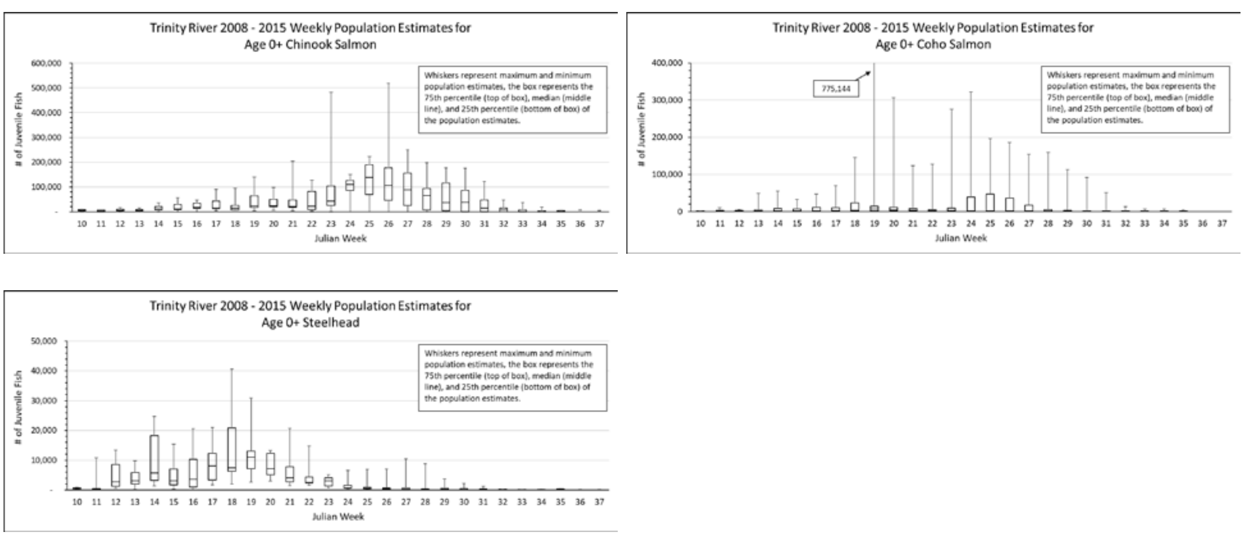


Figure 4-12 Chinook salmon, coho salmon and steelhead weekly population estimates for the Trinity River trap.

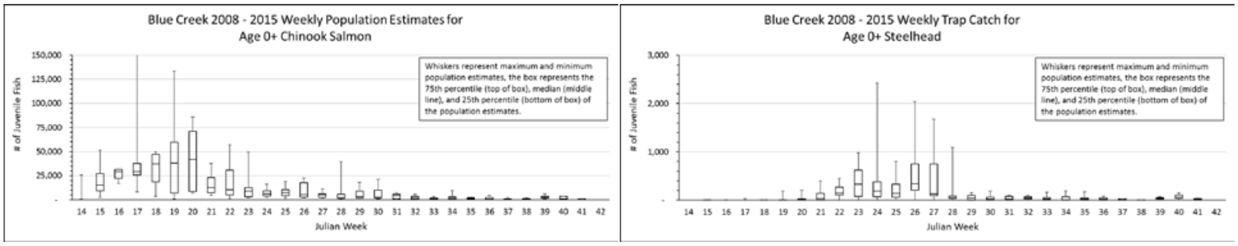


Figure 4-13 Chinook salmon and steelhead weekly population estimates for the Blue Creek trap.

4.5 Summary

The Project is anticipated to have significant short-term effects, but long-term benefits, for fall Chinook salmon, coho salmon, winter steelhead, and Pacific lamprey. KRRC's proposed outmigrating juveniles measure includes three primary actions; salvaging mainstem overwintering juvenile salmonids prior to reservoir drawdown; maintaining tributary-mainstem connectivity to ensure volitional fish passage between tributaries and the Klamath River; and developing a water quality monitoring network, trigger thresholds, and plan for salvaging and relocating juvenile fish from tributary confluence areas to cool water tributaries, nearby off-channel ponds, or in the Klamath River downstream of the confluence of the Trinity River. KRRC's proposed three-pronged approach is anticipated to offset the short-term effects to outmigrating juvenile salmonids.

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Chapter 5: Fall Pulse Flows

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5. FALL PULSE FLOWS

The objective of AR-3 in the 2012 EIS/R was to address reservoir drawdown and project effects on anadromous fish that migrate and spawn in the mainstem Klamath River and its tributaries. Specifically, the 2012 EIS/R AR-3 focused on increasing fall flows to encourage outmigration of post-spawned green sturgeon from the lower Klamath River and estuary to the Pacific Ocean, and increase fall Chinook salmon, coho salmon, and steelhead spawning in tributaries downstream from Iron Gate Dam. In 2012, the fall pulse flows were anticipated to reduce the effects of elevated suspended sediment concentrations on anadromous fish inhabiting the Klamath River.

However, KRRC and the ATWG have concluded that the use of fall pulse flows would likely be ineffective in reducing the effects of suspended sediment on migrating and spawning salmon, steelhead, and green sturgeon based on a review of the best available science regarding Klamath River fisheries and project effects. In particular, the uncertainty of storage water availability on the mainstem Klamath River prior to reservoir drawdown, and the natural (unregulated) hydrology of most Klamath River tributaries make implementation and success of this measure unpredictable. The measure would therefore be either infeasible and/or unnecessary to implement depending on the meteorological conditions prior to the Project. Therefore, KRRC will not implement fall pulse flows to offset the suspended sediment effects related to the Project.

5.1 Summary of the Affected Species, Project Benefits and Effects, Recent Fisheries Literature, and the 2012 EIS/R AR-3

The following sections review the components of the 2012 EIS/R AR-3, anticipated project effects and benefits on AR-3 species, and recent fisheries literature relative to juvenile salmonid outmigration.

5.1.1 Affected Species

Species identified in the measure include:

- Coho salmon *(Oncorhynchus kisutch)* – Southern Oregon/Northern California Coastal (SONCC) ESU: Federally Threatened; California Threatened; Tribal Trust Species
- Chinook salmon *(O. tshawytscha)* – Upper Klamath-Trinity Rivers ESU - Fall Run: California Species of Special Concern; Tribal Trust Species
- Steelhead *(O. mykiss)* – Klamath Mountains Province DPS – Summer Run: California Species of Special Concern; Tribal Trust Species
- Steelhead *(O. mykiss)* – Klamath Mountains Province DPS – Winter Run: Tribal Trust Species

- Green sturgeon *(Acipenser medirostris)* - Northern DPS: Tribal Trust Species

5.1.2 Anticipated Project Effects on AR-3 Species

Short-term project effects (from both suspended sediment and bedload movement) were predicted to result in high mortality of fall Chinook salmon and coho salmon embryos and pre-emergent alevin within redds that are constructed in the mainstem Klamath River downstream from Iron Gate Dam in the fall prior to reservoir drawdown (USBR and CDFG 2012). The 2012 EIS/R analysis predicted that approximately 2,100 fall Chinook salmon redds and approximately 13 SONCC coho salmon redds would be affected during reservoir drawdown. Migrating steelhead within the mainstem Klamath River after December 31 prior to reservoir drawdown are also anticipated to be directly affected by suspended sediment related to reservoir drawdown. Additionally, any adult green sturgeon remaining in the lower Klamath River and estuary could be exposed to elevated suspended sediment concentrations which could result in major stress to affected fish, although the effects of the Project are expected to be the same as under existing conditions (USBR and CDFG 2012). Table 5-1 includes the likely and worst-case effects to adult anadromous fish species downstream from Iron Gate Dam from the 2012 EIS/R.

Table 5-1 2012 EIS/R anticipated effects summary for migratory adult salmonids and green sturgeon

Species	Life Stage	Likely Effects	Worst Effects
Coho Salmon	Adult Spawning	Loss of 13 redds (0.7-26%)[1]	Loss of 13 redds (0.7-26%)[1]
Chinook Salmon - Fall	Adult Spawning	Loss of 2,100 redds (8%)[1]	Loss of 2,100 redds (8%)[1]
Steelhead - Summer	Migrating Adults	No anticipated mortality	Loss of 0-130 adults (0-9%)
Steelhead - Winter	Migrating Adults	Loss of up to 1,008 adults (14%)[1]	Loss of up to 1,988 adults (28%)
Green Sturgeon	Holding Adults	Sublethal effects	Sublethal effects

Source: USBR and CDFG 2012
[1] Range of potential year class loss based on the average number of redds associated with the evaluated population(s).

The following sections include an overview of the 2012 EIS/R analysis of species-specific effects (USBR and CDFG 2012; Vol. I, pp. 3.3-129 to 3.3-168).

Coho Salmon

The wide distribution and use of tributaries by both juvenile and adult coho salmon will likely protect the population from the worst effects of the increased sediment during implementation of the Project. However, the 2012 EIS/R anticipated direct mortality of redds and smolts from the upper Klamath River, mid-Klamath River, Shasta River, and Scott River population units. No mortality was anticipated for the Salmon River, Trinity River, and Lower Klamath River populations under the most likely or worst-case scenarios. Based on substantial reduction in the abundance of a year class in the short-term, the effect of the Project was found to be significant for the coho salmon from the Upper Klamath River, Mid-Klamath River, Shasta River, and Scott River population units.

Based on spawning surveys conducted from 2001 to 2005 (Magneson and Gough 2006), 6 to 13 redds were anticipated to be affected during reservoir drawdown. The anticipated loss of redds from the Upper Klamath River coho salmon population unit was based on the peak count of redds surveyed in all years (13 redds counted in 2001). Mainstem Upper Klamath River coho redd surveys completed between 2001 and 2016 (not completed in 6 years) yielded 6 redds on average and no redds in 2009. A total of only 38 mainstem redds were documented between 2001-2005, with two-thirds of those redds being found within 12 miles of the dam (NOAA 2010). Many of the redds anticipated to be affected by the Project are thought to be from returning hatchery fish (NOAA 2010). Based on the range of escapement estimates in Ackerman et al. (2006), the 2012 EIS/R concluded that 13 redds would represent anywhere from 0.7 to 26 percent of the naturally returning spawners in the upper Klamath River Population Unit, and likely much less than 1 percent of the natural and hatchery returns combined (Magneson and Gough 2006).

Chinook Salmon – Fall Run

Fall Chinook salmon use the mainstem Klamath River for spawning, rearing, and as a migratory corridor. Direct mortality is predicted for fall Chinook salmon redds and some smolts. The effect of suspended sediment concentrations on juvenile fall Chinook salmon from the Project was expected to be relatively minor because of variable life histories, the large majority of age-0 juveniles that remain in tributaries until later in the spring and summer, and because many of the fry that out-migrate to the mainstem come from tributaries in the middle or lower Klamath River, where suspended sediment concentrations resulting from the Project are expected to be lower due to dilution from tributaries.

Suspended sediment was predicted to result in 100 percent mortality of fall Chinook salmon eggs and fry spawned in the mainstem Klamath River during the fall prior to reservoir drawdown. Much of the overall effect on fall run Chinook salmon was anticipated to depend on the relative proportion of mainstem spawners during the fall prior to reservoir drawdown. Based on redd surveys using a mark and re-sight methodology from 1999 through 2009 (Magneson and Wright 2010), an average of 2,100 redds from hatchery and naturally returning adults were constructed in the mainstem Klamath River and represented approximately 8 percent of total, basin-wide escapement (USBR and CDFG 2012).

Steelhead – Summer and Winter

High suspended sediment concentrations resulting from the Project were anticipated to affect winter steelhead migrating during the winter and spring of reservoir drawdown, particularly for the portion of the population that spawns in tributaries upstream of the Trinity River. For that portion of the population, effects are anticipated on adults, run-backs, half-pounders, any juveniles rearing in the mainstem, and out-migrating smolts. However, the broad spatial distribution of steelhead in the Klamath Basin and their flexible life history suggests that some steelhead will avoid the most serious effects of the Project by remaining in tributaries for extended rearing, rearing farther downstream where suspended sediment concentrations should be lower due to dilution, and/or moving out of the mainstem into tributaries and off-channel habitats during winter to avoid periods of high suspended sediment concentrations.

Additionally, the life history variability observed in steelhead means that, although numerous year classes will be affected, not all individuals in any given year class will be exposed to project effects. Some portion of the progeny of those adults that spawn successfully would also rear in tributaries long enough to not only avoid the highest suspended sediment concentrations, but may also not return to spawn for up to 2 years, when suspended sediment resulting from the Project should be greatly reduced. The high incidence of repeat spawning among summer steelhead, ranging from 40 to 64 percent (Hopelain 1998) should also increase that population's resilience to project effects. Project modeling results suggests the loss of up to 1,988 winter steelhead redds and up to 130 summer steelhead redds.

Green Sturgeon

Under the 2012 EIS/R most-likely-to-occur scenario and worst-case scenario, the Project was anticipated to have no effect relative to existing conditions on adult green sturgeon (USBR and CDFG 2012; Vol. I, p. 3.3-164). Because green sturgeon are distributed downstream of Ishi Pishi Falls (river mile [RM 66]) in the lower Klamath River (McCovey 2008), and generally do not enter the lower Klamath River until April, green sturgeon are likely to experience lower project-related suspended sediment concentrations. Tributary inputs between Iron Gate Dam and Ishi Pishi Falls will dilute suspended sediment concentrations, and green sturgeon entering the system later in spring will be subjected to near background water quality conditions as project effects diminish into summer. Green sturgeon also emigrate from the Klamath River in the fall (Benson et al. 2007) and are not expected to experience high suspended sediment concentrations associated with the early stages of the Project.

Green sturgeon in the Klamath River spawn on average of every four years, although males occasionally spawn every two years (McCovey 2010), and therefore up to 75 percent of the mature adult population (as well as 100 percent of sub-adults) are likely to be in the ocean during the spring and summer of reservoir drawdown and avoid effects associated with the Project. Green sturgeon are long-lived (>40 years) and are able to spawn multiple times (Klimley et al. 2007), so effects on two year classes may have little influence on the population as a whole (USBR and CDFG 2012).

5.1.3 2012 EIS/R AR-3

The 2012 EIS/R AR-3 (Vol. I, pp. 3.3-245 and 3.3-246) described the potential for augmented fall flows in the mainstem Klamath River downstream from Iron Gate Dam to encourage the outmigration of post-spawned green sturgeon from the lower Klamath River and to potentially increase the proportion of fall Chinook salmon, coho salmon, and steelhead spawning in tributaries. Green sturgeon outmigration from the Klamath River and increased tributary spawning by anadromous salmonids would reduce the number of fish exposed to elevated suspended sediment concentrations in the Klamath River as a result of the Project.

The 2012 EIS/R AR-3 suggested that water releases from the Klamath River Hydroelectric Reach reservoirs would mimic the natural hydrograph during a wet year prior to the dam deconstruction project, and flows would be consistent with previous recommendations intended to recover endangered and threatened fishes in the Klamath River (National Research Council 2004). During a dry year, water balancing would need to be considered to meet the needs of other basin programs and ecological goals. The 2012 EIS/R AR-3 also stated that increasing fall flows would likely be most successful if elevated mainstem flows coincided with elevated tributary flows. Synchronized mainstem and tributary flows would create a large enough pulse of water to encourage upstream mainstem migration and unhindered access into tributary streams.

The 2012 EIS/R AR-3 also specified that spawning surveys could be conducted prior to reservoir drawdown to monitor the measure's effectiveness.

5.1.4 KRRC's and the ATWG's Review of AR-3 for Feasibility and Appropriateness

KRRC assessed the feasibility and appropriateness of the 2012 EIS/R AR-3 through multiple planning meetings held with the ATWG between May and August 2017. During these meetings, new information on Klamath River fisheries was presented and information on other dam removal projects conducted in the western United States was reviewed to understand how the aquatic ecosystem might respond to the Project. The ATWG's major concerns regarding the 2012 EIS/R AR-3 included:

- Uncertainty of water availability during fall prior to reservoir drawdown.
- Tributary flows influencing tributary spawning.
- Water needs during reservoir drawdown for sediment evacuation.
- Adult coho salmon locations at the time of the reservoir drawdowns.
- Green sturgeon outmigration timing.

Each of the ATWG's concerns are discussed in greater detail below.

Uncertainty of Water Availability Prior to Reservoir Drawdown

The ATWG is concerned that the extra water needed to create the fall pulse flows prior to reservoir drawdown may not be available depending on the water year, water rights, and other basin program needs. Given these concerns, water availability creates uncertainty and executing the measure may not be feasible. The ATWG concluded that the current operation plans in place for USBR's Klamath Project have been analyzed under a biological opinion (NOAA and USFWS 2013) and are sufficient to describe water releases throughout the year to meet biological goals in the basin.

Tributary Flows Influencing Tributary Spawning

The ATWG concluded that the proportion of tributary spawning by coho salmon and Chinook salmon is dictated by flows in natal tributaries and not by flow conditions in the mainstem Klamath River. Since many of the primary spawning tributaries are unregulated, fall flows will be determined by the meteorological conditions that occur during the fall prior to reservoir drawdown and thus cannot be predetermined. The

ATWG found that while some water leasing options could be pursued in the Shasta River, water leasing in other tributaries is unlikely based on a lack of existing water leasing agreements and therefore, tributary flows may have minimal influence on the number of spawning fish in the Klamath River. The ATWG also observed that efforts to use pulse flows in the past have been unsuccessful in moving large numbers of fish into the river or into tributary streams.

In summary, KRRC and the ATWG concluded that the prescribed fall pulse flows would have little or no effect on tributary streamflow and would not likely result in any additional tributary spawning during a dry year, and therefore should not be implemented as part of the Project.

Water Needs for Sediment Evaluation During Reservoir Drawdown

The ATWG expressed concerns that using available water volume for fall pulse flows could increase or extend the deleterious effects of elevated suspended sediment concentrations to other aquatic organisms in the Hydroelectric Reach and downstream from Iron Gate Dam due to insufficient water during reservoir drawdown. By using available water prior to reservoir drawdown, the ATWG expressed concern that less water during reservoir drawdown would result in less sediment being evacuated in the first year, causing prolonged sediment effects beyond the Project.

As such, KRRC and the ATWG concluded that using available storage water in the fall prior to reservoir drawdown could worsen or extend the deleterious effects of elevated suspended sediment concentrations on Klamath River focal species and stored water would be better used to evacuate as much sediment as possible during the Project.

Adult Coho Salmon Locations at Time of Reservoir Drawdown

KRRC and the ATWG concluded that since natural origin coho salmon primarily spawn in Klamath River tributaries, adult coho salmon will largely be unaffected by poor water quality conditions associated with reservoir drawdown in the mainstem Klamath River. Coho salmon peak spawning typically occurs in November and December after fall freshets contribute to tributary flows (USBR and CDFG 2012). Additionally, the low numbers of coho salmon that spawn in the mainstem Klamath River are mostly of hatchery origin (NOAA 2014).

KRRC and the ATWG therefore found that project effects to adult coho salmon will be minimal as the majority of coho salmon spawning takes place in tributaries, and that the implementation of fall pulse flows would not likely result in any further tributary spawning by natural origin coho salmon.

Green Sturgeon Outmigration Timing

KRRC and the ATWG found that while green sturgeon outmigration timing from the lower Klamath River and estuary is correlated to increasing streamflow and decreasing water temperatures, these conditions would likely occur naturally prior to reservoir drawdown and additional releases of water are unnecessary to promote outmigration. Benson et al. (2007) stated that outmigration of any holding green sturgeon occurred during the first significant rainfall, usually in November and December. A green sturgeon tagging program in the lower Klamath River, has found no green sturgeon in either the Klamath River or Trinity River after mid-December (Barry McCovey, Yurok Tribe, personal communication, 2017).

KRRC and ATWG concluded that streamflow will naturally increase with fall rains, and no additional flow augmentation will be necessary to ensure that green sturgeon will outmigrate from the lower Klamath River and estuary prior to the Project.

2012 EIS/R Baseline Population Estimates and Project Effects Uncertainty

Effects to adult fish outlined in the 2012 EIS/R (Vol. II, Appendix E) included approximations and assumptions that were based on limited data on Klamath River anadromous salmonids and green sturgeon; incorporated a conservative analysis of fish avoidance behavior to the anticipated water quality conditions; and in part included a worst-case scenario analysis of project effects on adult Chinook and coho salmon, and green sturgeon. Additionally, the 2012 EIS/R effects determination assumed that fish would not exhibit behavioral responses to poor water quality, and instead would experience high mortality by voluntarily remaining in areas that had lethal concentrations of suspended sediment for extended periods of time.

Project Effects Uncertainty

Studies suggest that high suspended sediment concentrations (Newcombe and Jensen 1996; Chapman et al. 2014; Kjelland et al. 2015) and low dissolved oxygen concentrations (Bjorn and Reiser 1991; Washington Department of Ecology [WDOE] 2002; Carter 2005) affect adult salmonid behavior. Adult salmonid behavioral changes to high suspended sediment concentrations include avoidance of turbid waters in homing adult anadromous salmonids. Physiological effects of high turbidity include physiological stress and respiratory impairment, damage to gills, reduced tolerance to disease and toxicants, reduced survival, and direct mortality (Newcombe and Jensen 1996). Concentration and duration of elevated suspended sediment, as well as other factors including water temperature, disease, and river flow, influence the effect of suspended sediment on salmonids.

Very little information is available on the effects of suspended sediment on sturgeon, and most life stages of sturgeon are more resilient to poor water quality than salmonids (USBR and CDFG 2012).

Adult steelhead and Pacific lamprey entering the Klamath River during reservoir drawdown and dam removal would encounter poor water conditions and would be expected to avoid poor water quality by either entering tributary streams or using habitats less affected by high suspended sediment concentrations (e.g., tributary confluences or off-channel areas). For instance, in 2012 during dam deconstruction on the Elwha River, a high proportion (44 percent) of Chinook salmon redds were documented in two clear water tributaries (Indian Creek and Little River), while surveys conducted following dam removal activities (2014-2016) resulted in over 95 percent of Chinook redds constructed in the mainstem river. The high proportion of tributary spawning by fall Chinook salmon in 2012 suggests that these streams provided refugia from the effects of dam removal (McHenry et al. 2017). There is increasing evidence that fish will modify their behavior to avoid areas of high suspended sediment concentrations immediately following dam removal, thereby reducing the impact of reduced water quality on their populations. This is consistent with ecological and evolutionary theories that would predict that fish would evolve behaviors to avoid episodic events resulting is poor water quality, such as landslides, fires, and other naturally occurring processes.

5.2 Summary of Rationale for Eliminating AR-3

The 2012 EIS/R AR-3 included fall pulse flows to promote adult Chinook salmon and coho salmon migration into tributary streams for spawning, and to encourage the outmigration of green sturgeon from the lower Klamath River and estuary in advance of the project. The 2012 EIS/R anticipated that these migratory behaviors in response to the fall pulse flows to reduce the effects of high suspended sediment concentrations on anadromous species in the mainstem Klamath River.

However, KRRC and the ATWG concluded that fall pulse flows would be difficult to execute due to unknown water availability and water needs of other water users in the basin. Additionally, the best available science suggests that higher mainstem flows would not improve tributary flow conditions unless higher tributary flows occurred concurrently with the mainstem pulse flows, or if water leasing could be undertaken on key tributaries. Chinook salmon, coho salmon, and green sturgeon have also evolved with the variable hydrology of the Klamath River and are likely to migrate into tributaries (Chinook and coho salmon) or to the Pacific Ocean (green sturgeon) with the onset of fall rain and increased flows which will precede the Project. Finally, implementing the fall pulse flows could also diminish available storage that could be used to maximize reservoir sediment flushing during reservoir drawdown. For these reasons, KRRC does not propose AR-3 as part of the Project.

Chapter 6: Iron Gate Hatchery Management

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6. IRON GATE HATCHERY MANAGEMENT

Under the Klamath Hydroelectric Project license, CDFW operates the Iron Gate Hatchery with funding from PacifiCorp. Under Section 7.6.6 of the KHSA, PacifiCorp will transfer the hatchery to CDFW at the time it transfers the Iron Gate Development to the KRRC. PacifiCorp will fund the operation of the hatchery for eight years after decommissioning of Iron Gate Development. CDFW will operate the hatchery; KRRC, PacifiCorp, and CDFW will enter into an agreement to implement these responsibilities.

The objective of the Iron Gate Hatchery management measure is to address reservoir drawdown and project effects on hatchery-produced Chinook salmon and coho salmon smolts that will be released from Iron Gate Hatchery during the spring of the reservoir drawdown year during periods of high suspended sediment concentration which are potentially lethal to outmigrating juvenile salmonids. The 2012 EIS/R AR-4 focused on delaying the release timing for hatchery produced smolts, or trucking hatchery smolts to downstream reaches of the Klamath River less affected by suspended sediment concentrations.

KRRC will cooperate with CDFW, which will implement this measure, so that Iron Gate Hatchery-reared yearling coho salmon scheduled to be released in the spring of the drawdown year would be held at Iron Gate Hatchery or at another facility (depending on Iron Gate Hatchery's operational capacity) until water quality conditions in the mainstem Klamath River improve to sublethal levels. Based on the current Iron Gate Hatchery release schedules and suspended sediment predictions in the Klamath River following dam removal, yearling coho salmon releases could be delayed to avoid lethal water quality conditions. Water quality monitoring stations established prior to reservoir drawdown will be used to determine when conditions in the mainstem Klamath River are suitable for the release of hatchery-reared coho salmon. CDFW, which will operate Iron Gate Hatchery, will implement this measure pursuant to the terms of the Iron Gate Hatchery Agreement and Section 7.6.6 of the KHSA.

6.1 Summary Affected Species, Anticipated Project Benefits and Effects, Recent Fisheries Literature, and Proposed Measure

The following sections review the components of the 2012 EIS/R AR-4, anticipated project effects and benefits on measure species, and recent fisheries literature relative to juvenile salmonid outmigration. This information is presented in support of the proposed measure.

6.1.1 Affected Species

Species that the measure is intended to address include:

- Coho salmon *(Oncorhynchus kisutch)* – SONCC ESU: Federally Threatened; California Threatened; Tribal Trust Species
- Chinook salmon *(O. tshawytscha)* – Upper Klamath-Trinity Rivers ESU - Fall Run: California Species of Special Concern; Tribal Trust Species

6.1.2 Anticipated Project Effects on Measure Species

The 2012 EIS/R concluded that short-term effects of the project would result in mostly sublethal, and in some cases lethal, impacts to a portion of the juvenile Chinook salmon, coho salmon, steelhead, and Pacific lamprey that are outmigrating from tributary streams to the Klamath River during late winter and early spring of 2020 (USBR and CDFG 2012). Deleterious short-term effects were expected to be caused by high SSC levels and low dissolved oxygen concentrations in the Klamath River from Iron Gate Dam downstream to Orleans. The 2012 EIS/R concluded that hatchery-produced Chinook and coho salmon smolts released from the Iron Gate Hatchery into this reach could suffer from high mortality if they are released during periods of high SSC levels as a result of the Project. Iron Gate Hatchery production goals include 75,000 yearling coho salmon, 900,000 yearling Chinook salmon, and 5,100,000 Chinook salmon smolts (CDFW and PacifiCorp 2014). Table 6-1 includes the production goals and typical release schedules for Iron Gate Hatchery. Table 6-2 includes the actual production for 2001 to 2017 (K. Pomeroy, CDFW, personal communication, 2017).

Table 6-1 Current Iron Gate Hatchery production goals and release schedules

Species	Release Type	Production Goal	Release Schedule
Coho Salmon	Yearling	75,000	March-April
Chinook Salmon - Fall	Yearling	900,000	November
Chinook Salmon - Fall	Smolt	5,100,000	May-June

Table 6-2 Iron Gate Hatchery actual annual production totals for 2001 to 2017

Release Year	Chinook	Coho	Steelhead	Total
2001	5,849,147	46,254	31,898	5,929,300
2002	5,880,294	67,933	141,362	6,091,591
2003	5,595,997	74,271	192,771	5,865,042
2004	5,777,904	109,374	148,991	6,038,273
2005	6,212,640	74,716	195,698	6,485,059
2006	7,046,755	89,482	83,034	7,221,277
2007	6,348,474	118,487	21,208	6,490,176
2008	6,394,875	53,950	18,461	6,469,294
2009	4,749,470	118,340	29,683	4,899,502

Release Year	Chinook	Coho	Steelhead	Total
2010	5,380,185	121,000	22,500	5,525,695
2011	4,882,247	22,236	21,034	4,927,528
2012	6,180,447	155,840	51,948	6,390,247
2013	5,091,396	39,402	-	5,132,811
2014	5,422,994	79,585	-	5,504,593
2015	4,738,180	89,500	-	1,035,004
2016	4,612,598	27,568	-	4,642,182
2017	1,431,471	17,102	-	429,805
Total	91,595,074	1,305,040	958,588	89,077,379
Max	7,046,755	155,840	195,698	7,221,277
Ave	5,387,946	76,767	79,882	5,239,846
Min	1,431,471	17,102	18,461	429,805

6.1.3 2012 EIS/R AR-4

The 2012 EIS/R AR-4 (Vol. I, p. 3.3-246) included two potential actions that could be implemented to reduce the impacts of high SSC levels on hatchery Chinook and coho salmon smolts as a result of the Project. The first action is to delay the coho salmon yearling release until later in the spring (e.g., early to mid-May) in order to avoid peak SSC levels associated with the Project. The 2012 EIS/R anticipated that avoiding the peak SSC levels would reduce smolt mortality.

The 2012 EIS/R AR-4 provided an alternative action to the delayed smolt release approach, which included allowing sub-yearling and yearling smolts to imprint at the hatchery and then truck them to Klamath River release locations downstream of the Trinity River where tributary flows are anticipated to reduce SSC levels to near background. The timing of the releases would have been consistent with normal hatchery release schedules.

The 2012 EIS/R AR-4 suggested that the implementation of this measure is contingent on the hatchery remaining open and having a suitable water supply during the Project.

6.1.4 KRRC's and ATWG's Review of AR-4 for Feasibility and Appropriateness

The KRRC assessed the feasibility and appropriateness of AR-4 through multiple planning meetings held with the ATWG between May and August 2017. During these meetings, new information on Klamath River fisheries and hatchery management was presented and information on other dam removal projects conducted in the western United States was reviewed to understand how the aquatic ecosystem might respond as discussed above. The ATWG's major concerns regarding the 2012 EIS/R AR-4 included:

- Iron Gate Hatchery water supply uncertainty during and after the Project.
- Potential mortality associated with hauling and releasing juvenile salmonids.
- Potential Chinook and coho salmon juvenile imprinting and adult straying issues.

The following sections provide additional information regarding AR-4 feasibility and appropriateness, based on fisheries literature and ATWG input.

Iron Gate Hatchery Water Supply Uncertainty

The ATWG voiced concerns that the current water supply for the Iron Gate Hatchery is located in Irong Gate Reservoir which will no longer be operational following the Project. Additionally, high suspended sediment concentrations in the Klamath River during reservoir drawdown will require an alternative water source(s) or filtration of river water for use in the hatchery, as the water quality will not be sufficient for hatchery operation.

Potential Mortality Associated with Hauling and Releasing Juvenile Salmonids

The ATWG expressed concerns that long trucking distances could result in stress and handling mortality of transported fish and that truck or equipment malfunction could also result in smolt losses during transport. Studies confirm that transporting juvenile salmonids causes stress in smolts (Barton et al. 1980; Specker and Schreck 1980; Matthews et al. 1986), which may reduce survival when fish are released (Kenaston et al. 2001).

The ATWG concluded therefore that transporting hatchery Chinook and coho salmon smolts long distances downstream from Iron Gate Hatchery could lead to high mortality rates.

Potential Chinook and Coho Salmon Juvenile Imprinting and Adult Straying Issues

The ATWG observed that how juvenile salmonids are handled and transported may affect imprinting processes resulting in future straying of returning adults. Juvenile imprinting is influenced by natal stream water chemistry and the juvenile fish's physiological state during rearing and outmigration (Keefer and Caudill 2014). Juvenile fish with extended freshwater residency times, or long-distance migrations, almost certainly experience multiple imprinting events that contribute to homing success of adult spawners. Transporting juvenile fish has been shown to disrupt this 'sequential imprinting' process, and several studies on coho salmon (Solazzi et al. 1991) and Atlantic salmon (Gunnerød et al. 1988; Heggberget et al. 1991) have shown that adult homing success is inversely related to transport distance from rearing sites (Keefer and Caudill 2014).

Therefore, the ATWG concluded that release of juvenile fish downstream of the Trinity River could compromise the imprinting process for relocated juvenile fish. Insufficient imprinting to natal streams or the loss of spatially distinct imprinting events during outmigration could potentially increase adult straying rates during future returns and result in the loss of genetic integrity in distinct populations. Future, elevated stray rates could result in a more homogenous distribution of fish returning to the lower Klamath River and also hinder the natural recolonization of areas upstream of Iron Gate Dam.

The ATWG found that releasing hatchery-reared fish downstream of the Trinity River could jeopardize future hatchery returns to the upper Klamath River and could increase straying rates that could negatively affect wild populations.

6.2 Summary

The 2012 EIS/R AR-4 included two strategies for addressing short-term project effects to hatchery-produced Chinook and coho salmon smolts. The two strategies included either delaying the release of Chinook salmon smolts and coho salmon yearlings, or the transport of these fish from Iron Gate Hatchery to the Lower Klamath River where the fish would be released into reaches less affected by poor water quality associated with the Project. Delaying the release of yearling coho salmon is not expected to require a substantial change in the typical hatchery release schedule and may only require a two-week delay in the release schedule. KRRC therefore recommends to CDFW that the release schedule be delayed to that limited extent. However, KRRC does not propose the trucking option because of concerns about potential juvenile stress and mortality, as well as increased stray rates of returning adults due to insufficient juvenile imprinting.

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Chapter 7: Pacific Lamprey Ammocoetes

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7. PACIFIC LAMPREY AMMOCOETES

The objective of the 2012 EIS/R AR-5 was to monitor the distribution and abundance of Pacific lamprey ammocoetes downstream of Iron Gate Dam. The 2012 EIS/R AR-5 involved capturing and relocating Pacific lamprey ammocoetes from the Klamath River starting at, and extending 2 miles downstream from Iron Gate Dam (RM 193.1). Relocating lamprey ammocoetes from this reach was expected to offset some of the potential effects of high suspended sediment concentrations and low dissolved oxygen levels during reservoir drawdown.

However, the KRRC does not intend to implement AR-5 as part of the Project. Based on the best available information on lamprey ammocoete presence in the Klamath River downstream from Iron Gate Dam, it is expected that Project effects to Pacific lamprey ammocoetes in the 2-mile reach downstream from Iron Gate Dam (RM 193.1) will be minimal.

7.1 Summary of the 2012 EIS/R AR-5, Project Benefits and Effects, and Recent Fisheries Literature

The following sections review the components of the 2012 EIS/R AR-5, anticipated project effects and benefits on Pacific lamprey ammocoetes, and recent fisheries literature relative to Pacific lamprey ammocoetes that support KRRC's decision not to include AR-5 as part of the Project.

7.1.1 Affected Species

Species intended to be addressed in the 2012 EIS/R AR-5 include:

- Pacific lamprey *(Entosphenus tridentatus):* California Species of Special Concern; Oregon Sensitive Species, Tribal Trust Species

7.1.2 Anticipated Project Effects on AR-5 Species

The short-term effects of the Project (high suspended sediment concentrations and low dissolved oxygen) are anticipated to result in high rates of ammocoete mortality, although there is uncertainty in how resilient ammocoetes are to extended periods of high suspended sediment concentrations and low dissolved oxygen (Goodman and Reid 2012). The 2012 EIS/R (Reclamation and CDFG 2012; Vol. II, Appendix E, pp. E52-E56) analysis applied the effects of suspended sediment on salmonids to predict effects on Pacific lamprey ammocoetes, with the assumption that effects on Pacific lamprey ammocoetes are equivalent to or less severe than on salmonids. However, the best available science indicates that this overestimates effects to lamprey ammocoetes since their preferred rearing strategy is to burrow in fine sediments mixed with organic matter. In general, most life stages of Pacific lamprey appear to be more resilient to poor water quality conditions (such as suspended sediment) than salmonids (Zaroban et al. 1999). Table 7-1 includes the anticipated effects to Pacific lamprey ammocoetes presented in the 2012 EIS/R (Reclamation and CDFG 2012).

Table 7-1 2012 EIS/R anticipated effects summary for Pacific lamprey ammocoetes in the 2-mile reach of the Klamath River downstream from Iron Gate Dam

Species	Life Stage	Likely Effects	Worst Effects
Pacific Lamprey	Ammocoete Rearing	High mortality (52%)[1]	High mortality (71%)[1]

Source: USBR and CDFG 2012

The Project will have short-term effects on Pacific lamprey ammocoetes related to suspended sediment concentrations, bedload sediment transport and deposition, and impaired water quality (particularly low dissolved oxygen levels). Short-term effects on Pacific lamprey ammocoetesin the Klamath River are anticipated to be substantial because multiple year classes of Pacific lamprey rear in the mainstem Klamath River at any given time, and since adults will migrate upstream over the entire year, including January of the reservoir drawdown year when effects from the Project will be most pronounced. However, most of the population (which spans nearly the entire northern Pacific Rim), would not be affected by the Project because of the species' wide spatial distribution and varied life history. In addition, Pacific lamprey are considered to have low fidelity to their natal streams (FERC 2006), and may not enter the mainstem Klamath River if environmental conditions are unfavorable during the reservoir drawdown period. Migration into the Trinity River and other lower Klamath River tributaries may also increase during reservoir drawdown because of poor water quality in the upper Klamath River. Low site fidelity and a prevalence of tributary ammocoetes also increases the potential for Pacific lamprey recolonization of mainstem habitats following the Project.

The 2-mile reach of the Klamath River downstream from Iron Gate Dam (RM 193.1) was the focus of the proposed lamprey relocation efforts proposed in the 2012 EIS/R (Reclamation and CDFG 2012). However, at the time of the 2012 EIS/R, lamprey ammocoete presence downstream from Iron Gate Dam was unknown. Recent surveys have found very low numbers or absence of lamprey ammocoetes in the Klamath River between Iron Gate Dam and the Scott River (approximately 47 river miles; Goodman and Hetrick 2017). The low ammocoete density in this reach is presumably related to flow management, poor water quality, lack of sandy fines, and high deposition rates of organic material (Goodman and Reid 2015). Kostow (2002) also found Pacific lamprey ammocoete distributions can be patchy, perhaps due to environmental conditions, and Petersen (2006) related tribal eelers' belief that the effects of the dams on anadromous fish returns may affect marine-derived nutrients that sustain ammocoetes.

Tribal elders and eelers with the Yurok and Karuk Tribes were interviewed as part of a traditional ecological knowledge (TEK) project investigating the importance of Pacific lamprey to the lower Klamath River tribes (Petersen 2006). Eelers noted the dramatic reduction in Pacific lamprey since European-American settlement and specifically over the last 50 years. The construction of Iron Gate Dam, mining, forest fire suppression, commercial logging, other forestry practices including herbicide application, road building, rotenone treatments (see Jackson et al. 1996 for similar treatments in the Columbia Basin), periodic high magnitude floods, and changing ocean conditions were frequently identified by these sources as reasons for Pacific lamprey declines in the basin (Petersen 2006). Of these impacts, loss of the natural flow regime on the Klamath River was highlighted as having the most detrimental effect on Pacific lamprey spawning and ammocoete rearing habitats. Dewatering of channel margin ammocoete rearing habitats downstream from Iron Gate Dam caused by hydropower ramping were also suspected in the decline of Pacific lamprey (Petersen 2006).

The Project will address some of the limiting factors that are believed to currently affect Pacific lamprey across their geographic region and in the Klamath River basin. Increasing connectivity across the river network and restoring connectivity between the Klamath River and tributaries in the Hydroelectric Reach will provide access to more Pacific lamprey spawning and rearing habitats (Schultz et al. 2014). Restoring more natural flow and temperature regimes, and transport of fine sediments downstream of Iron Gate Dam, will improve ammocoete rearing habitat conditions. Ammocoete rearing habitats are believed to be important for maintaining recruitment to the population as these areas provide pheromone-based migratory cues for spawning adults (Stone et al. 2002; Li et al. 2003) and may preserve lamprey population persistence (Jolley et al. 2016).

7.1.3 2012 EIS/R AR-5

The 2012 EIS/R AR-5 directed the capture and relocation of Pacific lamprey ammocoetes from preferred habitats in the reach of the Klamath River starting at, and extending 2 miles downstream from Iron Gate Dam. Relocating lamprey ammocoetes from this reach was expected to offset some of the potential effects of high suspended sediment concentrations and low dissolved oxygen levels during reservoir drawdown.

The 2012 EIS/R AR-5 included the following actions.

- Identify preferred habitat areas where dissolved oxygen levels would be particularly low, including pools, alcoves, backwaters, and channel margins that experience low water velocities and sand and silt deposition from the reach within 2 miles downstream from Iron Gate Dam.
- Conduct reconnaissance level surveys to assess if enough ammocoetes are present in this reach to warrant protection.
- The salvage operation, if implemented, would be conducted utilizing a specialized backpack electrofishing unit to capture ammocoetes. Captured individuals would be transported to suitable locations (with current low occurrences of lamprey) within tributaries upstream or upstream of Keno Dam.

7.1.4 KRRC's and the ATWG's Review of AR-5 for Feasibility and Appropriateness

The KRRC assessed the feasibility and appropriateness of AR-5 through multiple planning meetings held with the ATWG between May and August 2017. During these meetings, current information on Klamath River fisheries was presented and information on other dam removal projects conducted in the western United

States were reviewed to understand how the aquatic ecosystem might respond as discuss above. The ATWG's major concerns regarding the 2012 EIS/R AR-5 included:

- Pacific lamprey ammocoete absence in the prescribed 2012 EIS/R salvage reach.
- Potential effects of relocated Pacific lamprey ammocoetes on endemic lamprey species.
- Effects to the Pacific lamprey metapopulation.

The following sections provide additional information regarding feasibility and appropriateness of the 2012 EIS/R AR-5 based on supplemental information provided in the 2012 EIS/R, current fisheries research literature, and input from the ATWG.

Pacific Lamprey Ammocoetes Absence from Salvage Reach

Recent sampling efforts conducted by the Karuk Tribe and USFWS in the proposed salvage reach (2 miles downstream from Iron Gate Dam) found very few or no ammocoetes in sampled habitats (Goodman and Hetrick 2017; T. Soto, Karuk Tribe, personal communication, 2017). At 37 sites sampled in the Klamath River, ammocoetes were detected at an expected catch per unit effort at all locations except those within proximity to Iron Gate Dam (Goodman and Hetrick 2017). Goodman and Reid (2015) documented the 47-mile reach of the Klamath River from Iron Gate Dam to the Scott River as a zone containing few ammocoetes, presumably due to flow management, poor water quality, lack of sandy fines, and high deposition rates of organic material. Since river conditions and river management have not changed since these recent ammocoete surveys were completed, Pacific lamprey ammocoete habitation in the 2-mile reach downstream of Iron Gate Dam is unlikely. The ATWG concluded that further allocation of resources to sample ammocoetes from this reach is not warranted.

Effects of Relocated Pacific Lamprey Ammocoetes on Endemic Lamprey Ammocoetes

Currently, five other resident species of lamprey occur in the Klamath Basin. Although Pacific lamprey likely historically occupied the Upper Klamath Basin (Goodman and Reid 2015) and tribal knowledge relates that Pacific lamprey occupied habitats beyond the upstream limit of steelhead occupation (Petersen 2006), there are uncertainties regarding the historical overlap of Pacific lamprey and endemic lamprey species (ODFW 2008). The ATWG suggested that it would be difficult or impossible to differentiate larval lamprey ammocoetes of a variety of species during a field relocation effort. With this in mind, the ATWG expressed concerns regarding the potential effects of relocating non-target ammocoetes to areas upstream of Keno Dam or into Klamath River tributaries as the 2012 EIS/R AR-5 specified. Potential effects on endemic lamprey species could include competition for habitat and food, and disease transmission from relocated lamprey ammocoetes to existing populations. ODFW's 2008 draft of *A Plan for the Reintroduction of Anadromous Fish in the Upper Klamath Basin* sought a passive reintroduction strategy for Pacific lamprey. ODFW's current strategy is likely to follow a similar passive reintroduction process (T. Wise, ODFW, personal communication, 2017). The ATWG concluded that relocating salvaged lamprey ammocoetes from the mainstem Klamath River could pose significant risks to other endemic lamprey species.

Pacific Lamprey Metapopulation

Recent genetic analysis of Pacific lamprey suggests no significant population structure exists across populations or regions, indicating a high degree of historical gene flow even across expansive distances of the northern Pacific Rim (Goodman and Reid 2012). Klamath Basin Pacific lampreys are part of a more geographically-widespread interbreeding population that exhibits little basin-specific site fidelity (Goodman and Hetrick 2017). Because the metapopulation is now believed to extend potentially across the species' range, the percentage of the metapopulation's adult and larval Pacific lamprey that will be affected by the Project will be insignificant. The ATWG concluded that the potential loss of Pacific lamprey ammocoetes during the Project would be a temporary impact to the population and ammocoete mortality would constitute a minimal impact to the metapopulation.

7.2 Summary of Rationale for Eliminating AR-5

The Klamath River from Iron Gate Dam downstream to the Scott River (47 river miles) is referred to as a zone of low Pacific lamprey ammocoete densities. Recent sampling efforts conducted after the release of the 2012 EIS/R have detected few or no ammocoetes in this reach. Based on these sampling efforts and concerns regarding Pacific lamprey ammocoete relocation, KRRC does not propose AR-5 as part of the Project. Pacific lamprey are expected to benefit from the Project over the long-term due to the restoration of access to historical habitat upstream of Iron Gate Dam, fine sediment transport and local fining of channel bed sediments downstream of Iron Gate Dam, and improved water quality conditions.

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Chapter 8: Suckers

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8. SUCKERS

The objective of the suckers measure is to address reservoir drawdown and project effects on Lost River and shortnose suckers inhabiting the Hydroelectric Reach reservoirs by salvaging suckers from the reservoirs and relocating the salvaged suckers to waterbodies outside of the affected area. The 2012 EIS/R AR-6 focused on trapping and hauling Lost River, shortnose, and Klamath smallscale suckers. Lost River and shortnose suckers will be released into Upper Klamath Lake, and Klamath small smallscale suckers released into Spencer Creek, a tributary to the Klamath River in the Hydroelectric Reach. Based on a review of the information provided herein, the KRRC concluded that revisions to AR-6 are necessary to address anticipated short-term effects of the Project. The measure proposed as part of the Project includes a step-wise adaptive process for sampling, salvaging, and releasing Lost River and shortnose suckers into waterbodies that will not be affected by project effects.

8.1 Proposed Measure

Based on a review of the 2012 EIS/R AR-6 presented in Section 8.2 below, input from the ATWG, and recent Lost River and shortnose suckers literature, KRRC concluded that revisions to AR-6 is necessary to offset the anticipated short-term effects of the Project on Lost River and shortnose suckers. The proposed measure includes sampling, and salvaging and releasing suckers into designated waterbodies that are isolated from sucker recovery populations in Upper Klamath Lake. The proposed measure has two actions.

- **Action 1:** Lost River and shortnose suckers will be sampled in the Klamath River and in Hydroelectric Reach reservoirs in 2018, 2019, and 2020. River sampling will be completed in spring of 2019 and 2020, and reservoir sampling will be completed in fall of 2018 and 2019. Each sampling will require approximately 6 days for an estimated 24 days of sampling across the 2018 to 2020 period. The purpose of sampling is to document the abundance and genetics of Lost River and shortnose suckers in the Hydroelectric Reach. Captured fish will be marked with a passive integrated transponder (PIT) tag, fin clipped for genetic material, measured, and released. Recaptured fish will be used to estimate sucker abundance in the sampled reservoirs. Fin clips will be used to determine the genetics of the sampled fish. USFWS is currently developing genetic markers for Lost River and shortnose suckers.
- **Action 2:** Adult Lost River and shortnose suckers in reservoirs downstream from Keno Dam will be captured and relocated to isolated water bodies in the Klamath Basin. The proposed relocation of rescued suckers to isolated waterbodies is to ensure hybridized suckers do not mix with sucker populations designated as recovery populations in Upper Klamath Lake. An estimated 14 days will be required for salvage and release efforts. Due to the poor current understanding of Lost River and shortnose sucker populations in the reservoirs, we are unsure of the number of adult suckers inhabiting the reservoirs. Based on past study results (e.g., Desjardins and Markle 2000), we anticipate salvaging and translocating 100 adult Lost River and 100 adult shortnose suckers from each of the three Klamath River reservoirs (600 fish total). The number of translocated fish will not

exceed 3,000 fish, which is the capacity of the currently identified recipient waterbody (Tule Lake). The proposed actions are intended to reduce project effects on Lost River and shortnose suckers inhabiting the Hydroelectric Reach reservoirs. The following sections provide additional detail on the proposed actions.

8.1.1 Action 1: Reservoir and River Sampling

Lost River and shortnose suckers will be sampled in the Hydroelectric Reach reservoirs and the Klamath River in 2018, 2019, and 2020. Sampling in both the reservoirs and the Klamath River is anticipated to improve the number of fish encounters since suckers may not spawn every year (Buettner 2000) and the current population demographics are unknown.

River sampling will be completed in spring of 2019 and 2020, and reservoir sampling will be completed in fall of 2018 and 2019. The intent of the sampling is to document the abundance and genetics of Lost River and shortnose suckers in the Hydroelectric Reach. Sampling will include placing trammel nets in the reservoirs (reservoir sampling) and in Klamath River segments upstream of the reservoirs (river sampling) to determine the abundance and genetics of suckers in the Hydroelectric Reach. Electrofishing or other means of trapping suckers may also be employed if trammel netting is ineffective. Captured fish will be identified by species and sex, marked with a PIT tag (Burdick 2013), fin clipped for genetic material, measured, and released. Recaptured fish will be used to estimate sucker abundance, and fin clips will be used to determine the genetics of the sampled fish. Each sampling will require approximately 6 days for an estimated 24 days of sampling across the 2018 to 2020 period. Summary reports will be prepared following each sampling effort and the ATWG will meet to review the sampling data and determine if additional sampling is necessary. Collected data will be stored in a database managed by USFWS or USGS.

Primers will need to be developed from the genetic markers that USFWS's Abernathy Fish Technology Center identifies for Lost River and shortnose suckers. Genetic analysis of the sampled suckers will be used by managers to understand the genetics of Lost River and shortnose sucker populations in the Hydroelectric Reach. Genetic information will in part be used to determine appropriate salvaged suckers' release locations.

8.1.2 Action 2: Sucker Salvage and Relocation

Adult Lost River and shortnose suckers in reservoirs downstream from Keno Dam will be captured and relocated to isolated water bodies in the Klamath Basin using similar methods as outlined for the sampling. The proposed relocation of rescued suckers to isolated waterbodies is to ensure hybridized suckers do not mix with sucker populations designated as recovery populations in Upper Klamath Lake. An estimated 14 days will be required for salvage and release efforts. We anticipate salvaging and translocating 100 adult Lost River and 100 adult shortnose suckers from each of the three Klamath River reservoirs (600 fish total). The number of translocated fish will not exceed 3,000 fish, which is the capacity of the currently identified recipient waterbody (Tule Lake). During the course of these actions, it is not anticipated that the entire populations of suckers residing in the Hydroelectric Reach reservoirs will be recovered.

In summary, the proposed measure includes two actions to sample and then salvage and relocate Lost River and shortnose suckers from the Hydroelectric Reservoirs to Tule Lake.

8.2 Summary of Affected Species, Anticipated Project Benefits and Effects, Recent Fisheries Literature, the 2012 EIS/R AR-6, and the Proposed Measure

The following sections review anticipated project effects on Lost River and shortnose suckers, current sucker literature, and the 2012 EIS/R AR-6.

8.2.1 Affected Species

Species intended to be addressed in the 2012 EIS/R AR-6 include:

- Lost River sucker *(Deltistes luxatus)*: Federally Endangered; California Endangered and Fully Protected; Oregon Endangered; Tribal Trust Species
- Shortnose sucker *(Chasmistes brevirostris):* Federally Endangered; California Endangered and Fully Protected; Oregon Endangered; Tribal Trust Species
- Klamath smallscale sucker *(Catostomus rimiculus)*

8.2.2 Anticipated Project Effects on Measure Species

The Project will result in the loss of Lost River and shortnose sucker reservoir populations as the lake-type habitat these sucker species inhabit will be restored to free-flowing riverine conditions. Although sucker populations in the Hydroelectric Reach reservoirs are generally unknown (Buettner et al. 2006), past sampling efforts have documented larval and adult suckers in Topsy Reservoir (J.C. Boyle Dam; Desjardins and Markle 2000), Copco Reservoir (Copco 1 Dam; Beak Consultants 1987; Desjardins and Markle 2000), and Iron Gate Reservoir (Desjardins and Markle 2000). Table 8-1 includes the likely and worst-case effects to Lost River and shortnose suckers in the Hydroelectric Reach reservoirs.

Table 8-1 2012 EIS/R anticipated effects summary for Lost River and shortnose suckers

Species	Life Stage	Likely Effects	Worst Effects
Lost River & Shortnose Suckers	All	Loss of reservoir populations	Loss of reservoir populations

Source: USBR and CDFG 2012

The following section includes a description of species-specific effects adapted from the 2012 EIS/R (Reclamation and CDFG 2012; Vol. I, pp. 3.3-166 to 3.3-168) and other literature.

Lost River Suckers and Shortnose Suckers

Lost River and shortnose suckers are endemic to the Upper Klamath Basin (Moyle 2002). The Lost River sucker historically occurred in Upper Klamath Lake (Williams et al. 1985) and its tributaries, and the Lost River watershed, Tule Lake, Lower Klamath Lake, and Sheepy Lake (Moyle 1976). Shortnose suckers historically occurred throughout Upper Klamath Lake and its tributaries (Williams et al. 1985; Miller and Smith 1981). The present distribution of both species includes Upper Klamath Lake and its tributaries (Buettner and Scoppettone 1990), Clear Lake Reservoir and its tributaries (USFWS 1993), Tule Lake, Lost River up to Anderson-Rose Dam (USFWS 1993), and the Klamath River downstream to Copco Reservoir and probably to Iron Gate Reservoir (USFWS 1993). Shortnose sucker occur in Gerber Reservoir and its tributaries, but Lost River sucker do not.

The Project will eliminate existing reservoir habitat used by Lost River and shortnose suckers. The Lost River and shortnose suckers that have been observed in the Hydroelectric Reach reservoirs are believed to be fish that originated in Upper Klamath Lake and moved down through Lake Euwana and the Hydroelectric Reach (Buettner and Scoppettone 1991; Markle et al. 1999; Desjardins and Markle 2000). The populations are not thought to represent a viable, self-supporting populations (Buettner et al. 2006; USFWS 2012), and no longer interact with Upper Klamath Lake populations. The Hydroelectric Reach habitat is not designated critical habitat for either species, and Hydroelectric Reach populations are not part of the species' recovery units (USFWS 2012).

8.2.3 2012 EIS/R AR-6

The 2012 EIS/R AR-6 (Vol. I, pp. 3.3-247 to 3.3-248) directed a multi-step process that included a telemetry study to determine sucker locations in the Hydroelectric Reach reservoirs, followed by salvaging Lost River and shortnose suckers during the reservoir drawdowns, and releasing the salvaged suckers into Upper Klamath Lake. If deemed feasible prior to the Project, the 2012 EIS/R AR-6 called for Klamath smallscale suckers to be collected in a 2-mile reach downstream from J.C. Boyle Dam and transported for release into Spencer Creek immediately downstream of the Spencer Creek hook-up road (upper limits for sucker in Spencer Creek; Reclamation and CDFG 2012).

8.2.4 KRRC's and the ATWG's Review of AR-6 for Feasibility and Appropriateness

The KRRC assessed the feasibility and appropriateness of AR-6 through multiple planning meetings held with the ATWG between May and August 2017. During these meetings, current information on Klamath River fisheries was presented and information on other dam removal projects conducted in the western United States were reviewed to understand how the aquatic ecosystem might respond as discussed above. Major concerns of the ATWG regarding the 2012 EIS/R AR-6 include:

- Genetic integrity of salvaged suckers and effects on recipient populations.
- Relocation site availability.
- Klamath small scale sucker salvage.

- Designated critical habitat and sink populations.
- Telemetry study feasibility and benefit.
- 2012 EIS/R baseline population estimates and effects uncertainty.

The following sections provide additional information regarding these concerns, AR-6 feasibility and appropriateness based on fisheries literature and ATWG input.

Genetic Integrity of Salvaged Suckers and Effects on Recipient Populations

Klamath reservoir sucker populations have not been formally studied since the late 1990s (see Beak Consultants 1987; 1988; Desjardins and Markle 2000). Current population sizes, age class distribution, and genetic composition of Lost River and shortnose suckers are unknown, although genetic introgression between Lost River and shortnose suckers and Klamath smallscale suckers is suspected (Beak Consultants 1987; Markle et al. 1999). USFWS is concerned that the potential relocation of hybridized Lost River and shortnose suckers into Upper Klamath Lake could compromise the genetic integrity of recovery unit populations in Upper Klamath Lake. As Klamath smallscale suckers are very rare in Upper Klamath Lake (one has been found in Upper Klamath Lake; Markle et al. 1999), hybridized Lost River-Klamath smallscale suckers or shortnose-Klamath smallscale suckers in Upper Klamath Lake would create a novel sucker hybrid not known to exist in designated critical habitat (i.e., Klamath Basin upstream from Keno Dam). However, Markle et al. (1999) found more genetic similarity between Lost River suckers and Klamath smallscale suckers, and shortnose suckers and Klamath largescale suckers, although there also geographic-related differences among individuals within the respective species (e.g., Lost River suckers from Lost River and the Upper Klamath subbasins had meristic differences). Markle et al. (1999) concluded that Klamath Basin suckers are part of a species complex, or syngameon, defined as groups of interbreeding species that maintain their ecological, morphological, genetic, and evolutionary integrity in spite of hybridization (Templeton 1989 *cited in* Markle et al. 1999). In these hybrid species complexes, species integrity may be maintained by selection.

Based on the unknown genetic composition of suckers in the Hydroelectric Reach, KRRC and the ATWG concluded that relocating salvaged suckers to Upper Klamath Lake could threaten recovery populations and alternative release locations are necessary.

Relocation Site Availability

Salvaged sucker relocation sites must be isolated from Lost River and shortnose sucker populations inhabiting critical habitat or recovery areas to maintain the genetic integrity and health of recovery populations. Although it is unlikely that Lost River and shortnose suckers would have disease and parasite loads different from suckers in Upper Klamath Lake, such concerns further require the separation of salvage fish from recovery populations in the Upper Klamath Basin.

Tule Lake is the most likely relocation site for salvaged suckers. Tule Lake is an agricultural sump that is maintained by agricultural return flow. USFWS currently uses Tule Lake as a relocation site for Lost River and shortnose suckers salvaged from other areas in the basin, and the lake currently has the capacity for an additional 3,000 relocated suckers (J. Rasmussen, USFWS, personal communication, 2017). Management of Tule Lake is complicated by multiple user groups and the periodic need to draw down the reservoir for sediment maintenance. USFWS is currently investigating other potential sucker relocation sites in the Upper Klamath Basin.

KRRC will coordinate with USFWS the release of salvaged suckers into Tule Lake or another isolated waterbody during the fall of 2020 salvage. USFWS will determine if/when suckers are translocated from Tule Lake to Upper Klamath Lake. USFWS' decision will in part depend on a better understanding of Hydroelectric Reach sucker genetics.

Klamath Smallscale Sucker Salvage

Klamath smallscale sucker is a riverine sucker species that historically inhabited the Klamath River below the Keno reef, and the adjacent Rogue River basin (Markle et al. 1999). The species is not known to inhabit Upper Klamath Lake or Upper Klamath Basin tributaries. Klamath smallscale sucker salvage would require sorting and releasing Klamath smallscale suckers at different locations than Lost River and shortnose suckers since the listed suckers are lake-type suckers (Buettner and Scoppettone 1991). ODFW also expressed concern with releasing salvaged Klamath smallscale suckers into Spencer Creek due to competition with the existing Spencer Creek sucker population (T. Wise, ODFW, personal communication, 2017). Although included in the 2012 EIS/R AR-6, Klamath smallscale sucker is not a federal or state listed species, and is not recognized as a tribal trust species. Therefore, KRRC and the ATWG agreed that Klamath smallscale sucker be removed from consideration in the proposed measure.

Designated Critical Habitat and Sink Populations

Hydroelectric Reach reservoirs and Klamath River downstream from Keno Dam were not designated as critical habitat by USFWS (2012). The sucker populations inhabiting the Klamath reservoirs are part of the Upper Klamath Lake Recovery Unit, however, they are sink populations that will likely never be viable and therefore are not actively managed for recovery (USFWS 2012). USFWS does not consider the preservation of the Hydroelectric Reach reservoirs or the sucker populations within them to be a requirement for Lost River and shortnose sucker species recovery.

Telemetry Study

Based on research in Upper Klamath Lake and past studies in the Klamath River reservoirs, USFWS and the U.S. Geological Survey (USGS) are in support of a multi-stage sampling and salvage effort that would use passive integrated transponder (PIT) tag technology to mark suckers. Lost River and shortnose suckers would be netted during a two-year sampling effort prior to reservoir drawdown (2018 and 2019) and marked to estimate population sizes and demographics for suckers in the Hydroelectric Reach reservoirs. Sampling would occur in the reservoirs in the fall and in reaches of the Klamath River upstream of the reservoirs in the spring. Fall sampling would focus on shallow areas in the reservoirs and spring sampling would target sucker spawning migrations as fish leave the reservoirs and enter river reaches for spawning (Janney et al. 2009; Hewitt et al. 2014). Genetic material collected during the sampling phase would be used to develop genetic profiles of reservoir suckers and inform the sucker relocation effort. Suckers would be relocated during salvage efforts in the spring and fall of prior to drawdown. Based on this information, we have concluded the proposed PIT tag study will be more informative and less costly to implement relative to the originally proposed telemetry study.

2012 EIS/R Baseline Population Estimates

Desjardins and Markle (2000) provided the most comprehensive population estimates for suckers in the Hydroelectric Reach reservoirs. The number of adult shortnose suckers was estimated to be highest in Copco Reservoir (n=165), followed by J.C. Boyle (n=50), and then Iron Gate (n=22). Larger and older individuals dominated Copco and Iron Gate reservoirs and little size structure was detected. J. C. Boyle tended to have smaller adult shortnose suckers and many size classes were present. It appeared that recruitment of young-of-the-year suckers only occurred in J.C. Boyle with downstream reservoirs recruiting older individuals, perhaps those that had earlier recruited to J.C. Boyle Reservoir.

No new baseline population data have been produced for suckers inhabiting the Hydroelectric Reach reservoirs since the issuance of the 2012 EIS/R. However, anecdotal evidence (B. Tinniswood, ODFW, personal communication, 2017) suggests more suckers may inhabit the reservoirs than previously anticipated (e.g., Buettner and Scoppettone 1991; Beak Consultants 1987). USFWS's Abernathy Fish Technology Center, Longview, Washington, is also currently undertaking a genetic analysis of Lost River, shortnose, and other basin sucker species to identify genetic markers that may be used to differentiate suckers in the future. The Abernathy lab is anticipated to produce a report on sucker genetics by summer or fall of 2018.

8.3 Summary

The Project is anticipated to have significant short-term effects on Lost River and shortnose suckers in the Hydroelectric Reach. Because the reservoirs will be restored to free-flowing historical conditions and the special-status suckers are lake-type suckers, individuals of these species that remain in the Hydroelectric Reach following dam removal are not expected to survive. The 2012 EIS/R AR-6 included a telemetry study to assess potential sucker locations in the Hydroelectric Reach, followed by a sucker salvage effort to remove fish from the reservoirs and transport them to Upper Klamath Lake for release. The ATWG and KRRC have concerns with the 2012 EIS/R AR-6, including the genetic integrity of Hydroelectric Reach suckers, relocation site availability, the need to salvage Klamath smallscale suckers, and the feasibility and benefit of the proposed telemetry study. Therefore, KRRC and the ATWG determined that revisions to AR-6 were warranted.

The proposed measure, includes two primary actions including reservoir and river sampling, and sucker salvage and release into appropriate waterbodies selected by fisheries managers. The proposed measure is anticipated to maximize the survival of Lost River and shortnose suckers currently inhabiting the Hydroelectric Reach. The number of translocated fish will not exceed 3,000 fish, which is the capacity of the currently identified recipient waterbody (Tule Lake). During the course of these actions, it is not anticipated that the entire populations of suckers residing in the Hydroelectric Reach reservoirs will be recovered.

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Chapter 9: Freshwater Mussels

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9. FRESHWATER MUSSELS

The objective of the freshwater mussels measure is to address reservoir drawdown and project effects on freshwater mussels located in the Klamath River in the Hydroelectric Reach and downstream from Iron Gate Dam (RM 193.1). The 2012 EIS/R AR-7 focused conducting a freshwater mussel relocation pilot study followed by the salvage and relocation of freshwater mussels prior to reservoir drawdown. Salvaged mussels were to be held in a temporary location for later placement following reservoir drawdown, and placed in locations that will not be affected by the reservoir drawdown. Based on a review of the information discussed in greater detail below, KRRC and the ATWG concluded that a moderate scale freshwater mussel relocation effort is warranted. The proposed measure includes a freshwater mussel reconnaissance in 2019 followed by a limited freshwater mussel salvage prior to reservoir drawdown. Specifically, KRRC will salvage freshwater mussels from the 8-mile long Iron Gate Dam (RM 193.1) to Cottonwood Creek (RM 185.1) reach and translocate these mussels to the Klamath River between the upstream extent of J.C. Boyle Reservoir (RM 234.1) and Keno Dam (RM 239.2).

9.1 Proposed Measure

Based on a review of the 2012 EIS/R AR-7 presented in Section 9.2 below, input from the ATWG, and current freshwater mussels literature, the KRRC concluded that revisions to AR-7 are necessary to offset the anticipated short-term effects of the Project on freshwater mussels. The proposed measure includes a reconnaissance, salvage, and relocation of freshwater mussels from the 8-mile reach between Iron Gate Dam and the Cottonwood Creek confluence with the Klamath River. The monitoring and adaptive management plan has two specific actions.

- **Action 1:** KRRC will complete a reconnaissance in 2019 to assess the distribution and density of freshwater mussels in the 8-mile long bedload deposition reach from Iron Gate Dam (RM 193.1) downstream to the Cottonwood Creek confluence (RM 185.1). The reconnaissance effort will determine if the mussel beds identified in the 2007-2010 surveys are still present, and estimate abundance of a subset of the mussel beds in the reach.
- **Action 2**: Based on the reconnaissance, KRRC will salvage and relocate a portion of the freshwater mussels located between Iron Gate Dam and Cottonwood Creek prior to drawdown to reduce project effects to the mussel community. Up to 20,000 mussels are planned for translocation to appropriate habitats in the Klamath River between the upstream extent of J.C. Boyle Reservoir (RM 234.1) and Keno Dam (RM 239.2).

The proposed measure is intended to reduce project effects on freshwater mussels located downstream from Iron Gate Dam. The following sections provide additional detail on the proposed measure actions.

9.1.1 Action 1: Freshwater Mussel Reconnaissance

The KRRC will prepare a reconnaissance plan to assess freshwater mussels in the Iron Gate Dam to Cottonwood Creek reach in 2018. Habitat conditions will also be evaluated from the upstream extent of J.C. Boyle Reservoir (RM 234.1) upstream to Keno Dam (RM 239.2) to determine the habitat capacity for translocated mussels. An existing freshwater mussel data set (base data for Davis et al. 2013), compiled by the Karuk Tribe, USFWS, and other collaborators from 2007 to 2010 for the Klamath River downstream from Iron Gate Dam, will be reviewed and used to plan the reconnaissance. The reconnaissance will confirm mussel beds identified in the 2007-2010 surveys and estimate abundance at a subset of the mussel beds locations. Habitat metrics in the potential translocation reach will be evaluated to maximize translocation success. The freshwater mussel reconnaissance and translocation reach habitat assessment are anticipated to take 5 days.

9.1.2 Action 2: Freshwater Mussel Salvage and Relocation

The KRRC will coordinate and implement a freshwater mussel salvage plan with freshwater mussel specialists. Based on the reconnaissance, a portion of the freshwater mussels located between Iron Gate Dam and Cottonwood Creek will be salvaged and relocated to reduce project effects to the freshwater mussel community. The freshwater mussel salvage and translocation effort is anticipated to require 10 days. The percentage of the existing mussel beds that will be salvaged and translocated is predicated on the available habitat in the Klamath River from the upstream extent of J.C. Boyle Reservoir to Keno Dam, and the abundance of mussels between Iron Gate Dam and Cottonwood Creek. Approximately 15,000 to 20,000 mussels are planned for translocation. During the course of these actions, it is not anticipated that the entire population of mussels residing below Iron Gate Dam will be recovered.

9.2 Summary of the Affected Species, Anticipated Project Benefits and Effects, Recent Literature, 2012 EIS/R AR-7, and Proposed Measure

The following sections review the components of the 2012 EIS/R AR-7, anticipated project effects and long-term benefits on freshwater mussels, and current freshwater mussel literature.

9.2.1 Affected Species

Species intended to be addressed in the 2012 EIS/R AR-7 include:

- Oregon floater *(Anodonta oregonensis)*
- California floater *(A. californiensis)*
- Western ridged mussel *(Gonidea angulata)*
- Western pearlshell mussel *(Margaritifera falcata)*

9.2.2 Anticipated Project Effects on Measure Species

Short-term effects of the Project (prolonged exposure to high suspended sediment levels and bedload movement) are predicted to be deleterious to freshwater mussels in the Hydroelectric Reach and in the lower Klamath River downstream from Iron Gate Dam (Reclamation and CDFG 2012). Substantial freshwater mussel population reductions are expected due to sediment effects and possibly low dissolved oxygen levels. The change in hydrological properties following project implementation may also disrupt the current distribution of freshwater mussels downstream from Iron Gate Dam (Davis et al. 2013). Table 9-1 includes the likely and worst-case effects on freshwater mussel species in the Klamath River.

Table 9-1 2012 EIS/R anticipated effects summary for freshwater mussels

Species	Life Stage	Likely Effects	Worst Effects
California Floater Oregon Floater Western Ridged Western Pearlshell	All	Substantial reduction in populations	Substantial reduction in populations

Source: USBR and CDFG 2012

The following sections include descriptions of anticipated effects to freshwater mussels based on information 2012 EIS/R (Reclamation and CDFG 2012; Vol. 1, pp. 3.3-173 to 3.3-175) as well as additional information from additional freshwater mussel studies, some of which were completed after the publication of the 2012 EIS/EIR.

Freshwater Mussels

Available studies have evaluated Klamath River Basin freshwater mussel age structure, growth rates, and size distribution (*G. angulata*; Tennant 2010); population distribution and habitat use (Krall 2010; Davis et al. 2013; May and Pryor 2015); and habitat associations (Westover 2010; Davis et al. 2013). Klamath River mussels are long lived (from 10 to more than 100 years, depending on species) and may not reach sexual maturity until 4 years of age or more. *Anodonta* species are found primarily downstream from Iron Gate Dam, and likely benefit from the stable hydrology and fine sediment deposits attributed to hydroregulation below the dam (Davis et al. 2013). *G. angulata* is the most abundant freshwater mussel in the Klamath River and the species is widely distributed between Iron Gate Dam and the Trinity River (Westover 2010; Davis et al. 2013). *M. falcata* is the least abundant freshwater mussel found in the Klamath River and seems to be mostly found downstream from the confluence of the Salmon River (Westover 2010; Davis et al. 2013).

Freshwater mussel tolerance of high suspended sediment, low dissolved oxygen, and bedload deposition are not well understood. Vannote and Minshall (1982) evaluated freshwater mussels in an aggrading river system in Idaho and concluded that *G. angulata* appear to be better adapted for aggrading rivers based on siphon positions, shell morphology, and foot placement in the underlying substrate. *M. falcata* seemed to be less adapted for aggrading rivers due to a less developed siphon for filtering water. *M. falcata* also rarely burrow into substrate more than 25-40 percent of the valve length which may increase the mussel's susceptibility to scour (Vannote and Minshall 1982). *G. angulata* migrate vertically in the channel bed and are capable of maintaining position near the channel bed surface (Vannote and Minshall 1982). *M. falcata* are not known to migrate and are therefore more susceptible to sediment burial. *Anodonta* species are likewise susceptible to sediment scour and burial due to their thinner shells. Mussels that are dislodged from their normal vertical position and fall onto their sides may not regain the normal position and may perish (Vannote and Minshall 1982).

Mussels play important roles in aquatic ecosystems. Mussels influence water quality, nutrient cycling, and habitat and are also known as "ecosystem engineers" that actively modify their environment (Xerces Society 2009; Lopes-Lima et al. 2016; Lummer et al. 2016). They filter fine sediment and organic particles, create byproducts that are food items for macroinvertebrates, and comprise the greatest proportion of animal biomass in some waterbodies (Xerces Society 2009). In the Klamath River Basin, freshwater mussels filter and sequester toxins including toxigenic algae microsystins (Kann et al. 2010) and mercury (Bettaso and Goodman 2010). Filtration of waterborne toxins may result in bioaccumulation in freshwater mussels leading to human consumption risks (Bettaso and Goodman 2010; Kann et al. 2010).

The Project is anticipated to result in high suspended sediment levels and bedload deposition in the 8 miles of the Klamath River between Iron Gate Dam and Cottonwood Creek. Extremely poor water quality due to high suspended sediment concentrations is expected in the first 2 miles of the Klamath River downstream from Iron Gate Dam (Reclamation and CDFG 2012). Fine sediment effects on freshwater mussels include gill clogging, possible growth reduction, and impairment to mussel larval stages (Lummer et al. 2016). Due to both the anticipated deleterious high suspended sediment concentrations and low dissolved oxygen levels, freshwater mussels downstream from Iron Gate Dam may experience substantial mortality with the most significant impacts anticipated to mussels located immediately downstream from Iron Gate Dam.

Over the long-term, freshwater mussels are expected to benefit from the Project through the conversion of Hydroelectric Reach reservoirs to gravel bed rivers which will restore freshwater mussel habitat, reduce water quality and water temperature impairments related to the reservoirs, and restore access for anadromous and resident host fish species that will distribute freshwater mussel larvae throughout the Klamath River upstream from Iron Gate Dam. However, due to the long time freshwater mussels take to reach sexual maturity, the recolonization and/or growth of existing freshwater mussel populations upstream of Iron Gate Dam may be slow and may not be readily noticeable for some time.

9.2.3 2012 EIS/R AR-7

The 2012 EIS/R AR-1 (Vol. I, pp. 3.3-248 to 3.3-249) directed the salvage of freshwater mussels from the Hydroelectric Reach and downstream from Iron Gate Dam. Salvaged mussels were to be relocated to suitable instream habitat unaffected by high suspended sediment concentrations, or could be placed in temporary facilities and returned to the Klamath River following the Project. A salvage and relocation pilot study was also suggested to assess salvage feasibility and relocated mussel survival. Based on the pilot study results, a detailed salvage and relocation plan was to be developed.

9.2.4 KRRC's and the ATWG's Review of AR-7 for Feasibility and Appropriateness

The KRRC assessed the feasibility and appropriateness of AR-7 through multiple planning meetings held with the ATWG between May and August 2017. During these meetings, current information on Klamath River fisheries was presented and information on other dam removal projects conducted in the western United States was reviewed to understand how the aquatic ecosystem might respond, as discussed above. The ATWG's concerns regarding the 2012 AR-7 included:

- Unfamiliarity with successful freshwater mussel relocation efforts.
- Disease transmission concerns.

The following sections provide additional information regarding AR-7 feasibility and appropriateness, based on fisheries literature and ATWG input.

Unfamiliarity with Successful Freshwater Mussel Relocation Efforts

The ATWG was unfamiliar with successful freshwater mussel translocation efforts. Anecdotal information discussed during the ATWG planning meeting (Yreka, CA, May 23, 2017) alluded to low translocation success for the Elwha Dam Removal Project and highway construction projects. Additional information was acquired by the KRRC on the Elwha Dam Removal Project freshwater mussel (*M. falcata*) translocation. For that project, freshwater mussels were translocated to two sites and remained in one site prior to the dam removal project (P. Crain, U.S. Park Service, personal communication, 2017). The relocated freshwater mussels had high survival following the translocation and prior to the dam removals. Subsequent events that impacted the translocated mussels resulted in high mussel mortality. The events included raccoon predation due to shallow habitat at the first translocation site, and excessive sediment deposition at a side channel translocation site. The third monitored site was an artificial outfall channel from the water treatment facility that went dry due to inadvertent project operations. Mussels that remained in the Elwha River downstream from Elwha Dam are suspected to have experienced high mortality due to excessive sediment deposition following dam removal, followed by channel scour during the post-dam sediment sorting process.

Freshwater mussel translocation project monitoring results are not well represented in the fisheries literature. Unpublished freshwater mussel translocation monitoring manuscripts were reviewed to better understand the range of potential translocation success. Fernandez (2013) described the translocation success of 265 individual *M. falcata* in coastal southwest Washington. Between 55 percent and 95 percent of the transplanted *M. falcata* were accounted for in the translocation sites between one and three years following the translocation.

A review of translocation projects found mean mortality of relocated mussels was 49 percent based on an average recovery rate of 43 percent (Cope and Waller 1995). Cope and Waller (1995) found that survival of relocated mussels was generally poor and the factors influencing the survival of relocated mussels were poorly understood. For mussel relocation to be successful, more consideration must be given to habitat characterization at both the source and translocation sites. Olden et al. (2010) and Germano et al. (2015)

offer considerations for successful freshwater organism and wildlife translocation efforts, respectively Luzier and Miller (2009) offer suggestions and considerations for freshwater mussel translocations.

Disease Transmission Concerns

The role of freshwater mussels in freshwater disease transmission is not well understood. Freshwater mussels are known to provide habitat for polychaete worms, one of the hosts in the life *C. shasta*. Polychaetes have been infrequently collected from freshwater mussel shells in the Hydroelectric Reach of the Klamath River (PacifiCorp 2004). Mussels may serve as a vector for other fish pathogens like *Flavobacterium columnare* and *Ichthyophthirius multifiliis* that are endemic to the Klamath River Basin (K. Kwak, CDFW, personal communication 2017).

Freshwater mussels inhabit the Klamath River upstream from Iron Gate Dam (Byron and Tupen 2017) and in tributaries upstream (Byron and Tupen 2017) and downstream from Iron Gate Dam (Davis et al. 2013; Howard et al. 2015; May and Pryor 2015), disease transmission may be less of a concern.

9.3 Summary

The Project is anticipated to have significant short-term effects, but long-term benefits for freshwater mussels. The 2012 EIS/R AR-7 included a freshwater mussel salvage and relocation pilot study followed by an informed salvage and relocation plan prior to the Project. The proposed measure includes completing a reconnaissance of existing freshwater mussels from Iron Gate Dam to Cottonwood Creek and potential relocation habitat between the upstream extent of J.C. Boyle Reservoir and Keno Dam. KRRC will salvage and relocate freshwater mussels prior to the reservoir drawdown. It is not anticipated that the entire population of mussels residing below Iron Gate Dam will be recovered.

Chapter 10: References

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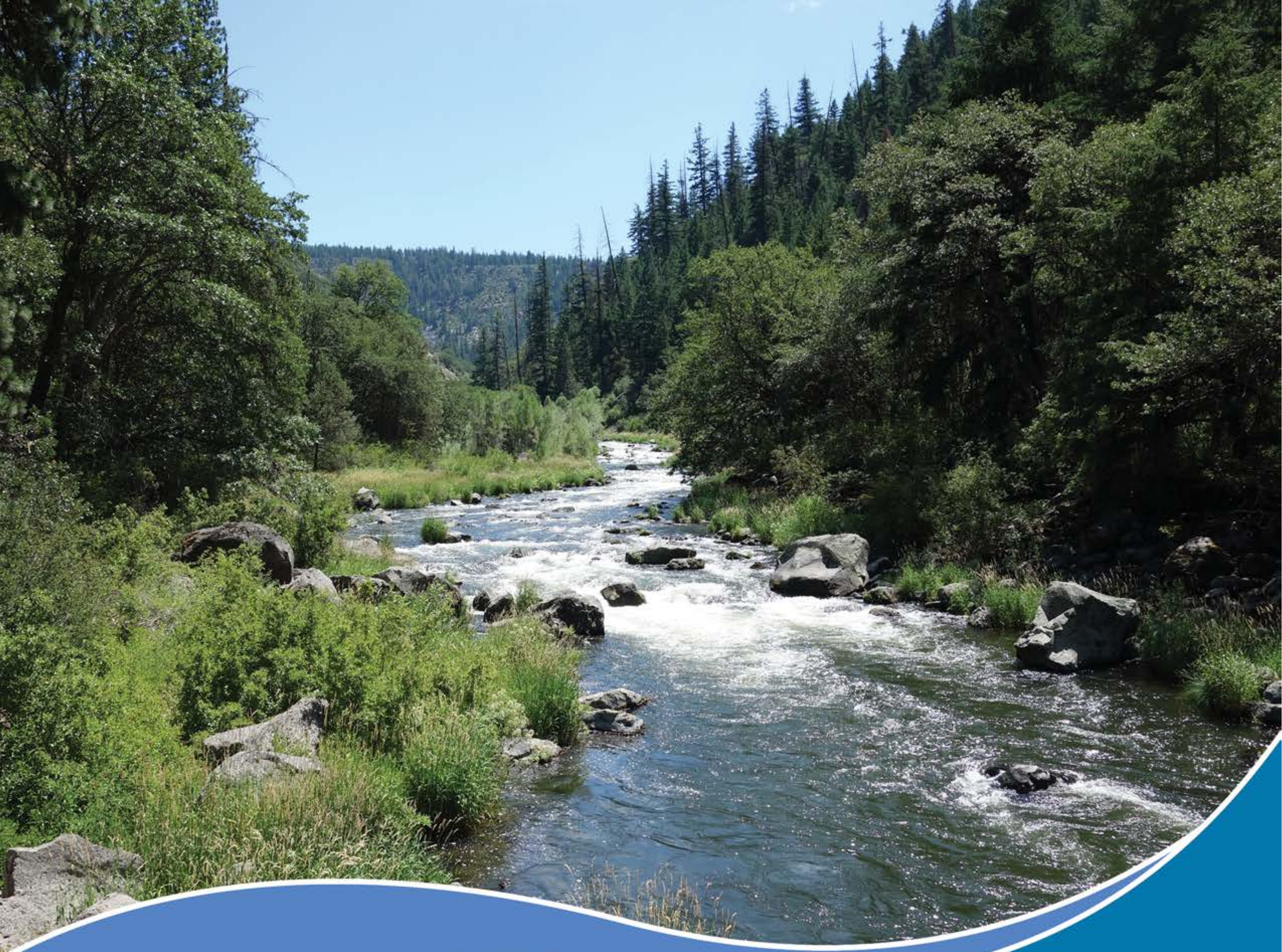

Definite Plan for the Lower Klamath Project

Appendix J - Terrestrial Resource Measures

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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KLAMATH RIVER RENEWAL CORPORATION

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Attachments

Acronyms

BA	Biological Assessment
BLM	Bureau of Land Management,
BO	Biological Opinion
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CWHRS	California Wildlife Habitat Relations System
DBH	diameter at breast height
EIS/R	Environmental Impact Statement/Environmental Impact Report
GIS	geographic information system
IPaC	Information for Planning and Consultation
MBTA	Migratory Bird Treaty Act
mph	miles per hour
NCASI	National Council for Air and Stream Improvement, Inc.
NED	National Elevation Dataset
NISIMS	National Invasive Species Information Management System
NMFS	NOAA National Marine Fisheries Service
NSO	Northern Spotted Owl
ODA	Oregon Department of Agriculture

ODFW	Oregon Department of Fish and Wildlife
ODSL	Oregon Department of State Lands
ONHP	Oregon Natural Heritage Program
ORBIC	Oregon Biodiversity Information Center
ORWAP	Oregon Rapid Wetland Assessment Protocol
RHS	Relative Habitat Suitability
USFWS	U.S. Fish and Wildlife Service
USFS	U.S. Forest Service
USGS	U.S. Geological Survey

Chapter 1: Northern Spotted Owl Measures

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1. NORTHERN SPOTTED OWL MEASURES

1.1 Objectives

The primary objective of the Northern Spotted Owl (NSO) *(Strix occidentalis)* measures is to identify any NSO activity centers (including any nesting sites) within the project area. As FERC's designated non-federal representative pursuant to 50 CFR § 402.08, KRRC is developing a Biological Assessment to evaluate effects on NSO and other federally listed species. KRRC is coordinating with the U.S. Fish and Wildlife Service (USFWS) and NOAA National Marine Fisheries Service (NMFS) on the development of the draft Biological Assessment. The first step is to conduct surveys in suitable habitats as described below. If KRRC identifies NSO activity centers within the project area, the design plans and/or construction methods or sequencing will be modified to avoid and minimize potential effects on NSO.

The 2012 Final EIS/R (USBR and CDFW 2012) TER-2 described measures to reduce project impacts on nesting birds including NSO. The 2012 EIS/R recommended surveys to identify the locations of active nests and then to incorporate that information into the project design and construction planning to avoid impacts. This measure has been incorporated as part of the Project and will be implemented as described in the following sections. The objective of the proposed TER-2 is to identify, document, and confirm spotted owl presence, and use of areas that may be directly or indirectly disturbed by project construction activities including noise. KRRC will use that information to develop a plan in coordination with the USFWS and California Department of Fish and Wildlife (CDFW) to provide avoidance and minimization measures for NSO and NSO habitat and use.

1.2 Methods

Study methods include a desktop evaluation, selection of calling stations, and field surveys. Initially biologists compiled existing data on known NSO occurrences and spatial information on habitat suitability to select calling stations. KRRC conducted a field reconnaissance survey in October 2017 to view and refine calling station locations. The methodology for NSO surveys is based on the 2012 USFWS NSO Survey Protocol (USFWS 2012b).

1.2.1 Desktop Evaluation

KRRC conducted a desktop review of existing databases (including California Natural Diversity Database [CNDDB] and the Oregon Biodiversity Information Center [ORBIC]) to identify known NSO detections and activity centers in the project area. During PacifiCorp surveys in 2002-2003, NSO presence was documented near J.C. Boyle Reservoir and southeast of Copco No. 1 Reservoir (PacifiCorp 2004). Figures A-1 and A-2, respectively, show these detections.

In addition to the 2002-2003 PacifiCorp protocol surveys, information was obtained from USFWS, U.S. Department of the Interior, Bureau of Land Management (BLM), and U.S. Forest Service (USFS) biologists, and the National Council for Air and Stream Improvement, Inc. (NCASI), a nonprofit research institute focusing on issues of concern to timber and other forest products companies. There were no NSO detections during NCASI surveys in 2002 and 2003, and NCASI no longer surveys for NSO in the project area (Verschuyl, pers. comm., 2017).

BLM (Hayner 2017) confirmed there are no known NSO territories within the 1-mile noise disturbance buffer from potential blasting at the J.C. Boyle Dam (described below) or within 0.5 miles of the limits of work. USFS (Freeling 2017) confirmed a known NSO activity center located approximately 1.3 miles southeast of the eastern end of Copco Lake and over 5 miles southeast of the Copco No. 1 Dam and powerhouse. Based on CNDDB records, this activity center has been monitored by USFS since 1988. Surveys over the years have confirmed NSO nesting activity, and adults and young have been banded by USFS biologists.

Therefore, based on the desktop evaluation, no NSO activity centers have been documented within the disturbance distances established in the Biological Assessment (i.e., 1 mile from blasting at dams, 0.5 miles from limits of work) (Biological Assessment (BA), U.S. Bureau of Reclamation [USBR] 2011) for the anticipated construction activities. KRRC will confirm this through field surveys, as described below.

The J.C. Boyle powerhouse is located within designated critical habitat for NSO. KRRC does not anticipate effects on designated critical habitat at the J.C. Boyle facilities because removal of the facilities will not involve the removal of forest cover and will provide opportunities for habitat restoration. Removal of mature trees will occur at the proposed disposal site at J.C. Boyle, which does not provide suitable NSO habitat, as described below. The proposed disposal site is not located within designated critical habitat for NSO.

1.2.2 Selection of Calling Stations

USFWS provided KRRC with a Relative Habitat Suitability (RHS) model, which uses 2012 vegetation information (Galloway 2017). The RHS model indicates "highly suitable habitat" for NSO occurs adjacent to the J.C. Boyle powerhouse and approximately 1 mile away from the J.C. Boyle Reservoir. BLM also provided 2014 NSO habitat suitability data for the J.C. Boyle project area. Based on a review of historical aerial photography, timber harvest has been conducted in several locations within the project area. Ongoing habitat alteration due to logging is not reflected in the USFWS or BLM habitat suitability data. It is likely that this alteration has reduced the habitat suitability for NSO within the noise disturbance areas.

Based on the habitat suitability information and verified during the field reconnaissance described below, suitable NSO habitat is not present within 1 mile of the Copco or Iron Gate Dams and facilities. Suitable habitat includes mature or old-growth forests containing large diameter trees with multiple canopy layers in areas with high canopy closure and complex structure. Based on the USFWS RHS, the nearest suitable habitat is approximately 3 miles southeast of the Copco No. 1 Dam and over 5 miles from Iron Gate Dam.

To develop proposed calling stations, KRRC evaluated aerial imagery with topographic contours against the habitat suitability information and the limits of work, with haul and access roads and the boundaries of staging and disposal areas defined to the extent possible. Information on construction equipment and details regarding activities such as the potential for blasting (i.e., where it will occur, frequency, duration, and season) was used to outline potential calling stations based on the noise disturbance distances established in the BA. KRRC also considered Activities such as grading or other use of heavy machinery that may occur during restoration of the reservoir areas.

KRRC conducted a focused field reconnaissance in October 2017 by CDM Smith biologists and USFWS biologist Bob Carey to evaluate proposed calling stations. During the reconnaissance, these biologists visited each of the proposed calling stations and noted the habitat present, ambient noise and acoustics, topography, and accessibility for nighttime surveys. Based on the findings of the field reconnaissance, KRRC revised calling station locations as appropriate to cover existing suitable habitat and to ensure adequate coverage of all suitable habitat. Figures 1-3 in Attachment A show calling stations.

The boundaries of the proposed disposal site at J.C. Boyle Dam are still being refined, although KRRC has identified the general location. A portion of the approximately six-acre disposal site is disturbed; however, trees will be removed from a forested area consisting of approximately 2 acres. During the field reconnaissance in October 2017, KRRC noted that trees that may be removed at the disposal site consist primarily of Ponderosa pines ranging between approximately 16 to 30 inches diameter at breast height (DBH), with a majority of trees between 18 and 22 inches DBH. During the field reconnaissance in October 2017, it was noted that the forested habitat that occurs within a portion of the disposal site and surrounding the disposal site consists of an open canopy (30-40 percent cover; much less than the 70 percent or more cover that NSO prefer) with a lack of complex, multi-layered understories and mature forest habitat structure preferred by NSO. Therefore, the disposal site and vicinity is not suitable NSO habitat. However, the NSOs surveys, which KRRC has begun for the 2018 NSO breeding season, will confirm whether there is NSO use in the area.

During the field reconnaissance conducted in October 2017, KRRC also evaluated the habitat in the vicinity of the known NSO activity center southeast of the Copco Reservoir. In this area, the habitat consists of relatively young deciduous-oak woodland in the lower elevations with relatively open mixed forest at the higher elevations. Suitable NSO habitat at the higher elevations is outside the noise disturbance distance from Ager-Beswick Road that runs along the south side of the Copco Reservoir. The nearest NSO detection documented in the CNDDB is over one mile from the bridge that crosses the east end of Copco Lake. The NSO activity center itself is farther to the southeast. In addition, most of the NSO detections documented in the CNDDB are within a drainage and not within line-of-sight to the Project. Because suitable habitat is located outside the noise disturbance buffer from proposed project activities, KRRC will not conduct NSO surveys in the Copco area.

Habitat modification is defined as activities that occur in spotted owl nesting, roosting, or foraging habitat that reduce the canopy or other elements of spotted owl habitat at the stand-level (USFWS 2012b). KRRC does not anticipate project activities that may remove individual or small groups of trees or other vegetation, such as widening existing roads, to rise to the level of NSO habitat modification, given the lack of suitable nesting, roosting, or foraging habitat within the areas where those activities will be conducted. KRRC used a distance of 1.3 miles in California and 1.2 miles in Oregon for analyzing effects to nesting spotted owls from habitat modification such as timber harvest. Since the Project will not result in NSO habitat modification, avoiding noise disturbance is the focus of the surveys KRRC will complete during the 2018 NSO breeding season.

KRRC will apply the following NSO disturbance distances developed for the 2012 BA and 2012 Joint Preliminary Biological Opinion (2012 Preliminary BO) prepared for dam removal as proposed in 2012:

- Blasting: 1,760 yards (1 mile)
- Hauling on open roads: 440 yards (0.25 mile)
- Heavy equipment: 440 yards (0.25 mile)
- Rock crushing: 440 yards (0.25 mile)
- Helicopter: 880 yards (0.5 mile)
- Fixed Wing Aircraft: 440 yards (0.25 mile)

Based on the desktop evaluation and field reconnaissance, KRRC determined that NSO protocol surveys will focus on suitable habitat around J.C. Boyle Dam and associated facilities, the disposal site, and haul and access roads. KRRC will not perform NSO protocol surveys for facilities associated with Copco No. 1 Dam, Copco No. 2 Dam, and Iron Gate Dam and associated reservoirs based on the lack of suitable habitat for NSO.

The survey area encompasses the disposal site at J.C. Boyle due to its proximity to suitable habitat. KRRC may use a noise attenuation evaluation to evaluate the need for avoidance and minimization measures in accordance with the USFWS 2006 guidance (USFWS 2006) and agency input (Reilly 2017). KRRC has not yet evaluated noise attenuation from topography and other physical features as well as the duration of anticipated noise activities in certain areas.

1.2.3 Protocol Surveys

The 2012 BA and Measure NSO in the 2012 Preliminary BO called for protocol-level surveys to be conducted within suitable nesting and roosting habitats that occur within the NSO noise disturbance buffer around proposed construction activities. As described above, KRRC does not anticipate the Project to result in modification of NSO habitat. Therefore, KRRC will conduct protocol surveys for noise-only disturbance consistent with the 2012 USFWS NSO Survey Protocol.

For noise-only disturbance, 1 year of protocol surveys is underway during the 2018 nesting season in suitable habitat within the noise disturbance areas shown in Figures 1 to 3 in Attachment A and as refined based on the field reconnaissance, noise attenuation evaluation, or other information. Figures 1 to 3 in Attachment A show the proposed survey locations on a habitat suitability model generated by USFWS, a habitat suitability model generated by BLM, and on an aerial photo showing the existing vegetation. KRRC only applied the BLM habitat suitability model to BLM lands within the project area.

KRRC is conducting NSO protocol surveys with a team of at least two biologists, with at least one spotted owl surveyor meeting the qualifications outlined in the USFWS NSO Survey Protocol developed in 2012. Visits are spaced out over the breeding season from March through August. KRRC conducted at least three of the visits before the end of June 2018.

Survey methods include nighttime spot calling and daytime stand searches. If KRRC detects a spotted owl during the night survey, the biologist will return to the area during the daytime as soon as possible (preferably within 48 hours) and conduct a follow-up visit to verify status as needed. KRRC noted details of field efforts, including the methods used, weather conditions, and identified occupancy/nesting status, on field forms consistent with the 2012 USFWS NSO Survey Protocol.

Calling stations are shown in Figures 1 to 3 in Attachment A. Calling routes and stations were confirmed in the field to achieve complete coverage of all habitat within the survey area such that surveyors are able to hear responding owls within the entire survey area. KRRC determined the spacing of calling stations by the topography and acoustical characteristics of the area (e.g., background noise such as creeks); stations are spaced between 0.25 and 0.5 mile apart.

To summarize, KRRC is conducting NSO surveys as follows:

- KRRC is conducting six (6) disturbance-only protocol surveys in the J.C. Boyle project area during the 2018 breeding season.
- KRRC is conducting surveys in suitable habitat within the 1-mile noise-disturbance area surrounding the J.C. Boyle Dam as shown in Figure 2 in Attachment A. This includes the disposal site due to its proximity to suitable habitat. KRRC is also conducting surveys in suitable habitat surrounding the J.C. Boyle powerhouse, as shown in Figure 3 in Attachment A. As described above, suitable NSO habitat is outside the noise disturbance buffer in the Copco project area; therefore, KRRC is not conducting surveys in the Copco project area.
- Six survey visits are underway between March 15 and August 31, 2018, with at least three visits before the end of June. KRRC covers the project area in a span of 7 days for a complete visit. Complete visits are spaced at least 7 calendar days apart.
- Calling stations are at least 0.25 to 0.50 miles apart. Calling stations are shown in Figures 1 to 3 in Attachment A and may be revised further based on field conditions. KRRC identified a total of 18 calling stations: 11 within the 1-mile noise disturbance area around the J.C. Boyle Dam and 7 within 0.5 miles of the limits of work downstream of the J.C. Boyle Dam.
- KRRC is using nighttime spot calling surveys, with a minimum of 10 minutes spent at each calling station. KRRC will conduct follow-up daytime surveys if a spotted owl is detected during the nighttime spot calling surveys.
- KRRC is not conducting surveys under inclement weather, including rain, heavy fog, high wind speed (> 12 mph), or at high noise levels (e.g., stream noise, tree drip after rain event, machine/road noise).

KRRC will provide survey results to USFWS, CDFW, and ODFW following completion. Based on the findings, KRRC may conduct additional protocol surveys in 2019 (the next consecutive year following the 2018 surveys) in coordination with USFWS, CDFW, and ODFW.

1.3 Avoidance and Minimization Measures

KRRC will implement the following measures as part of the Project:

Measure NSO 1: KRRC will use the results of the 2018 field surveys to modify the design and/or construction plans and timing as appropriate, with an overall goal of preventing or minimizing impacts. KRRC will evaluate locations of the individual components of the Proposed Action, noise disturbances, and habitat geographic information system (GIS) layers to determine whether or not additional measures are needed.

Measure NSO 2: KRRC will conduct protocol-level surveys within suitable nesting, roosting, and foraging habitat (assessed by using best available GIS information, aerial photos, and coordination with the USFWS) as described above. If KRRC observes no nesting, no seasonal restriction will be required during project implementation. If KRRC observes nesting during the protocol surveys, a seasonal restriction (March 1–September 30) will be followed or a restriction buffer will be applied surrounding the nest to minimize the disturbance. Limited operating periods can be waived in the event of nest failure as confirmed by a biologist.

Measure NSO 3: To prevent direct injury of young resulting from aircraft, no helicopter flights will occur within or at an elevation lower than 0.8 km (0.5 mi) of suitable nesting and roosting habitat during the entire breeding season unless the protocol level surveys identify no activity centers, or it is determined in coordination with USFWS that there would be no effect on an NSO activity center.

Measure NSO 4: No component of suitable nesting, roosting, foraging, or dispersal habitat will be modified or removed during the removal of transmission lines or installation or removal of fencing.

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Chapter 2: Bald Eagle and Golden Eagle Measures

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2. BALD EAGLE AND GOLDEN EAGLE MEASURES

2.1 Objectives

Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. § 668), the Migratory Bird Treaty Act (16 U.S.C. §§ 701-12), and are fully protected under California law. Bald eagles are listed as endangered under the California Endangered Species Act (CESA). Bald eagles are not listed in the State of Oregon.

The 2012 EIS/R (Section 3.5) TER-3 described measures to reduce project impacts on bald and golden eagles. The 2012 EIS/R recommended surveys to identify the locations of active nests and then to incorporate that information into the project design and construction planning to avoid impacts. KRRC has incorporated the proposed TER-3 into the Project and will implement it as described in the following sections. The objective of TER-3 is to identify, document, and confirm eagle presence, and eagle use of areas that may be directly or indirectly disturbed by project construction. KRRC will use that information to develop a plan in coordination with the USFWS and CDFW to provide avoidance and minimization measures for bald and golden eagles on eagle nesting, roosting, and foraging activities.

2.2 Existing Information

The Upper Klamath Basin is known to support bald eagle and golden eagle populations and provides suitable habitat for eagle nesting, roosting, and foraging.

2.2.1 Bald Eagle

The upper Klamath Basin supports a high number of nesting bald eagles and historically supports one of the largest wintering populations of bald eagles in the coterminous United States (Shuford et al. 2004). In previous years, up to 117 bald eagle pairs nest and 1,100 individuals winter in the Klamath Basin (PacifiCorp 2004). Bald eagle nesting trees are known to exist in and near the project area and bald eagles often use the same nests in multiple years. In addition, eagles may have more than one nest within an active territory and they may alternate their use of the nests between years.

Based on recent monitoring of bald and golden eagle nests and territories in the Klamath region, there are a minimum of four bald eagle nests within 0.5 miles of J.C Boyle Reservoir and one bald eagle nest within 0.5 miles of the Copco Lake (BLM 2017; USFWS 2017). Table 2-1 provides a summary of all known nests within 2-miles of the limits of work.

Oregon Cooperative Fish and Wildlife Research Unit conducted bald eagle nest surveys in the Klamath River area on March 27, 2002, and May 29, 2002 (PacifiCorp 2004). They recorded six known nests within and near the project area, with distances to the nearest facility ranging from approximately 0.7 miles to 7.1 miles (two near J.C. Boyle Reservoir, three near J.C. Boyle peaking reach, and one near Copco Lake). Aerial surveys conducted in 2003 found a new nest located approximately 540 feet southeast of Copco No. 1 Dam.

PacifiCorp has documented additional bald eagle observations at the Iron Gate, Copco, and J.C. Boyle Reservoirs, and at other locations along the middle and lower Klamath River. At least 32 individual sightings of bald eagles in flight, perched, or foraging were recorded during targeted avian surveys in 2002 (see Attachment B), and numerous incidental sightings occurred during general wildlife and facility surveys and other field studies (PacifiCorp 2004). These observation data are useful in establishing that nesting and foraging habitat are present within and near the project area. By agency request, exact nesting locations were not published in the PacifiCorp 2004 report. To continue to protect eagle nests, KRRC will not provide exact locations in this report.

2.2.2 Golden Eagle

Golden eagles are known to have historically nested on cliffs near the project area (USBR and CDFW 2012). Golden eagles also nest within pine, juniper and oak trees and suitable habitat is present in the project area. Golden eagles have historically nested on cliffs from J.C. Boyle bypass reach to Iron Gate Reservoir. During PacifiCorp surveys, golden eagles were observed in several locations, including Copco Lake and Iron Gate Reservoir and J.C. Boyle powerhouse, but no nests were found (PacifiCorp 2004). Natural densities for this species in southern Oregon and northern California are low (PacifiCorp 2004).

2.3 Methods

Study methods include desktop analysis, a GIS viewshed analysis, and field surveys. Initially biologists compiled existing data on bald and golden eagles and conducted a desktop analysis to locate known nests and territories. KRRC conducted a field reconnaissance survey in July 2017. KRRC will use the viewshed analysis to refine the survey area and additional field surveys are planned as described below.

2.3.1 Desktop Analysis

The desktop analysis includes a review of existing data. These data are compiled from:

1. Federal and state agency databases (CNDDB and ORBIC) and datasets from the USFWS, ODFW, and CDFW (collectively, the wildlife agencies) and the BLM;
2. Previous biological survey data such as the PacifiCorp 2004 report; and
3. Reports of surveys completed at or near the project area.

In addition to the above sources, KRRC has contacted regional experts, including Frank Isaacs of the Oregon Eagle Foundation. Mr. Isaacs conducted aerial helicopter surveys in 2002 and 2003 to document eagle nests, perching sites, and foraging sites, and to determine occupancy and productivity of territories in the Klamath Basin. If additional information becomes available through contacts with regional experts it will be included in future reports.

Another component of the desktop analysis is an evaluation of aerial imagery and topography correlated with the results of the field reconnaissance. To refine the survey area, KRRC conducted a viewshed analysis in ArcGIS (ESRI, Version 10.4.1) to generate visibility extents using a NED (National Elevation Dataset) topographic surface and observer points derived from the limits of work. This analysis calculates all locations that are simultaneously visible from any observer point distributed along the limits of work. It considers topography but not vegetation.

Because the project area's geometry is complex, there are potentially tens of thousands of observer points that could be used in the generation process. To limit the number of observer points to a feasible number, the analysis estimated observer points approximately every 20 feet along the limits of work, while retaining the limit's geometry. From each of these observer points, a hypothetical observer could look in any direction – any topographical feature that's within the view of this observer will be included in the viewshed.

To refine the survey area to areas where eagles are more likely to be affected by project activities, and also to comply with recommended avoidance buffers for bald eagles (Jackman and Jenkins 2004), KRRC proposes limiting the surveys to those viewshed areas within 0.5 mile of the limits of work. This 0.5-mile buffer will be extended to the area within the viewshed for up to 2 miles where construction or demolitions will occur (Pagel et al. 2010). The variance will account for differences in the level of impact among locations within the limits of work. Proposed construction activities associated with the removal of the dams and facilities, creation of disposal sites, and use of haul and access roads will be mostly limited to the areas where facilities are or will be located. Much of the project area includes the associated reservoirs, where little construction work is currently anticipated. KRRC defined the survey area based on the nature and timing of proposed construction activities, the location of known eagle nests and use areas, and further evaluation of the viewshed, prior to initiating 2018 surveys.

2.3.2 Field Surveys

KRRC is conducting bald and golden eagle surveys concurrently in 2018 by qualified avian biologists. To meet the project schedule, all eagle surveys will be complete by the end of 2018. The surveys are focusing on areas with suitable nesting, roosting, or foraging habitat for bald and golden eagles. The main goal of the surveys is to determine where nest sites are distributed within the survey area and to determine baseline eagle use and behavior at nests and other key habitat features so that any disturbances that may occur during construction can be recognized and corrective actions can be taken. Field surveys are employing a variety of techniques and multiple survey windows to capture seasonal activity.

2017 Surveys

KRRC conducted a field reconnaissance survey July 24-26, 2017. Surveyors assessed habitats in the project area by vehicle and on foot, noted bird activity, and attempted to locate known nests (based on data received to-date) within a 0.5-mile radius of the project area. Biologists spent one day at each dam and associated facilities and reservoir. The reconnaissance survey primarily assessed habitat and site conditions, and was not a focused eagle nest survey.

2018 Surveys

The 2018 bald and golden eagle survey protocol was informed by the desktop analysis, information obtained during the 2017 reconnaissance survey, and established protocols including:

- Bald Eagle Nest Survey and Reporting Guide: Reporting Observations at Nest Sites in Oregon (Isaacs 2009),
- Protocol for Evaluating Bald Eagle Habitat and Populations in California (Jackman and Jenkins 2004), and
- Interim Golden Eagle Inventory and Monitoring Protocols (Pagel et al. 2010).

In the field, surveyors are gathering information on eagle nesting behavior and habitat use within the survey area that could potentially be directly or indirectly affected by project activities. This information will provide a pre-construction baseline for monitoring eagles during project activities to assess whether such activities will adversely affect eagle behavior or habitat use.

A synthesized field survey to encompass bald and golden eagle nesting habitat use will include:

1. Breeding season surveys (late January through July 2018).
   a) KRRC conducted an initial nest search in late January and early February 2018, early in the breeding season when eagles are most likely to be found at nest sites, to determine occupancy. KRRC conducted this inventory and monitoring survey early in the season during courtship when the adults are mobile and conspicuous.
   b) KRRC conducted a second survey in early June 2018 to observe any changes in eagle behavior or mid-late season nesting activity.
   c) During these breeding season surveys, biologists have conducted at least 2 ground observation periods lasting at least 4 hours or more as necessary to designate a survey area unoccupied. Ground observers will survey from observation points for a minimum of 4 hours, unless observations yield eagle presence, or eagle behavior indicates eggs or young, or observation suggests the observer is disturbing the birds.
2. KRRC will conduct additional surveys during the early nesting season of the year prior to drawdown to determine continued activity and to observe eagle activity patterns to establish a baseline of normal behavior, prior to construction.

Based on accessibility, KRRC is conducting surveys on foot, with terrestrial vehicles and potentially by boat. KRRC may use motorized vehicles to transport KRRC biologists to the vicinity of nest site, but close access will be by foot to avoid disturbing nesting eagles if they are present. During the June 2018 survey, KRRC conducted helicopter surveys concurrently with ground-based surveys. During the aerial surveys, two biologists inspected suitable habitat such as treetops and cliffs for eagle nests. The biologists searched for historical/known nests to determine current nesting status, and searched for new nests based on observed eagle activity and locations of known or suspected territories. Biologists use binoculars and spotting scopes when surveying for nest occupancy. KRRC recorded detailed data based on the guidelines and datasheets provided in the protocols.

2.4 Preliminary Results

2.4.1 Desktop Analysis

GIS specialists mapped known bald and golden eagle nests (based on data received as of July 2017) within 2 miles of the project area and generated an initial viewshed analysis from the edge of the limits of work (Figure 1 in Attachment B). The areas in green are within the viewshed; any area in green is potentially visible to an observer standing at a point on the perimeter of the limits of work. This analysis is based on topography and does not account for environmental conditions, distance, trees, or other potential obstructions, which will result in additional visual blinding beyond what is suggested by the viewshed analysis. A 2-mile buffer around the limits of work encompasses an area of approximately 112 square miles. The viewshed analysis reduced this to approximately 57 square miles, approximately half of the original size. When more precise data delineating active work areas are available, the analysis will be re-run and used to refine the survey area prior to 2019 surveys.

2.4.2 Field Surveys

During the July 2017 reconnaissance survey, KRRC located three of the four known nests within a 0.5-mile radius of the project area. Of the three located, one juvenile bald eagle was observed near nest BE1-36 (Table 2-1). KRRC presumed this nest active for this year. Biologist observed substantial whitewash and prey remains (fish bones) under the nest. The other two nests surveyed did not have conspicuous indications that they were active; KRRC did not observe whitewash, prey remains, or juveniles. However, as there is high potential that bald eagles had already fledged prior to the survey date, some active nests may have been missed, especially if eagles used alternate or unknown nests. An additional nest location (BE3-1) within 0.5-miles of J. C. Boyle was provided after the reconnaissance survey was completed (Hayner 2017). KRRC surveyed this nest in 2018. Table 2-1 provides a summary table of known bald and golden eagle nests within 2-miles of the limits of work.

2.5 Avoidance and Minimization Measures

KRRC will use the results of the surveys described above to develop an eagle avoidance and minimization plan in coordination with USFWS that identifies procedures and protocols for avoiding and minimizing potential impacts to eagles. With implementation of the avoidance and minimization measures described below, KRRC does not anticipate that there will be a take of bald or golden eagles.

KRRC will implement the following measures to avoid or reduce the Project's potential impacts on bald and golden eagles:

- KRRC completed the survey of eagle use patterns prior to construction activities as described above. KRRC conducted surveys by a qualified avian biologist and included any facilities to be removed or modified to determine bird use patterns. KRRC conducted surveys during the time of year most likely to detect eagle usage.
- During the early nesting season of the year prior to drawdown, KRRC will conduct additional focused surveys for bald and golden eagle nests within the survey area using the survey plan outlined in Section 2.3.2.2. KRRC will conduct at least one pre-construction survey within 2 weeks prior to beginning ground disturbing activities.
- Wherever possible, clearing, cutting, and grubbing activities shall be conducted outside the eagle breeding period (January 1 through August 31);
- If active nests are present within 2 miles of limits of work, KRRC will establish a 0.5-mile restriction buffer in coordination with the resource agencies to ensure nests are not disturbed. If active eagle nests are present within 0.5 miles of limits of work, KRRC's contractor will halt construction activities until coordination with the resource agencies (i.e., USFWS and CDFW or ODFW depending on where the nest is located) determines construction can resume. If a nest is not within line of sight of project activities, meaning that trees or topographic features physically block the eagle's view of construction activities, the buffer could be reduced to 0.25 miles. Further reduction of buffers or limited activity inside of buffers could occur in coordination with biological monitors and the USFWS, if it is determined that the activities would not jeopardize nesting success.

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Table 2-1 Summary of Bald and Golden Eagle Nests within 2 Miles of the Limits of Work (2017 Data)

Reservoir	Name	Species	Distance	History	July 2017 Reconnaissance[3]
J.C. Boyle	BE1-31	Bald Eagle	Within 0.5-mile	Active between 2004-2007. 1 nestling observed in 2013. Active but failed in 2014.[1]	Nest located, no activity or sign of recent activity observed.
J.C. Boyle	BE1-32	Bald Eagle	Within 0.5-mile	Active between 2006-2010; one fledged in 2010; unoccupied in 2011; active 2012; nest down in 2013. [1]	Nest appears to have been rebuilt since the last survey, nest located, no activity or sign of recent activity observed.
J.C. Boyle	BE1-36	Bald Eagle	Within 0.5-mile	Active between 1998-2010, 2 fledged chicks in 2013, occupied in 2014. [1]	Nest located, bald eagle juvenile observed nearby, abundant whitewash and prey remains at base of nest; presumed active this year.
J.C. Boyle	BE3-1	Bald Eagle	Within 0.5-mile	Nest observed in 1995, no additional data.[2]	Nest location data received after reconnaissance, nest was not surveyed.
J.C. Boyle	BE1-30	Bald Eagle	Within 2-miles	Potentially occupied in 1982, nest down in 1990.[1]	Not surveyed.
J.C. Boyle	BE1-33	Bald Eagle	Within 2-miles	Active 1983-1986, nest down 2005. [1]	Not surveyed.
J.C. Boyle	BE1-34	Bald Eagle	Within 2-miles	Active intermittently between 1987-2002, unoccupied 2011-2014. [1]	Not surveyed.
J.C. Boyle	BE1-35	Bald Eagle	Within 2-miles	1997-1999, nest down in 2005.[1]	Not surveyed.
J.C. Boyle	GE1-6	Golden Eagle	Within 2-miles	No data, unverified nest.[1]	Not surveyed.
J.C. Boyle	GE3-1	Golden Eagle	Within 2-miles	Active 2011 and 2012, no verified nesting.[2]	Not surveyed.
Iron Gate	BE2-1	Bald Eagle	Within 2-miles	Active between 1986-1997.[1]	Not surveyed.
Copco	BE2-3	Bald Eagle	Within 0.5-mile	2002 - new nest.[1]	Searched for nest, but access was limited. Nest was not found.
Copco	BE2-0	Bald Eagle	Within 2-miles	Active between 1993-1997.[1]	Not surveyed.

[1] Nest location and history sourced from Willy 2017.
[2] Nest location and history sourced from Heyner 2017.
[3] Data collected during reconnaissance surveys in July 24-26, 2017.

Chapter 3: Special Status Wildlife Species Measures

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3. SPECIAL STATUS WILDLIFE SPECIES MEASURES

3.1 Objectives

KRRC is conducting surveys in spring and summer 2018 to identify the special status wildlife species and their habitats that are present in the project area. These surveys will provide a baseline understanding of the presence and use of the project area by special status wildlife species and habitats, and enable KRRC to efficiently plan construction sequencing and conduct pre-construction surveys that may be necessary to avoid impacts on those species and their habitats from the Project. Findings of the 2018 special status wildlife surveys will be used for project design and construction planning and, in coordination with USFWS, CDFW, and Oregon Department of Fish and Wildlife (ODFW), to develop special status wildlife species avoidance and mitigation measures to be incorporated into any regulatory approvals that may be necessary for the Project. KRRC will conduct additional focused field surveys as required.

For the purposes of this section, special status wildlife species include federal and state threatened, endangered, proposed, and candidate species, California Species of Special Concern, Oregon Natural Heritage Program (ONHP) List 1 and 2 species, and Oregon Sensitive species. KRRC is also considering BLM and USFS Sensitive Species, Assessment Species, Tracking Species, and Survey and Manage species, where BLM and USFS lands occur in the project area; however, not all of these species are of regulatory concern. Northern spotted owls, bald eagles, golden eagles, bats, and special status plants are covered under separate sections in this appendix and are not included here.

3.2 Existing Information

KRRC has identified several special status wildlife species as occurring in the project area. PacifiCorp conducted comprehensive surveys of the project area in 2002 and 2003 and the findings were compiled in 2012 EIS/R (Section 3.5). PacifiCorp documented several special status wildlife species within 0.25 mile of the PacifiCorp facilities, reservoirs, and river reaches (PacifiCorp 2004, Attachment A). Information on special status wildlife species occurrences has also been obtained from USFWS, CDFW, ODFW, BLM, and USFS (Godwin 2017, Harris 2017, Henderson 2017, and Wray 2017). Most of the special status wildlife species are birds, some of which are year-round residents while others are migratory, utilizing the project area for nesting or for overwintering. In addition, a small number of invertebrate, amphibian, reptile, and mammal special status wildlife species have potential to occur in the project area, based on PacifiCorp surveys and information from ORBIC, CNDDB, and the USFWS Information for Planning and Consultation (IPaC) database.

Table 3-1 lists the special status wildlife species that KRRC identified as having potential to occur in the Klamath River watershed. The list includes species with a range of regulatory protections and associated permitting considerations, and generally does not include species that are not federally or state listed and that are identified as lower priority on state sensitive species lists (e.g., Oregon Natural Heritage Program list 3 or 4) or other federal or state watch lists.

Table 3-1 presents summary information on each species' habitat and occurrence in the project area and identifies the proposed survey effort. KRRC based proposed survey efforts on regulatory requirements, occurrence information, and a preliminary determination of the potential for impacts from project implementation, using best professional judgement and input from the resource agencies.

3.3 Methods

3.3.1 Field Reconnaissance

KRRC conducted a field reconnaissance in July 2017. During the field reconnaissance, biologists visited proposed limits of work, focusing on areas with documented occurrences of special status wildlife species based on previous biological survey data, reports completed at or near the project area (e.g., surveys conducted by PacifiCorp in 2001-2003), and additional existing information as outlined above.

Biologists gathered qualitative information on habitats present, determined access for surveys and other information to aid in planning for 2018 surveys. Biologists also noted evidence of changes to existing conditions since the PacifiCorp surveys were conducted, including wildfires, development, agriculture and grazing, and logging activities that may have altered the habitats present.

3.3.2 General Wildlife Surveys

General wildlife surveys are underway, concurrent with vegetation and habitat mapping efforts. During the spring and summer of 2018, biologists are recording observations of birds and other wildlife heard or seen, including sign and other evidence of wildlife presence and use (e.g., courtship activities, breeding, nesting, dens and burrows, feeding, family groups). Findings of these surveys will provide a baseline understanding of the special status wildlife and habitats in the project area, facilitating efficient pre-construction surveys focused on specific locations of suitable habitat identified during the baseline surveys.

As part of the ongoing survey efforts, biologists are noting special status bird species that are using the reservoirs and limits of work, including dams and associated facilities, disposal sites, and haul and access roads around each. Using a boat, biologists are surveying reservoir shorelines and open water, noting all species seen or heard, their approximate number and behavior (e.g., roosting, loafing, foraging, courtship, mating, incubating eggs, feeding young).

KRRC established transects to cover terrestrial areas within 0.25 miles of dams and structures to be removed, disposal sites, and haul and access roads. Biologists are walking the length of each transect, noting species seen or heard and their behavior, as described above. KRRC is conducting night surveys for northern spotted owls, based on input from USFWS, CDFW, and ODFW, and entail calling from established survey stations along roads or walking transects and using a digital caller to elicit responses. These surveys are underway during both the spring and summer breeding season of 2018 (Section 1 discusses spotted owl surveys).

Based on input from USFWS, CDFW, and ODFW, focused surveys for amphibian and reptile species are not being conducted with the exception of surveys for western pond turtle (see "Other Focused Surveys" below). Rather, field surveys will identify suitable habitat for these species to determine if and to what extent suitable habitat will be modified or destroyed by project activities. KRRC will note amphibians and reptiles observed during the special status wildlife species surveys for birds and turtles.

KRRC is not conducting mammal trapping or other focused survey methods. KRRC will note any mammals or mammal sign, den sites, or excavated burrows observed during special status wildlife species surveys. (Section 4 discusses the survey plan for bats.)

3.3.3 Nest Surveys

All migratory birds are covered by the Migratory Bird Treaty Act (MBTA). Some species of birds may return to the same nesting site every year (e.g., Osprey nesting platform), while others may utilize a specific location (e.g., sandhill crane returning to the same wetland to nest and rear young).

KRRC conducted nest site surveys in May 2018. For some birds (e.g., raptors), nest surveys considered the viewshed analysis described under the Bald and Golden Eagle Measures (Section 2 of this Appendix) in identifying priority areas for surveys.

Nest site surveys focused on special status bird species that may return to the same nest locations (e.g., osprey, peregrine falcon, sandhill crane). The objective of bird nest site surveys is to identify and map any nest trees, heron colonies, cliff nests, nests on structures, or other types of nests that may be removed or disturbed by construction.

For osprey nests, biologists surveyed all nest platforms, transmission line towers, and reservoir and river shorelines for nests within 0.75 miles of limits of work, defined as the potential area within which construction activities may affect active nests (USBR and CDFW 2012, Section 3.5). KRRC will check nest sites identified in 2018 for occupancy in the year that construction activities are planned to commence. In coordination with the resource agencies (i.e., USFWS throughout the project area and in California, KRRC will consult with CDFW and in Oregon, KRRC will consult with ODFW), osprey nests within 0.75 miles of the limits of work may be removed or blocked from use following the breeding season in the year prior to drawdown. KRRC will closely monitor osprey nesting activity during the breeding season of the year prior to drawdown and the year of drawdown. Nests and nest platforms will be blocked and nesting material may be removed within both the limits of work and a disturbance buffer based on the proposed construction activities, vegetation and line of sight conditions, and other factors that contribute to the potential for nesting disturbance.

KRRC surveyed reservoir and river shorelines within 0.25 miles of limits of work for heron colonies in May 2018. KRRC will survey reservoir and river shorelines in spring of the year prior to drawdown for active heron colonies. If KRRC finds an active heron colony, a spatial buffer may be established in coordination with the resource agencies.

KRRC surveyed cliffs within 1 mile of limits of work in May 2018 for peregrine falcon nests. KRRC will survey these areas again in spring of the year prior to drawdown. If KRRC finds an active peregrine falcon nest, a spatial buffer may be established in coordination with the resource agencies.

KRRC surveyed documented nesting habitat for sandhill crane at J.C. Boyle Reservoir in May 2018 and will conduct an additional survey prior to construction (i.e., spring of the year prior to drawdown). KRRC will use a boat as needed to access these areas. If KRRC finds sandhill crane nesting, a spatial buffer may be established in coordination with the resource agencies.

During surveys, KRRC notes all species seen or heard, their approximate number and behavior (e.g., roosting, loafing, foraging, courtship, mating, incubating eggs, feeding young). KRRC records GPS coordinates for all active nests and spatial buffers established as needed in coordination with the resource agencies.

3.3.4 Other Focused Surveys

Several additional species with potential to occur in the project area have been identified by USFWS, CDFW, and/or ODFW as warranting additional consideration based on their status or potential status (i.e., species have been petitioned for listing on the federal and/or state level). These species include western pond turtle, foothill yellow-legged frog, Cascades frog, Siskiyou Mountains salamander, and tricolored blackbird. These species are discussed in the following sections.

Western Pond Turtle

Western pond turtles are known to occur at project reservoirs. U.S. Geological Survey (USGS) conducted visual surveys of basking turtles at J.C. Boyle Reservoir in the mid- to late-1990s and recorded turtle use (Wray 2017). A petition for federal listing is currently being considered by USFWS, and a decision regarding listing is expected by 2021. The 2001-2003 PacifiCorp surveys also noted the presence of western pond turtles at project reservoirs (PacifiCorp 2004).

Impacts on western pond turtles from project implementation are uncertain and depend on factors that are hard to predict, including the amount of sediment moved during drawdown. In early 2018, KRRC conducted a desktop analysis of western pond turtle habitat and overwintering requirements and the potential for impacts on pond turtles during drawdown. Following review and input from the resource agencies and other experts on the results of the analysis, ODFW recommended additional pond turtle surveys. KRRC is coordinating with ODFW, USFWS, and CDFW on a preliminary scope for a study to determine 1) the abundance of western pond turtles in the J.C. Boyle Reservoir area and 2) where western pond turtles are overwintering in the J.C. Boyle Reservoir area. The study may include mark/recapture surveys, temperature monitoring and/or radio telemetry to determine overwintering locations. KRRC will conduct the study beginning in the late summer/fall through the spring of 2018 or 2019.

Foothill Yellow-legged Frog

The foothill yellow-legged frog is under review for federal listing and is a candidate for listing in California. Foothill yellow-legged frogs are not known to occur in the project reservoirs or tributary streams within the project area (PacifiCorp 2004). PacifiCorp surveys conducted in 2003 along the mainstem Klamath River and in stream segments directly adjacent to the mainstem channel did not detect foothill yellow-legged frogs, suggesting the species was extirpated from the project area. Farther downstream of the dams, foothill yellow-legged frogs are known to inhabit the lower reaches and tributaries of the Klamath River. In June 2009, float surveys along 3.5 km of the mainstem Klamath River downstream of the Blue Creek confluence found adults, juveniles, and egg masses. Egg masses were stranded on the bank, potentially due to wake disturbance from jet boats (Bettaso, pers. comm., 2017).

The findings of previous surveys indicate the species does not occur in the reservoirs but may be present several miles downstream. Because drawdown activities will occur prior to the main foothill yellow-legged frog breeding season, seasonal flows and sediment transport associated with drawdown are unlikely to affect egg masses or tadpoles downstream of the dams. KRRC is coordinating with USFWS, CDFW, and ODFW to determine the potential for impacts to the species. If, after further review and evaluation, it is determined that there is a high probability of take of the species as defined by CESA during the project implementation in California, focused surveys will be conducted during spring and summer of the year prior to drawdown for the purpose of estimating population information as needed for a California Incidental Take Permit.

Cascades Frog

The Cascades frog is under review for federal listing and is a candidate for listing in California. The species inhabits lakes, ponds, wet meadows, and streams at moderate to high elevations in the Cascades Range and is documented in the CNDDB within the Klamath National Forest. The species was not detected during PacifiCorp surveys (PacifiCorp 2004). Due to the presence of non-native predators such as bullfrogs and introduced sport fishes in the reservoirs, Cascades frog is unlikely to occur. Therefore, KRRC does not propose to complete focused surveys for this species. The KRRC has coordinated this decision with the resource agencies.

Siskiyou Mountains Salamander

The Siskiyou Mountains salamander is a California threatened species that is documented in the CNDDB along tributaries to the Klamath River in the Klamath National Forest. The species was not detected during PacifiCorp surveys (PacifiCorp 2004). The species is associated with rocky, forested areas and, specifically, stabilized talus in old-growth stands. The forests within the project area are heavily managed by timber harvest and do not provide suitable habitat for the Siskiyou Mountains salamander. Therefore, KRRC does not propose to conduct focused surveys. The KRRC has coordinated this decision with the resource agencies.

Tricolored Blackbird

The tricolored blackbird is under review for federal listing and is a candidate for listing in California. In February 2018, CDFW recommended listing the tricolored blackbird as threatened under CESA. The species forms large nesting colonies, most typically in dairy silage fields or other agricultural areas near wetlands. The species will use emergent-marsh habitat and may occur transiently in such habitats within the project area. However, there are no agricultural fields that typically support tricolored blackbird colonies in the project area. Therefore, KRRC does not anticipate nesting within the project area. KRRC is noting observations of the species during wildlife surveys in 2018, particularly within emergent wetland habitats. If KRRC finds nesting tricolored blackbirds in the project area during 2018 surveys, KRRC will survey the nesting location again in spring of the year prior to drawdown. If KRRC finds tricolored blackbirds nesting at that time, a disturbance buffer may be established in coordination with the resource agencies.

Willow Flycatcher

Willow flycatchers have been documented in the project area (PacifiCorp 2004, Attachment A). Willow flycatcher is a California endangered species. KRRC does not propose protocol surveys for willow flycatcher; however, surveys will be conducted in willow-dominated riparian/meadow communities to identify potential habitat for willow flycatcher. If it is determined that there would be impacts on potential willow flycatcher habitat from project implementation in areas where presence is uncertain or cannot be assumed, KRRC will conduct protocol surveys for willow flycatcher in spring of the year prior to drawdown in coordination with the resource agencies.

3.3.5 Pre-construction Nesting Bird Surveys

Prior to project activities that involve clearing of vegetation or other habitat, KRRC will conduct targeted, pre-construction bird surveys for all birds protected by the MBTA to avoid or minimize nesting disturbance. KRRC will conduct nesting surveys within 2 weeks before the start of construction activities that occur during nesting bird season (February through July). Biologists will search for nests in potential bird nesting habitat within 300 feet of limits of work. KRRC will map active nests and an activity restriction buffer may be established in coordination with the resource agencies to minimize disturbance from construction activities. Construction planning will include efforts to limit activities that would disturb vegetation to the non-breeding season.

KRRC will remove and discard cliff swallow nests along dam faces or structures during the non-nesting season to discourage swallows from returning to nest within the limits of work.

3.3.6 Construction Monitoring

KRRC will conduct biological monitoring during construction. KRRC will develop a detailed construction monitoring plan in coordination with the resource agencies.

3.4 Avoidance and Minimization Measures

The Project incorporates the following specific elements that will avoid or reduce potential impacts on migratory birds and their nests during construction:

- KRRC will conduct removal or trimming of any trees or other vegetation for construction outside of the nesting season (January 1 through August 20). This will include removal or trimming of trees along access roads and haul routes and within disposal sites. Where clearing, trimming, and grubbing work cannot occur outside the migratory bird nesting season, a qualified avian biologist will survey limits of work to determine if any migratory birds are present and nesting in those areas as described in Section 3.3.6.
- For raptors (other than eagles), KRRC will remove inactive nests before nesting season begins, to the greatest extent practicable and to the extent allowed under applicable laws and regulations. KRRC will conduct any nest removals in close coordination with CDFW, ODFW, and USFWS. KRRC will implement deterrent actions such as placing traffic cones or other exclusionary devices in nests or on nest platforms to prevent nesting in the year of construction. KRRC will remove all deterrents as soon as possible after construction activities have progressed to a point beyond the disturbance buffer for that species. KRRC will confirm buffer distances with the resource agencies for each species and location.
- If an active nest of a migratory bird species is located, a restriction buffer may be established by the biological monitor as appropriate. The buffer size established by the biological monitor will consider the species, noise effects, line of sight, and other site-specific considerations of the specific nest. KRRC may reduce the buffer size or allow certain project activities within the buffer if the biological monitor confirms that the activity is not disturbing the nest.
- KRRC may remove osprey nests within 0.75 miles of limits of work or block them from use following the breeding season in the year prior to drawdown if such removal is consistent with applicable federal and state law. Osprey nests that are removed may be replaced following construction or relocated to suitable areas outside of the project area.
- KRRC will conduct biological monitoring during construction. KRRC will develop a detailed construction monitoring plan in coordination with the resource agencies and will include the following measures:
  + Before any ground-disturbing work (including vegetation clearing and grading) begins in the construction area, a qualified biologist will conduct a mandatory biological resources awareness training for all construction personnel and the construction foreman. This training will inform the crews about special status species that could occur on site. The training will consist of a brief

discussion of the biology and life history of the species; how to identify each species, including all life stages; the habitat requirements of these species; their status; measures being taken for the protection of these species and their habitats; and actions to be taken if a species is found within the project area during construction activities. KRRC will issue species identification cards to shift supervisors; these cards will have photos, descriptions, and actions to be taken upon sighting of special-status species during construction. Upon completion of the training, all employees will sign an acknowledgment form stating that they attended the training and understand all protection measures. KRRC will give an updated training to new personnel and in the event that a change in special-status species occurs.

  + KRRC's contractor will fence construction areas, including staging areas and access routes, with orange plastic snow fencing to demarcate work areas. The approved biologist will confirm the location of the fenced area prior to habitat clearing, and KRRC's contractor will maintain the fencing throughout the construction period. KRRC will implement additional exclusion fencing or other appropriate measures in coordination with the resource agencies to prevent use of limits of work by special-status species during construction.
  + To prevent entrapment of wildlife that do enter limits of work during construction, all excavated, steep-walled holes or trenches in excess of two feet deep will be inspected by a biologist or construction personnel approved by the resource agencies at the start and end of each working day. If no animals are present during the evening inspection, plywood or similar materials will be used to immediately cover the trench, or it will be provided with one or more escape ramps set at no greater than 1,000-foot intervals and constructed of earth fill or wooden planks. KRRC's contractor will inspect trenches and pipes for entrapped wildlife each morning prior to onset of activity. Before KRRC's contractor fills such holes or trenches, they will be thoroughly inspected for entrapped animals. KRRC's contractor will allow any animals so discovered to escape voluntarily, without harassment, before activities resume, or removed from the trench or hole by a qualified biologist approved by the resource agencies and the animals will be allowed to escape unimpeded. A biologist approved by the resource agencies will be responsible for overseeing compliance with protective measures during clearing and construction activities within designated areas throughout the construction activities.
  + If the design includes coffer dams, KRRC will monitor them immediately following closure and prior to the start of construction activities for the presence of special status species such as western pond turtles. If individuals are detected within enclosed spaces, they will be captured and removed by qualified biologists.
- General Requirements for Construction Personnel include the following:
  + KRRC's contractor will clearly delineate the limits of work and prohibit any construction-related traffic outside these boundaries.
  + KRRC's contractor will require construction crews to maintain a 20-miles per hour (mph) speed limit on all unpaved roads to reduce the chance of wildlife being harmed if struck by construction equipment.

+ KRRC's contractor will dispose of all food-related trash items such as wrappers, cans, bottles, and food scraps generated during construction or permitted operations and maintenance activities of existing facilities in closed containers only and removed at least once a week from the site. KRRC's contractor will fence the identified sites for trash collection to minimize access by wildlife.
+ KRRC's contractor will not allow deliberate feeding of wildlife.
+ KRRC's contractor will not allow pets in the limits of work.
+ KRRC's contractor will not allow firearms in the limits of work.
+ If vehicle or equipment maintenance is necessary, KRRC's contractor will perform it in designated staging areas.
+ Any worker who inadvertently injures or kills a federally- or state-listed species, bald eagle, or golden eagle, or finds one dead, injured, or entrapped will immediately report the incident to the construction foreman or biological monitor.
+ The construction foreman or biological monitor will notify the resource agencies within 24 hours of the incident.

3.5 References

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Godwin, Steve. 2017. Wildlife Biologist, BLM, Medford office. Personal communication with Jennifer Jones, KRRC, June 21, 2017.

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Table 3-1 Special Status Species with Potential to Occur in the Project Area (Terrestrial or Semi-Aquatic Species Only)

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Invertebrates					
Franklin's bumble bee	*Bombus franklini*	Petitioned for federal listing	Generalist forager of wildflowers such as lupine, California poppy, and horsemint. Found only in southern Oregon/northern California between the coast and Sierra-Cascade ranges.	Not found during PacifiCorp surveys. Documented occurrences in meadows in Siskiyou County (CNDDB 2017).	Focused surveys are not proposed. Observations during general wildlife surveys and vegetation mapping will be noted.
Conservancy fairy shrimp	*Branchinecta conservatio*	FE	Vernal pools	Not found during PacifiCorp surveys. Not listed on CNDDB search (2017); identified on IPaC (2017).	Vernal pools are not expected to be present. If noted during vegetation or wildlife surveys, focused surveys for vernal pool species will be conducted as appropriate based on the potential for impacts from project implementation.
Vernal pool fairy shrimp	*Branchinecta lynchi*	FT	Vernal pools	Not found during PacifiCorp surveys. Not listed on CNDDB search (2017); identified on IPaC (2017).	Vernal pools are not expected to be present. If noted during vegetation or wildlife surveys, focused surveys for vernal pool species will be conducted as appropriate based on the potential for impacts from project implementation.
Vernal pool tadpole shrimp	*Lepidurus packardi*	FE	Vernal pools	Not found during PacifiCorp surveys. Not listed on CNDDB search (2017); identified on IPaC (2017).	Vernal pools are not expected to be present. If noted during vegetation or wildlife surveys, focused surveys for vernal pool species will be conducted as appropriate based on the potential for impacts from project implementation.
Klamath pebblesnail	*Fluminicola sp. 5*	ONHP List 1	Medium rivers in cold and relatively pristine hard-subhabitats with little disturbance	ORBIC occurrence at confluence of Spencer Creek and J.C. Boyle Reservoir/Klamath River and just east of powerhouse (ORBIC 2017).	Focused surveys are not proposed. Observations during general wildlife surveys and vegetation mapping will be noted.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Klamath Rim pebblesnail	*Fluminicola sp.6*	ONHP List 1	Small, cold, spring runs with shallow water and gravel-cobble substrate	ORBIC occurrence at Klamath River 0.3 miles east of J.C. Boyle powerhouse (ORBIC 2017).	Focused surveys are not proposed. Observations during general wildlife surveys and vegetation mapping will be noted.
Blue Mountains juga (snail)	*Juga sp. 2*	ONHP List 1	Freshwater	ORBIC occurrence near Rock Creek (ORBIC 2017).	Focused surveys are not proposed. Observations during general wildlife surveys and vegetation mapping will be noted.
Scale lanx (snail)	*Lanx klamathensis*	ONHP List 1	Freshwater	ORBIC occurrence near Rock Creek (ORBIC 2017).	Focused surveys are not proposed. Observations during general wildlife surveys and vegetation mapping will be noted.
Siskiyou (= Chase) sideband	*Monadenia chaceana*	BLM, ONHP List 1, tracked on CNDDB	Lower reaches of major drainages, in talus and rock slides, under rocks and woody debris in moist conifer forests, in caves, and in shrubby areas in riparian corridors. Rocks and large woody debris serve as refugia during the summer and late winter seasons.	Not documented during PacifiCorp surveys. Historic occurrence 0.25 miles below Copco Dam in lava rockslide (CNDDB 2017). May occur in large piles of rocks (termed “derrick pile” by KNF) (Henderson 2017).	Focused surveys are not proposed. Observations during general wildlife surveys and vegetation mapping will be noted.
Amphibians					
Tailed frog	*Ascaphus truei*	CSSC	Perennial, cold, fast-flowing mountain streams with dense vegetation cover, or streams in steep-walled valleys in non-forested areas.	Widespread in tributary streams in the lower Klamath River (Green Diamond Resource Company 2006).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Western toad	*Anaxyrus boreas*	BLM, OSS	Breeds from February to early May in ponds, the edges of shallow lakes, and in slow-moving streams. Adults are common near marshes and small lakes but may also be found in dry forests, shrubby areas, and meadows.	Documented during PacifiCorp surveys along J.C. Boyle peaking reach, along the north shore of Iron Gate Reservoir, and along Klamath River near river mile 185 (between the confluence of Bogus and Cottonwood Creeks). One occurrence near Frain Ranch, Klamath River Canyon (ORBIC 2017).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Northern red-legged frog	*Rana aurora*	OSS, CSSC	Breeds in quiet low-velocity habitats, such as wetlands, ponds, and disconnected side channel habitats in coastal areas of the Lower Klamath River. Usually breeds January through March (Lannoo 2005).	Documented by CDFW as breeding in coastal areas of the Lower Klamath River.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Foothill yellow-legged frog	*Rana boylii*	Petitioned for federal listing, BLM, OSS, CSSC, CC	Streams and rivers with cobble-size or larger substrate. Breeds generally between late April and June (Lannoo 2005).	Known to CDFW to breed in the Lower Klamath River Mainstem and major tributaries. ORBIC occurrence downstream of J.C. Boyle Reservoir (ORBIC 2017).	Observations during general wildlife surveys will be noted. Based on an initial evaluation of known occurrences and potential for impacts from project activities, focused surveys are not proposed. However, focused surveys may be conducted to obtain population estimate information as needed for a California Incidental Take Permit if found warranted based on further evaluation and agency input.
Cascades frog	*Rana cascadae*	Petitioned for federal listing, OSS, CSSC, CC	Montane aquatic habitats such as mountain lakes, small streams, and ponds in meadows; open coniferous forests.	Documented occurrence in Klamath National Forest (CNDDB 2017). Unlikely to occur in project reservoirs due to the presence of non-native predators such as bullfrogs and introduced sport fishes.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Oregon spotted frog	*Rana pretiosa*	FT, BLM, OSS, CSSC	Highly aquatic and generally avoids dry uplands. It is rarely found far from permanent quiet water. Usually occurs in vegetated shallows or among grasses or sedges along the margins of streams, lakes, ponds (including those behind beaver dams), oxbows, springs, and marshes.	Not found during PacifiCorp surveys. Not listed on CNDDB search (2017); identified on IPaC (2017). Unlikely to occur in project reservoirs due to the presence of non-native predators such as bullfrogs and introduced sport fishes.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Siskiyou Mountains salamander	*Plethodon stormi*	OSS, CT	Mixed conifer habitat of dense, pole-to-mature size, trees and stabilized rock talus. Active above ground only during spring & fall rains.	Documented occurrences along Klamath River in Klamath National Forest (CNDDB 2017). Not likely to occur in the project area due to lack of old growth forests with rock talus.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Southern torrent salamander	*Rhyacotriton variegatus*	OSS, CSSC	Uppermost portions of cold, well shaded permanent streams with a loose gravel substrate, springs, headwater seeps, waterfalls, and moss covered rock rubble with flowing water.	Widespread in tributary streams in the lower Klamath River (Green Diamond Resource Company 2006).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Cope's giant Salamander	*Dicamptodon copei*	OSS	Streams and rivers in moist coniferous forests. Sometimes found in clear, cold mountain lakes and ponds	Not known to occur in project area.	Focused surveys are not proposed due to unlikelihood of occurrence. Observations during general wildlife surveys and vegetation mapping will be noted.
Reptiles					
Western pond turtle	*Actinemys marmorata*	Petitioned for federal listing, BLM, OSS, ONHP List 2, CSSC	Prefers quiet water in small lakes, marshes, and sluggish streams and rivers; requires basking sites.	Documented during PacifiCorp surveys at Keno, J.C. Boyle, Copco, and Iron Gate Reservoirs, along J.C. Boyle bypass reach, along J.C. Boyle peaking reach in California, and along Klamath River from Iron Gate Dam to Shasta River. Also documented at Iron Gate Reservoir and along Klamath River (ORBIC, CNDDB 2017).	Observations of the species and habitat will be noted during wildlife surveys and vegetation mapping. An additional study may include mark/recapture surveys, temperature monitoring and/or radio telemetry to determine overwintering locations.
Western painted turtle	*Chrysemys picta bellii*	OSS	Ponds, marshes, lakes, ditches, quiet streams with sandy or muddy bottoms and aquatic vegetation.	Not known to occur in project area.	Focused surveys are not proposed due to unlikelihood of occurrence. Observations during general wildlife surveys and vegetation mapping will be noted.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Northern sagebrush lizard	*Sceloporus graciosus graciosus*	BLM, ONHP List 4	Inhabits sagebrush, chaparral, juniper woodlands, and dry conifer forests.	Documented during PacifiCorp surveys in the rocky riparian shrub habitat of Keno reach, along J.C. Boyle peaking reach, near J.C. Boyle powerhouse intake canal, and near the edge of a forested wetland along Iron Gate Reservoir.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Sharptail snake	*Contia tenuis*	BLM	Inhabits moist sites in chaparral, conifer forests, and deciduous forests, but primarily occurs in oaks and other deciduous tree woodlands, particularly in the forest edges.	Known to occur along upper J.C. Boyle peaking reach west of Frain Ranch in Douglas-fir habitat but not detected by PacifiCorp during its surveys.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
California mountain kingsnake	*Lampropeltis zonata*	BLM, OSS, ONHP List 4	Inhabits thick vegetation along watercourses, farmland, chaparral, deciduous, and mixed-coniferous forests; specifically associated with moist river valleys and dense riparian vegetation.	Documented during PacifiCorp surveys along Copco Road and in close proximity to J.C. Boyle powerhouse intake canal. Also known to occur along J.C. Boyle peaking reach. Documented in Klamath River Canyon and east of J.C. Boyle powerhouse (ORBIC 2017).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Common kingsnake	*Lampropeltis getula*	BLM, OSS, ONHP List 4	Occurs in pine forests, oak woodlands, and chaparral in, under, or near rotting logs and usually near streams; associated with well-illuminated rocky riparian habitat with mixed deciduous and coniferous trees.	Documented during PacifiCorp surveys along J.C. Boyle peaking reach in oak/woodland and mixed conifer woodland and along Copco Road.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Birds					

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Common loon	*Gavia immer*	CSSC	May over-winter on project reservoirs or occur in aquatic habitat associated with large bodies of water like the project reservoirs while migrating from sub-arctic freshwater breeding grounds to coastal and near-shore pelagic marine habitat along the Pacific coast.	Documented during PacifiCorp surveys at Iron Gate Reservoir.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
American white pelican	*Pelecanus erythrorhynchos*	BLM, OSS, ONHP List 2, CSSC. Nesting colonies afforded special protection by CDFW	Nests at lakes and marshes and uses almost any lake outside of the breeding season; have a restricted range in southern Oregon and along the California border, where they are found to be associated with only a few large bodies of inland water.	Documented during PacifiCorp surveys on all project reservoirs, with the highest number occurring on Keno Impoundment, and along Link River, Keno reach, J.C. Boyle bypass reach, and on Klamath River between Iron Gate Dam and Shasta River.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Double-crested cormorant	*Phalacrocorax auritus*	CWL, Nesting colonies afforded special protection by CDFW	Colonial nester on coastal cliffs, rocks, offshore islands, and along lake margins.	Documented during PacifiCorp surveys at Keno and J.C. Boyle Dams. Documented nesting colonies near mouth of Klamath River (CNDDB 2017).	Wildlife surveys will note presence and nesting colonies to identify potential for impacts from project implementation.
Black-crowned night heron	*Nycticorax nycticorax*	Nesting colonies afforded special protection by CDFW	Found in riparian habitats and in wetland sites.	Documented during PacifiCorp surveys primarily along Keno reach, but also along Link River, at Keno Impoundment, and along Klamath River from Iron Gate Dam to Shasta River. Communal roost used by night herons and other heron species in a group of willow trees near the East Side powerhouse adjacent to Link River.	Wildlife surveys will note presence and nesting colonies to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Snowy egret	*Egretta thula*	BLM, ONHP List 2, Nesting colonies afforded special protection by CDFW	Inhabits emergent wetlands associated with freshwater marshes and along the periphery of large water bodies. The northern limit of the species range includes southern Oregon.	Documented during PacifiCorp surveys near Link River Dam, at Keno Dam, and along Keno reach.	Wildlife surveys will note presence and nesting colonies to identify potential for impacts from project implementation.
Great egret	*Casmerodius albius*	BLM, Nesting colonies afforded special protection by CDFW	Nests in willows and other trees; forages in shallow water, wetlands, and fields. Range includes Klamath basin and eastern Siskiyou County. Known to occur in the study area.	Documented during PacifiCorp surveys at J.C. Boyle and Keno Impoundments, Keno Canyon reach, J.C. Boyle bypass and peaking reaches, and Link River.	Wildlife surveys will note presence and nesting colonies to identify potential for impacts from project implementation.
Great blue heron	*Ardea herodias*	Nesting colonies afforded special status protection by CDFW	Forages mostly in slow-moving or calm salt, fresh, or brackish water in a variety of habitats, including rocky shores, coastal lagoons, saltwater and freshwater marshes, mudflats, bays, estuaries, along the margins of rivers, lakes, and irrigation canals, and in flooded fields. Nesting colonies are typically found in groves of large trees, often in mixed colonies with other herons, egrets, and cormorants.	Documented during PacifiCorp surveys at all reservoirs and most study area reaches. Known colony documented along the south side of Copco Lake (Harris 2017). No known rookeries at J.C. Boyle (Wray 2017). Several rookeries documented along the Klamath River (CNDDB 2017).	Wildlife surveys will note presence and nesting colonies to identify potential for impacts from project implementation.
White-faced ibis	*Plegadis chihi*	BLM, ONHP List 4, CWL, Nesting colonies afforded special protection by CDFW	Breeds in freshwater marshes and lakes, and estuaries, and nests near the water on mats of vegetation and twigs; usually occurs in isolated con-specific flocks. Does not typically overwinter in Oregon but is a fairly common visitor in the Klamath Wildlife Area during the spring and summer.	Documented during PacifiCorp surveys along Link River and at Keno Impoundment and J.C. Boyle Reservoir.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Bufflehead	*Bucephala albeola*	BLM, ONHP List 4	Typically breeds around isolated mountain lakes; nesting habitat includes mixed conifer forest and ponderosa pine forests with sparse to moderate tree canopy closure close to lakes and ponds. Nests in cavities, including artificial nest boxes. May be found in open water and riverine habitat throughout southern Oregon after the breeding season.	Documented during PacifiCorp surveys primarily from January until April along the Link River, at Keno Impoundment and Copco and Iron Gate Reservoirs.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Barrow's goldeneye	*Bucephala islandica*	ONHP List 4, CSSC	Tends to breed along high-elevation mountain lakes and winter in coastal areas. Potential nesting habitat includes forests with sparse to moderate tree canopy closure next to rivers and reservoirs.	Documented during PacifiCorp surveys along Keno Impoundment, in an inundated drainage ditch off of Copco Lake, and on Iron Gate Reservoir. Common winter migrant on the Link River and Keno Impoundment (R. Larson, USFWS).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Trumpeter swan	*Cygnus buccinator*	OSS, FP	Relatively shallow (less than 6 feet deep), undisturbed bodies of freshwater with abundant aquatic plants.	Not documented in project area.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Osprey	*Pandion haliaetus*	CWL	Nests in all forested vegetation types with large trees near water, as well as on platforms erected in less optimal habitat.	A minimum of 16 active osprey nests, both artificial nesting platforms and natural sites, are found along the shores of the project reservoirs and river reaches. Documented during PacifiCorp surveys along the Keno reach, along the J.C. Boyle bypass reach, along the J.C. Boyle peaking reach, at J.C. Boyle, Copco, and Iron Gate Reservoirs, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River. Several occurrences along lower Klamath River (CNDDB 2017).	Wildlife surveys will note presence and nest sites to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Northern harrier	*Circus cyaneus*	CSSC	Nests and forages in grasslands and emergent wetlands. Permanent residents in the project area and common at the Klamath Wildlife Area.	Documented during PacifiCorp surveys in the low-lying marshland and agricultural fields east of Keno Impoundment and along Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Golden eagle	*Aquila chrysaetos*	BGEPA, BLM, CSSC, FP, CWL	Breeds in open mountain and hill habitats, nests on cliff ledges, and forages in grasslands and open conifer forests and woodlands with sparse to open tree canopy closure. Eagles use two to three nests during a lifetime.	Historical records exist of several golden eagle nests on cliffs from J.C. Boyle bypass reach to Iron Gate Reservoir. Documented during PacifiCorp surveys at J.C. Boyle powerhouse, along the lower section of J.C. Boyle peaking reach, along Copco and Iron Gate Reservoirs, and Copco bypass reach.	Wildlife surveys will note presence and nest sites to identify potential for impacts from project implementation. See eagle measures.
Bald eagle	*Haliaeetus leucocephalus*	BGEPA, OSS, ONHP List 4, CE, FP	Nests in large conifers within several miles of water; forages in rivers and lakes for fish and waterfowl; requires large snags for perching and conifers for night roosts.	Documented during PacifiCorp surveys at all project reservoirs and in all project reaches throughout the project area. Also documented on Upper Klamath River, on the Klamath River near OR-CA border (ORBIC 2017), and along lower Klamath River (CNDDB 2017).	Wildlife surveys will note presence and nest sites to identify potential for impacts from project implementation. See eagle measures.
Cooper's hawk	*Accipiter cooperii*	CWL	Inhabits riparian deciduous forest, montane hardwood oak woodland, montane hardwood oak-juniper, montane hardwood oak-conifer, juniper woodland, mixed conifer forest, ponderosa pine forest, and lodgepole pine with any level of tree canopy closure.	Documented during PacifiCorp surveys along J.C. Boyle bypass and peaking reaches, and along Klamath River from the Iron Gate Dam to Shasta River. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Northern goshawk	*Accipiter gentilis*	BLM, OSS, ONHP List 4, CSSC	Inhabits forested communities with at least 60 percent canopy cover and trees greater than 6 inches in diameter, except oak woodland, oak-conifer woodland, and oak-juniper woodland; forages over large home ranges.	Documented during PacifiCorp surveys flying over J.C. Boyle peaking reach. Documented near tributaries of lower Klamath River (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Sharp-shinned hawk	*Accipiter striatus*	CWL	Inhabits riparian deciduous forest, montane hardwood oak woodland, montane hardwood oak juniper, montane hardwood oak-conifer, juniper woodland, mixed conifer forest, ponderosa pine forest, and lodgepole pine with any level of tree canopy closure and tree diameters ranging from 6 to 24 inches.	Documented during PacifiCorp surveys in oak habitat along J.C. Boyle bypass and peaking reaches, and along Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Swainson's hawk	*Buteo swainsoni*	BLM, OSS, ONHP List 4, CT	Dwells in open country and typically inhabits sagebrush, annual grassland, juniper woodland, montane hardwood oak-juniper, and riparian deciduous forest with sparse to open tree canopy closure. The species' range generally lies east of the project area and includes the plains of the Great Basin in southeast Oregon and eastern northern California.	Documented during PacifiCorp surveys flying over agricultural fields southeast of Keno Impoundment. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation. Focused surveys are not proposed.
Merlin	*Falco columbarius*	BLM, ONHP List 2, CWL	Uses a variety of forested and open habitats. Ranges throughout North America and travels great distances during migration from breeding grounds in northern Canada and Alaska to wintering habitat through the contiguous United States south to Central America.	Documented during PacifiCorp surveys at J.C. Boyle Reservoir and along J.C. Boyle peaking reach. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Prairie falcon	*Falco mexicanus*	CWL	Uses cliffs for nesting and plateau grasslands for foraging.	Documented during PacifiCorp surveys near Keno campground and boat ramp, above J.C. Boyle bypass reach, near Copco Lake, and flying over Klamath Wildlife Refuge. Several occurrences listed as sensitive (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
American peregrine falcon	*Falco peregrinus anatum*	BLM, ONHP List 2, FP	Breeds at suitable nest sites on cliffs and rocky outcroppings. Uses a variety of habitats, including open grassland areas, forest stands, and reservoirs throughout the project area.	The project area is in a management area designated for peregrine falcon recovery. Known to occur along Keno Impoundment and the J.C. Boyle bypass reach but not documented during PacifiCorp surveys. Several occurrences listed as sensitive (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Long-billed curlew	*Numenius americanus*	OSS, CWL	Sparse, short grasses, including shortgrass and mixed-grass prairies as well as agricultural fields.	Not documented in project area.	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation.
Yellow rail	*Coturnicops noveboracensis noveboracensis*	OSS	Shallow marshes, and wet meadows; in winter, drier fresh-water and brackish marshes, as well as dense, deep grass, and rice fields.	Not documented in project area.	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation.
Mountain quail	*Oreortyx pictus*	BLM, ONHP List 4	Inhabits open forests, chaparral, and juniper woodlands with dense undergrowth offering suitable refuge; breeds in higher elevation areas; migrates on foot up to 40 miles to lower elevation winter grounds.	Documented during PacifiCorp surveys at J.C. Boyle Reservoir, along the J.C. Boyle bypass reach and peaking reaches, along Fall Creek, and along Klamath River from the Iron Gate Dam to Shasta River.	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Greater sandhill crane	*Grus canadensis tabida*	BLM, OSS, ONHP List 4, CT, FP	Nests in marshes and wet meadows, and occasionally in pastures and irrigated hayfields. A primary requirement for suitable nesting habitat is the presence of surrounding water or undisturbed habitat.	Documented during PacifiCorp surveys east of Keno Impoundment and along J.C. Boyle Reservoir. PacifiCorp located an active nest with two eggs in it in the emergent wetland bordering J.C. Boyle Reservoir. Several occurrences in the Lower Klamath Lake NWR (CNDDB 2017).	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation.
Caspian tern	*Sterna caspia*	OSS	Nests in tightly packed colonies on undisturbed islands, levees, and shores along inland water bodies during the summer breeding season. Forages over water.	Documented during PacifiCorp surveys on all project reservoirs as well as along Link River, Keno and J.C. Boyle bypass reaches, and along the Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation.
Forster's tern	*Sterna forsteri*	BLM, ONHP List 4	Breeds at lakes and marshes and on mud or sand flats near water; forages over water.	Documented during PacifiCorp surveys along Link River, along Keno and J.C. Boyle bypass and peaking reaches, and at all project reservoirs. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation.
Black tern	*Chlidonias niger*	BLM, ONHP List 4, CSSC	Nests in emergent vegetation along the shoreline periphery of freshwater lakes, wetlands, and marshes along rivers and ponds; forages in wet meadows, pastures, agricultural fields, and water.	Documented during PacifiCorp surveys at Keno and J.C. Boyle Reservoirs. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation.
Marbled murrelet	*Brachyramphus marmoratus*	FT, OT, ONHP List 2, CE	Spends most of the time in the marine environment foraging in nearshore areas. Uses old-growth forests (coast Redwood forests in California) for nesting.	Known to occur within National Forest lands and Green Diamond Resource Company managed lands near the coast. Critical habitat has been designated near the mouth of the Klamath River.	Focused surveys are not proposed due to unlikelihood of occurrence. Observations during general wildlife surveys and vegetation mapping will be noted.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Flammulated owl	*Otus flammeolus*	BLM, OSS, ONHP List 4	Nests in abandoned woodpecker nest cavities in open forests with a ponderosa pine component.	Documented during PacifiCorp surveys along J.C. Boyle bypass and peaking reaches.	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation.
Great gray owl	*Strix nebulosa*	BLM, OSS, ONHP List 4, CE	Inhabits mixed conifer, ponderosa pine, and riparian mixed forest stands with trees greater than 11 inches in diameter providing at least 60 percent canopy cover within at least 984 feet of a natural or manmade opening greater than 10 acres. Breeds in tree cavities, typically near suitable open grassland foraging habitat.	Documented during PacifiCorp surveys east of Fall Creek near Jenny Creek. Not listed on CNDDB for project area; nearest location is 24 miles west of Iron Gate Dam (CNDDB 2017). Rarely detected south of Highway 66 by BLM (Godwin 2017).	Wildlife surveys will note any nesting activity to identify potential for impacts from project implementation. Focused surveys are not proposed due to unlikelihood of occurrence.
Northern spotted owl	*Strix occidentalis caurina*	FT, OT, ONHP List 1, CT, CSSC	Inhabits ponderosa pine forest, mixed conifer forest, and conifer forest with trees greater than 11 inches in diameter. Prefers old-growth forests with multi-layered tree canopies. Critical habitat occurs within the project area near the J.C. Boyle Powerhouse, upstream of Copco Lake and south of the Klamath River and along portions of the lower Klamath River.	Documented during PacifiCorp surveys near J.C. Boyle Reservoir and along J.C. Boyle peaking reach. Several occurrences within the project area (CNDDB 2017, ORBIC 2017). Known to occur within National Forest lands and Green Diamond Resource Company managed lands near the coast. Critical habitat has been designated near the J.C. Boyle Powerhouse.	Protocol surveys are proposed (see separate northern spotted owl measures).
Yellow-billed cuckoo	*Coccyzus americanus*	FT, BLM, CE	Riparian forest nester, along the broad, lower flood-bottoms of larger river systems.	Not found during PacifiCorp surveys. Not listed on CNDDB search (2017); identified on IPaC (2017).	Focused surveys are not proposed due to unlikelihood of occurrence. Observations during general wildlife surveys and vegetation mapping will be noted.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Vaux's swift	*Chaetura vauxi*	CSSC	Found in mixed conifer, ponderosa pine, lodgepole pine, riparian deciduous, montane hardwood oak woodland, montane hardwood oak-conifer, and montane hardwood oak-juniper forests with trees greater than 11 inches in diameter.	Documented during PacifiCorp surveys at J.C. Boyle, Copco, and Iron Gate Reservoirs, along the J.C. Boyle bypass and peaking reaches, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Black swift	*Cypseloides niger*	OSS, ONHP List 2, CSSC	Suitable nesting habitat is limited to cliffs near water courses. Breeding sites are widely distributed in Oregon and California; none known in Klamath or northern Siskiyou Counties.	Not documented during PacifiCorp surveys. Documented along Klamath River near Orleans (CNDDB 2017).	Observations during general wildlife surveys will be noted.
Pileated woodpecker	*Drycopus pileatus*	BLM, ONHP List 4	Occurs in all forest and woodland cover types with moderate to dense tree canopy closure. Requires large snags 25 inches or more in diameter for excavating suitable nest cavities.	Documented during PacifiCorp surveys along Keno reach, at J.C. Boyle Reservoir, along J.C. Boyle bypass and peaking reaches, and along Fall Creek.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Acorn woodpecker	*Melanerpes formicivorus*	BLM, OSS, ONHP List 4	Nests in cavities in snags of deciduous tree species, particularly oak snags at least 17 inches in diameter.	Several nesting colonies documented during PacifiCorp surveys in oak, oak-juniper, and oak/conifer habitats, primarily at Copco Lake. Also documented during PacifiCorp surveys at J.C. Boyle and Iron Gate Reservoirs, along J.C. Boyle peaking reach, along Copco bypass reach, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River.	Wildlife surveys will note presence, nesting activity, and granary trees to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Lewis' woodpecker	*Melanerpes lewis*	BLM, OSS, ONHP List 2	Associated with oak woodlands and mixed oak conifer habitat, but also can be found in a variety of open forest stands including ponderosa pine and cottonwood-dominated riparian areas.	Documented during PacifiCorp surveys in upland habitats along J.C. Boyle peaking reach, in riparian habitats at Iron Gate Reservoir, and along Klamath River from Iron Gate Dam to Shasta River. Documented in Klamath River Canyon (ORBIC 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
White-headed woodpecker	*Picoides albolarvatus*	BLM, OSS, ONHP List 2	Nests in cavities typically in ponderosa pine at least 18 inches in diameter. Occurs in lodgepole pine, ponderosa pine, and Klamath mixed conifer forests with trees greater than 11 inches in diameter.	Documented during PacifiCorp surveys along J.C. Boyle bypass reach. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Black-backed woodpecker	*Picoides arcticus*	BLM, OSS, Petitioned for CA listing	Recently burned coniferous forest in the Sierra Nevada and Cascades to the Siskiyou Mtns; areas with dense standing dead trees, and less commonly in unburned forests.	Not documented during PacifiCorp surveys or listed on CNDDB or ORBIC for the project area. May occur based on information from USFWS Yreka office (May 23, 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
American three-toed woodpecker	*Picoides tridactylus*	OSS	Montane coniferous forests with large stands of dead and dying conifers, including areas disturbed by fire.	Not documented during PacifiCorp surveys or listed on CNDDB or ORBIC for the project area.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Olive-sided flycatcher	*Contopus cooperi*	BLM, OSS, ONHP List 4	Typically found in coniferous forests with tall trees providing suitable perch sites.	Documented during PacifiCorp surveys along Link River, at Keno, J.C. Boyle and Iron Gate Reservoirs, and along Keno and J.C. Boyle peaking reaches. Not listed on CNDDB for project area (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Willow flycatcher	*Empidonax traillii*	BLM, CE	Associated with dense riparian willow thickets.	Documented during PacifiCorp surveys in some of the denser willow patches along Link River, at J.C. Boyle, Copco, and Iron Gate Reservoirs, along the J.C. Boyle peaking reach, and along Klamath River from Iron Gate Dam to Shasta River. Also documented at Iron Gate Reservoir at Jenny Creek (CNDDB 2017).	In addition to noting presence and nesting activity, surveys will be conducted in suitable habitat to quantify and map potential habitat and identify potential for impacts from project implementation.
Purple martin	*Progne subis*	BLM, OSS, ONHP List 2, CSSC	Riparian and wetland forests, as well as Klamath mixed conifer forest, ponderosa pine forest, montane hardwood oak woodland, montane hardwood oak-conifer, and montane hardwood oak-juniper with sparse to moderate tree canopy closure (<60 percent). Range is patchy and may include portions of the study area.	Documented during PacifiCorp surveys above the upper falls at Fall Creek.	Wildlife surveys will note presence and nesting activity/colonies to identify potential for impacts from project implementation.
Red-necked grebe	*Podiceps grisegena*	OSS	Breeds on shallow freshwater lakes, bays of larger lakes, marshes, and other inland bodies of water. Winters on open ocean or on large lakes.	Not documented in project area.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Black-capped chickadee	*Parus atricapillus*	CWL	Nests in a variety of woodland habitats wherever suitable, small nest cavities can be found.	Documented during PacifiCorp surveys along Link River and at Copco and Iron Gate Reservoirs.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Pygmy nuthatch	*Sitta pygmea*	BLM	Typically found in ponderosa pine forests with less than 70 percent canopy closure.	Documented during PacifiCorp surveys at Keno Impoundment and J.C. Boyle Reservoir.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Yellow warbler	*Dendroica petechia*	CSSC	Found in riparian deciduous forest, riparian shrub, scrub-shrub wetland, and forested wetland. Breeds in riparian habitat throughout North America and winters south from Mexico through South America.	Documented during PacifiCorp surveys throughout the project area at all project reservoirs and in all project reaches. Incidental occurrence documented with Willow flycatcher at Copco/Iron Gate Reservoirs (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Yellow-breasted chat	*Icteria virens*	BLM, OSS, CSSC	Found in the brushy understory of deciduous and mixed woodlands; breeds in brushy vegetation, typically willow thickets, along rivers and streams.	Documented during PacifiCorp surveys primarily in wetland and riparian habitats along J.C. Boyle peaking reach, at Copco Lake, along Fall Creek, and along Klamath River from Iron Gate Dam to Shasta River. Incidental occurrence documented with Willow flycatcher at Copco/Iron Gate Resevoirs (CNDDB 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Northern waterthrush	*Parkesia noveboracensis*	ONHP List 2	Nests in dense riparian willow thickets.	ORBIC occurrence at Grizzly Butte along Klamath River (ORBIC 2017).	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Tricolored blackbird	*Agelaius tricolor*	Petitioned for federal listing, BLM, CSSC, CC	Highly colonial species; requires open water, protected nesting substrate, and foraging area with insect prey within a few km of the colony. Historically found in large wetland complexes; nesting colonies are now typically found in agricultural areas such as dairy silage fields with wetlands.	Not documented during PacifiCorp surveys or listed on CNDDB or ORBIC for the project area. Nearest occurrences just north of Keno (Wray 2017). No agricultural fields typically used by the species for nesting colonies are present in the project area.	Wildlife surveys will note presence and nesting activity to identify potential for impacts from project implementation.
Mammals					
Townsend's big-eared bat	*Corynorhinus townsendii*	BLM, OSS, ONHP List 2, CSSC	Generally found in open forests and a variety of habitats; the availability of suitable roost sites (rock crevices, cliff ledges, and human-made structures) limits distribution and occurrence.	Known from J.C. Boyle peaking reach but not documented during PacifiCorp surveys. One occurrence in project area listed as sensitive by ORBIC (2017). Documented occurrences along Klamath River near Somes Bar (CNDDB 2017).	See bat measures.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Yuma myotis	*Myotis yumanensis*	BLM, ONHP List 4	Generally found in open forests and a variety of habitats; the availability of suitable roost sites (rock crevices, cliff ledges, and human-made structures) limits distribution and occurrence.	Documented during PacifiCorp surveys roosting in J.C. Boyle forebay spillway house, in transformer bays at Copco No. 1 powerhouse, and in rafters at Iron Gate south gatehouse. Also known from J.C. Boyle peaking reach. One occurrence outside project area (CNDDB 2017).	See bat measures.
California myotis	*Myotis californicus*	OSS	Wide tolerance of habitat including forested regions of the Pacific Northwest, humid coastal forests and montane forests.	Not documented in project area. Range overlaps with project area.	See bat measures.
Fringed myotis	*Myotis thysanodes*	BLM, OSS	Oak and pinyon woodlands appear to be the most commonly used vegetative associations. Roost sites may be in caves, mines, and buildings.	Not documented in project area. Range overlaps with project area.	See bat measures.
Hoary bat	*Lasiurus cinereus*	OSS	May prefer trees at the edge of clearings, but have also been found in trees in heavy forests, open wooded glades, and shade trees along urban streets and in city parks.	Not documented in project area. Range overlaps with project area.	See bat measures.
Long-legged myotis	*Myotis volans*	OSS	Roosts in trees, rock crevices, fissures in stream banks, and buildings. Caves and mines are used at night.	Not documented in project area. Range overlaps with project area.	See bat measures.
Pallid bat	*Antrozous pallidus*	BLM, CSSC, OSS	Variety of structures for day and night roosting, including live trees and snags, a rock crevice, and buildings.	Not documented in project area. Range overlaps with project area.	See bat measures.
Silver-haired bat	*Lasionycteris noctivagans*	OSS	Prefer temperate, northern hardwoods with ponds or streams nearby. The typical day roost for the bat is behind loose tree bark.	Not documented in project area. Range overlaps with project area.	See bat measures.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
American pika	*Ochotona princeps*	OSS	Restricted to rocky talus slopes, primarily the talus-meadow interface. Often they occur above treeline up to limit of vegetation but also can be found at lower elevations in rocky areas within forests or near lakes. Occasionally they inhabit mine tailings or even piles of lumber or scrap metal.	Not documented in project area.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Western gray squirrel	*Sciurus griseus*	BLM, ONHP List 4	Found in a variety of forested habitat types including mixed conifer forest, ponderosa pine forest, lodgepole pine, montane hardwood oak woodland, montane hardwood oak-conifer, and montane hardwood oak juniper with trees greater than 6 inches in diameter.	Documented during PacifiCorp surveys at J.C. Boyle Reservoir and Copco Lake, along J.C. Boyle peaking reach, and along Copco bypass reach.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Ringtail	*Bassariscus astutus*	BLM, OSS, ONHP List 4, FP	Uses a mixture of forest and shrublands or other habitats that provide vertical structure near rocky or riparian areas. Range overlaps the study area. The species is known to occur in the study area.	Not documented during PacifiCorp surveys. Documented in Klamath River Canyon (ORBIC 2017). Not listed on CNDDB for project area (CNDDB 2017).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Fisher- West Coast DPS	*Martes pennanti (Pekania pennanti)*	BLM, OSS, ONHP List 2, CC, CSSC	Mature, closed canopy forests with some deciduous trees; intermediate to large tree stages of conifer forests and riparian deciduous forests both with high tree canopy closure. Habitats in the study area include lodgepole pine, Klamath mixed conifer forest, ponderosa pine forest, riparian deciduous forest, montane hardwood oak-conifer with trees >11 inches DBH. Range overlaps the study area.	Not documented during PacifiCorp surveys. ORBIC occurrences along Klamath River near Rock Creek (ORBIC 2017). Documented along lower Klamath River (CNDDB 2017). Has been documented in the Upper Klamath Basin within the last two years (T. Collom, ODFW, personal communication, April 29, 2011).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort
Sierra Nevada red fox	*Vulpes vulpes necator*	FC, OSS, CT	High elevation, open conifer woodlands and mountain meadows near treeline. Range includes the Sierra Nevada and southern Cascade mountains of eastern California, into southern Oregon and western Nevada.	Not documented in project area.	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Wolverine	*Gulo gulo*	FPT, OT, CT, FP	Found in the north coast mountains and the Sierra Nevada. Found in a wide variety of high elevation habitats.	Documented occurrence outside of project area (CNDDB 2017).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
American badger	*Taxidea taxus*	CSSC	Most abundant in drier open stages of most shrub, forest, and herbaceous habitats, with friable soils.	Documented occurrences outside of project area (CNDDB 2017).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Canada lynx	*Lynx canadensis*	FT, ONHP List 2	Generally occurs in boreal and montane regions dominated by coniferous or mixed forest with thick undergrowth, but also sometimes enters open forest, rocky areas, and tundra to forage for abundant prey.	Not found during PacifiCorp surveys. Not listed on CNDDB search (2017); identified on IPaC (2017).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.
Gray wolf	*Canis lupus*	FE, CE, ONHP List 2	Habitat generalists, historically occupying diverse habitats including tundra, forests, grasslands, and deserts. Primary habitat requirements are the presence of adequate ungulate prey, water, and low human contact.	Not found during PacifiCorp surveys. Not listed on CNDDB search (2017); identified on IPaC (2017).	Focused surveys are not proposed. Observations during general wildlife surveys will be noted.

Common Name	Scientific Name	Status	Habitat	Occurrence in Project Area*	Proposed Survey Effort

Notes:
*Information on occurrence in the project area is based on PacifiCorp surveys (PacifiCorp 2004a) and information obtained from Oregon Biodiversity Information Center (ORBIC), California Natural Diversity Database (CNDDB), USFWS Information for Planning and Conservation (IPaC) databases (2017), and input for federal and state resource agencies. Please see Table 3.5-1 for a list of species observed during the July 2017 site reconnaissance.

Key:

BGEPA	Federal Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management sensitive species -species that could easily become endangered or extinct; and/or Survey and Manage Species
CC	Candidate listing by California Department of Fish and Wildlife
CDFW	California Department of Fish and Wildlife
CE	California Endangered
CSSC	California Department of Fish and Wildlife Species of Special Concern -not listed under the Federal or California Endangered Species Act but are believed to: 1) be declining at a rate that could result in listing, or 2) historically occurring in low numbers and having current known threats to their persistence
CT	California Threatened
CWL	California Department of Fish and Wildlife Watch List
FC	Federal Candidate Species
FE	Federal Endangered
FP	Fully protected under the California Fish and Game Code
FT	Federal Threatened
OC	Candidate listing by Oregon Department of Fish and Wildlife (ODFW)
OE	Listed as endangered by ODA or ODFW
ONHP List 1	Oregon Natural Heritage Program (ONHP) threatened with extinction or presumed to be extinct throughout their entire range
ONHP List 2	threatened with extirpation or presumed to be extirpated from the State of Oregon
ONHP List 3	more information is needed before status can be determined, but may be threatened or endangered in Oregon or throughout their range
OHNP List 4	of conservation concern but not currently threatened or endangered
OT	Listed as threatened by ODFW
OSS	Oregon Sensitive or Sensitive- Critical Species, East Cascades, West Cascades, and Klamath Mountains Ecoregions
USFWS	United States Fish and Wildlife Service

Chapter 4: Bats Measures

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4. BATS MEASURES

4.1 Objectives

The objectives of the bat survey are to document and confirm roosting locations and determine bat roost patterns at dam structures and associated facilities. KRRC will use the information collected during surveys to identify where roost structures can be retained and protected, if practicable, and will inform the development of bat exclusion and structure demolition plans prior to construction, as well as replacement habitat design.

The 2012 EIS/R (Section 3.5) TER-6 describes measures to reduce impacts on special status bats. The 2012 EIS/R recommended surveys to identify the locations of active bat roosts in facilities that may be affected by the dam removal. KRRC has incorporated this measure into the Project and will be implemented as described in the following sections. KRRC has incorporated the recommended avoidance and minimization measures into the Project's design and construction planning. This Section describes the initial phase of this process.

4.2 Existing Information

Based on a review of California and Oregon occurrence records, presence of suitable habitat, species range overlap, and previous survey results, eight bat species have potential to occur in the project area. Table 4-1 lists these species.

Yuma myotis have been previously documented at structures within the project area (PacifiCorp 2004). Townsend's big-eared bat and *Yuma myotis* have been previously documented in the Klamath Basin outside of the project area, in maternity roosts at Hoover Ranch and Salt Caves (approximately 6 miles east of Copco Reservoir and 9 miles downstream from the J.C. Boyle powerhouse) (Cross et al. 1998; PacifiCorp 2004). Of 24 facility sites visually-surveyed in June 2003, 6 had roosting bats, and 10 had evidence of recent bat use (PacifiCorp 2004, Attachment A).

4.3 Methods

4.3.1 Data Review

Recently-published data and literature, along with a current list of species with potential to occur obtained in coordination with ODFW, CDFW, BLM, USFS, and USFWS (Table 4-1), have been reviewed to complement and update the information cited in the 2012 EIS/R (USBR and CDFW 2012, Section 3.5). Coordination with local bat experts is ongoing as of December 2017.

4.3.2 Bat Roost Surveys

KRRC will conduct bat roost surveys for 2 years prior to construction activities. KRRC will conduct roost surveys cautiously to avoid disturbing bats at roost sites. An initial site reconnaissance and daytime visual inspection of buildings and bridges within the areas where removal or improvements will occur for the Project was conducted during the summer 2017 maternity season and is further described in the Preliminary Results section. KRRC planned a follow-up survey was planned during the 2017 maternity season to conduct dusk emergence surveys and pre-dawn re-entry surveys, but the survey was cancelled due to lack of right-of-entry to PacifiCorp property for the specific survey task. KRRC will consider the need to assess significant roosting habitat outside of buildings as project activities are further developed and refined. If determined to be potentially affected by noise or vibrations, significant roosting habitat in the vicinity of major project disturbances (such as trees planned for removal) will be evaluated during survey efforts, or as otherwise dictated by the project schedule.

KRRC is using the data review, ongoing coordination with regional bat experts, and conditions observed during the initial 2017 reconnaissance survey and daytime visual inspections to inform the design of and need for future survey efforts outside of the maternity season. Table 4-2 provides recommendations for future surveys based on the 2017 reconnaissance survey. These recommended surveys are underway in 2018 to identify which species occupy the habitat throughout the year, understand how the habitat is utilized throughout the year, and quantify habitat usage. These 2018 surveys include dusk emergence surveys and pre-dawn re-entry surveys, using night vision and acoustic detection as appropriate. KRRC is implementing acoustic monitoring as needed to determine bat roost patterns. KRRC tailored the number and location of emergence/re-entry surveys and acoustic monitoring surveys to the size of each structure and the species which have the potential to occupy it. KRRC is conducting the emergence surveys when weather conditions are suitable for the evening emergence of bats (e.g., temperatures are warm enough and rain and wind are minimal).

Townsend's big-eared bat (*Corynorhinus townsendii*) is extremely sensitive to disturbance, and there is a high probability of roost abandonment, reproductive failure, and/or fatality from disturbance. Accordingly, when KRRC surveys roosts during the maternity and hibernation seasons, KRRC uses specialized survey techniques for any structures that are suspected to be occupied by this species. Survey methodologies for Townsend's big-eared bat were developed on a case-by-case basis and are dependent on the current level of disturbance, site conditions, types of roost structures present, and season. For structures with the possibility of occupancy by the species, KRRC is only conducting exterior surveys to determine use of structures during their maternity season (April 15-August 31, 2018), to the extent possible. KRRC is conducting interior surveys, whether conducted after non-detection surveys during the maternity season, or conducted outside of the maternity season, in a manner to avoid disturbing roosting bats.

KRRC will use the information obtained during the surveys to (1) determine which facilities need to be removed or modified outside of the bat roosting and breeding period, (2) inform the design of bat exclusion methods where needed, and (3) determine the appropriate design and placement of artificial bat roosts. KRRC will consider and implement the Western Bat Working Group species-specific survey methodologies (http://wbwg.org/matrices/survey-matrix/) as appropriate.

The first year of winter hibernacula surveys that KRRC conducted in February-March 2018 were limited to structures at Copco 1 and 2 due to access constraints. KRRC is conducting additional roost surveys in May and June 2018. KRRC is conducting hibernacula surveys so as not to cause disturbance to hibernating bats. KRRC is conducting spring and fall migration surveys in approximately April/May and September/October, 2018. The level of survey effort throughout 2018-2019 will continue to be informed and modified according to the ongoing planning and development of the project design, findings of each consecutive focused survey, and in coordination with CDFW and ODFW. KRRC will conduct additional site-specific surveys prior to demolition or modification of structures to confirm that bats have successfully been excluded or are otherwise not present (see Section 4.5, Avoidance and Minimization Measures)

4.4 Preliminary Results

KRRC conducted a general site reconnaissance and daytime visual inspections of most project structures during the 2017 maternity season, from July 24-26, 2017 at J.C. Boyle, Copco No. 1 and No. 2, and Iron Gate. Qualified bat biologists conducted daytime visual inspections of each facility to be removed or modified for indications of bat use (e.g., occupancy, guano, staining, smells or sounds). KRRC inspected the exterior and interior of most structures. When bats were found, the species were identified visually to the extent possible. In order to minimize disturbance to roosting bats during the maternity season, KRRC limited interaction with live bats to brief viewing to confirm presence only. Table 4-2 summarizes initial survey findings and future survey plans. Recommendations for future surveys are informed by habitat suitability, the presence of bats or bat sign, and the presence of entry and exit points.

KRRC did not inspect five structures at Copco Village due to time constraints. For houses that are currently inhabited, KRRC limited the inspection to the exterior. KRRC plans interior inspections of these structures for future site visits. Because the tunnels near the Copco No. 1 and Iron Gate powerhouses were not accessible during the site reconnaissance, a qualified bat biologist will accompany future tunnel inspections to assess the habitat suitability inside of the tunnels, if possible, and/or bat use will be assessed using dusk emergence surveys and pre-dawn re-entry surveys.

4.5 Avoidance and Minimization Measures

If surveys indicate a facility is utilized as a bat roost, then one or more of the following measures will be employed to minimize disturbance and mortality to roosting bats:

- KRRC's contractor will remove the facility or modify it outside the bat roosting and breeding period where feasible (i.e. November 1 to March 1). If the facility is used as winter hibernacula (November 1 to March 1), then KRRC's contractor will remove the facility or modify it when it is determined to be unoccupied.
- Bat exclusion methods to seal-up facility entry sites (e.g., blocking and netting or installing sonic bat deterrence equipment) will occur during the fall migration period. KRRC will conduct humane bat exclusion by, or under the supervision of, a qualified bat biologist with experience in conducting exclusions and possessing a California Scientific Collecting Permit. KRRC will develop a bat exclusion plan and provide a copy to CDFW prior to initiation of exclusion activities for their information, technical expertise, and experience. The plan will include proposed exclusion methods for each structure and data describing the numbers of bats that have been observed emerging from the structures. Exclusion devices will be in place for at least 7 days to ensure all bats have had adequate time to exit. If climatic conditions occur that may deter roost exit (rain, cold temperatures, high winds, full moon, etc.), additional time will be added to the minimum number of nights the exclusion device is to remain in place. KRRC will monitor exclusion devices to ensure proper function.
- If demolition at a time when a structure is unoccupied and complete bat exclusion are both found to be infeasible at a given structure, KRRC will coordinate with USFWS and CDFW or ODFW, as appropriate to carefully remove the occupied bat habitat at a time when it will have the least impact on the bats present and in a manner that avoids bat injury and mortality.
- To reduce impacts on bats from the permanent loss of roosting habitat, KRRC will give preference to on-site and in-kind replacement roosting habitat. KRRC may retain facilities occupied by significant bat roosts, to the extent practicable.
- For those facilities that cannot be retained, KRRC will construct free-standing replacement bat roosts in coordination with bat specialists and the resource agencies. The size and design of each artificial bat roost will be informed by the features of the facility being utilized by roosting bats, the type of roost, and the size of the roost. Critical design elements will include access, ventilation, and thermal conditions. The total number of artificial bat roosts will depend on the total number of facilities with significant bat roosts to be demolished. Replacement roost structures will be in place prior to demolition of the existing facility. Experienced contractors will perform the installation of bat roosts. The structures will meet the specifications of Bats in American Bridges (Keeley and Tuttle 1999) and California Bat Mitigation Techniques, Solutions, and Effectiveness (H.T. Harvey and Associates 2004).
- KRRC will develop success criteria for replacement roost structures in coordination with bat specialists and the USFWS and CDFW or ODFW, as appropriate. Post-construction monitoring of the replacement roosts will occur seasonally (four times/year) until the earliest of the following: (1) up to five years after completion of project activities; (2) transfer of relevant Parcel B lands to the States and/or third parties; or (3) until the mitigation can be considered successful. After three years, adaptive management (i.e., reduced or discontinued monitoring of structures that have met criteria, or enhancement of structures that are not meeting criteria) will be applied as appropriate. KRRC will coordinate with the USFWS and CDFW or ODFW, as appropriate, to develop adaptive management strategies and determine that success criteria have been met.

4.6 References

Cross, S.P., H. Lauchstedt, M. Blankenship. 1998. Numerical status of Townsend's Big-eared Bats at Salt Caves in the Klamath River Canyon and other selected sites in Southern Oregon, 1997. Southern Oregon University, Ashland, Oregon.

Johnson, D., G. Tatarian, E. Pierson. 2004. California Bat Mitigation Techniques, Solutions, and Effectiveness. Prepared for California Department of Transportation and California State University Sacramento Foundation. Project Number 2394-01. December 29, 2004.

PacifiCorp. 2004. Terrestrial Resources Final Technical Report Klamath Hydroelectric Project FERC No. 2082. February 2004.

USBR and CDFW. 2012. Klamath Facilities Removal. Final Environmental Impact Statement/Environmental Impact Report (EIS/R). U.S. Bureau of Reclamation and California Department of Fish and Wildlife, December.

Table 4-1 Bat species with potential to occur in the project area

Common Name	Scientific Name	Status[1]	Suitable Habitat[2]	Known Occurrences within Project Area	Range Overlap?
Pallid bat	*Antrozous pallidus*	BLM, CSSC, OSS, USFS, WBWG-H	1) Buildings, bridges, and tree bark/hollows. 2) Caves, mines and cliffs/rock crevices.	None	Yes
Townsend's big-eared bat[3]	*Corynorhinus townsendii*	BLM, CSSC, OSS, USFS, WBWG-H	1) Caves, mines. 2) Buildings, bridges. 3) Tree bark/hollows.	Known from J.C. Boyle peaking reach. Not documented during PacifiCorp surveys (PacifiCorp 2004). Multiple observations in Rock Creek-Klamath River watershed (exact location not given; ORBIC 2017). Occurrences along Klamath River near Somes Bar (CNDDB 2017).	Yes
Silver-haired bat	*Lasionycteris noctivagans*	OSS, WBWG-M	1) Tree bark/hollows. 3) Bridges.	None	Yes
California myotis	*Myotis californicus*	OSS, WBWG-L	1) Buildings, cliffs/rock crevices. 2) Bridges, caves, mines, tree bark/hollows.	None	Yes

Common Name	Scientific Name	Status[1]	Suitable Habitat[2]	Known Occurrences within Project Area	Range Overlap?
Hoary bat	*Lasiurus cinereus*	OSS, WBWG-M	1) Tree foliage.	None	Yes
Fringed myotis	*Myotis thysanodes*	BLM, OSS, USFS, WBWG-H	1) Caves, mines, tree bark/hollows. 2) Buildings, bridges, cliffs/rock crevices.	None	Yes
Long-legged myotis	*Myotis volans*	OSS, WBWG-H	1) Tree bark/hollows. 2) Buildings, bridges, caves, mines.	None	Yes
Yuma myotis	*Myotis yumanensis*	BLM, WBWG-L	1) Buildings, bridges. 2) Caves, mines, tree bark/hollows. 3) Cliffs/rock crevices.	Documented during PacifiCorp surveys roosting in J.C. Boyle forebay spillway house, in transformer bays at Copco No. 1 powerhouse, and in rafters at Iron Gate south gatehouse (PacifiCorp 2004)	Yes

[1] USFS US Forest Service sensitive species not listed or proposed for listing under the federal Endangered Species Act for which population viability is a concern, as evidenced by significant current or predicted downward trends in population numbers or density, or significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.
BLM Bureau of Land Management sensitive species are species that could easily become endangered or extinct.
CSSC California Department of Fish and Wildlife Species of Special Concern are species not listed under the federal or California Endangered Species Act but are believed to: 1) be declining at a rate that could result in listing, or 2) historically occur in low numbers and have current known threats to their persistence.
OSS Oregon Sensitive or Sensitive-Critical Species, East Cascades, West Cascades, and Klamath Mountains Ecoregions.
WBWG Western Bat Working Group High (H), Medium (M), or Low (L) Priority for funding, planning and conservation actions in Ecoregion 5 (http://wbwg.org/matrices/species-matrix/).
[2] 1 = used frequently; 2 = used sometimes; 3 = used rarely (Johnson et al. 2004).
[3] PacifiCorp (2004) treated this as two subspecies; however, *Corynorhinus townsendii* is currently listed as one species.

Table 4-2 Initial findings (July 2017) and recommendations for future surveys

Building Name	Suitability for Roosting[1]	Live Bats Present?	Evidence of Bats Found?	Survey Recommendation
J.C. Boyle Dam and Facilities				

Building Name	Suitability for Roosting[1]	Live Bats Present?	Evidence of Bats Found?	Survey Recommendation
Red Barn	High	No	Yes - found dead bats outside of the building and inside the attic (badly dessicated - likely *Myotis* sp.). Abundant guano in attic.	Determine seasonal use. Next survey in winter 2017-2018.
Truck Shop	High	No	No	Emergence/re-entry survey.
HazMat	Low	No	No	No additional survey needed.
Well House	Low	No	No	No additional survey needed.
Fire System Control	Moderate-High	No	Yes - small amounts of guano.	Emergence/re-entry survey.
Dam Communications	Moderate	No	No	No additional survey needed.
Fish Screen House	Moderate	No	No	No additional survey needed.
Headgate Control	Moderate	No	No	Emergence/re-entry survey.
Headgate structure/concrete canal	Low	No	No	No additional survey needed.
Concrete Spillway (along canal)	Moderate	No	Yes - small amounts of guano.	No additional survey needed.
Spillway Gatehouse	High	Yes	Yes - occupied by several hundred bats.	Determine seasonal use. Next survey in winter 2017-2018.
M+K building	High	No	Yes - small amounts of guano.	Determine seasonal use. Next survey in winter 2017-2018.
Copco No. 1 and No. 2 Dams and Facilities				
Schoolhouse	Low	No	No	No additional survey needed.
House 19038 (next to schoolhouse)	High	No	Yes - abundant guano in crawlspace.	Determine seasonal use. Next survey in winter 2017-2018.
Vacant House 1 (tan)	High	Yes	Yes - small numbers of bats present under wood panels outside.	Determine seasonal use. Next survey in winter 2017-2018.
Vacant House 2 (blue)	High	Yes	Yes - small numbers of bats present under wood panels outside.	Determine seasonal use. Next survey in winter 2017-2018.

Building Name	Suitability for Roosting[1]	Live Bats Present?	Evidence of Bats Found?	Survey Recommendation
Vacant House 3 (yellow)	High	Yes	Yes - large colony in garage behind wood window framing, whole structure is being heavily used.	Determine seasonal use. Next survey in winter 2017-2018.
Vacant House 4 (peach)	High	Yes	Yes - colony between flashing & fascia board all around roof edge. Pups present.	Determine seasonal use. Next survey in winter 2017-2018.
Cookhouse	Moderate	Yes	Yes - bats present in awning over side door outside, no sign inside.	Determine seasonal use. Next survey in winter 2017-2018.
Bunkhouse	Moderate	No	Yes - guano on bed. Night roosting suspected from staining around outside lighting.	Emergence/re-entry survey.
Copco No. 1 Dam - C12 gatehouse	High	No	Yes - abundant guano/staining inside & out, dead bat (Myotis sp.) found outside on windowsill.	Emergence/re-entry survey.
Copco No. 1 powerhouse	High	Yes	Yes - several dozen bats clustered on wall above Transformer 3781; abundant staining/guano on basement level.	Determine seasonal use. Next survey in winter 2017-2018.
Tunnel outside of Copco No. 1 powerhouse	High	Unknown	Not inspected	Emergence/re-entry survey. Accompany future tunnel inspection.
Copco No. 2 Diversion Dam	Low	No	No	No additional survey needed.
Vacant House #21601 (light yellow house)	High	Yes	Yes - ~200 bats roosting in attic.	Determine seasonal use. Next survey in winter 2017-2018.
Shed (next to power station)	High	No	None found in main portion of shed. Back area of building was inaccessible.	Emergence/re-entry survey.
Vacant House (light blue)	Moderate	No	Yes - dead bat found in bathroom sink. No guano/staining inside. Attic vents are closed. No points of entry found.	No additional survey needed.

Building Name	Suitability for Roosting[1]	Live Bats Present?	Evidence of Bats Found?	Survey Recommendation
Tin Pumphouse (across from light blue house)	Low	No	No	No additional survey needed.
Tin Pumphouse at entrance to Copco Village	Moderate	No	Yes - small amount of guano outside. Multiple points of entry. Inside inaccessible.	Emergence/re-entry survey.
Copco No. 2 powerhouse	High	No	Yes - many dead bats on ground level (on floor, in storage room, control room) and dead pups at bottom of stairs on lower level. More sign/activity found at ground level.	Determine seasonal use. Next survey in winter 2017-2018.
Control Room at Copco No. 2 powerhouse	-	Unknown	Not inspected	Daytime inspection during future survey.
Shop next to powerstation at Copco No. 2	-	Unknown	Not inspected	Daytime inspection during future survey.
Occupied House next to Vacant House 4	-	Unknown	Not inspected	Daytime inspection during future survey.
Equipment shed (in front of bunkhouse/cookhouse)	-	Unknown	Not inspected	Daytime inspection during future survey.
Waste storage/wood shop by gas pumps (near houses/bunkhouse/cookhouse)	-	Unknown	Not inspected	Daytime inspection during future survey.
Iron Gate Dam and Facilities				
Gatehouse for low-level outlet (upstream side of dam)	Moderate	No	Yes - night roosting evidence outside. No sign found inside.	No additional survey needed.
Tunnel near Iron Gate powerhouse	High	Unknown	Not inspected	Emergence/re-entry survey. Accompany future tunnel inspection.
Iron Gate Powerhouse intake	High	Yes	Yes - from ground level, bats can be heard through grating below. Entry via open grate on outside. Two dead bats, abundant guano on plastic sheeting on floor inside.	Determine seasonal use. Next survey in winter 2017-2018.
Iron Gate Emergency Spill Equipment shed	Low	No	No	No additional survey needed.

Building Name	Suitability for Roosting[1]	Live Bats Present?	Evidence of Bats Found?	Survey Recommendation
Iron Gate Hydro Resources office/powerhouse	High	No	Yes - heavily used night roost by light fixture under stairwell (abundant staining on concrete wall). Sign of significant roost inside concrete shaft (heavy staining/guano). Confined space entry to bottom level of powerhouse, did not inspect.	Emergence/re-entry survey.
Bathroom/storage building near powerhouse	Moderate	No	No - multiple potential entry/exit points.	Emergence/re-entry survey.
Spawning building	Moderate	No	Yes - small amount of guano. Potential night roosting outside.	No additional survey needed.
2 storage trailers (parked next to each other)	Low	No	No	No additional survey needed.
Barn/garage at Iron Gate Village	High	Yes	Yes - bats present in rafters/ceiling, abundant guano.	Determine seasonal use. Next survey in winter 2017-2018.
Residence 1 (occupied) blue/gray	High	No	No (inspected outside only - inside/attic not accessed).	Daytime interior (attic) inspection during future survey.
Residence 2 (occupied) tan w/green roof	High	Yes	Yes - ~15 bats present behind clock on back porch. Attic access likely through loose screen over vent. Outside inspection only - inside/attic not accessed.	Daytime interior (attic) inspection during future survey.

[1]"Low" suitability for roosting was assigned to well-sealed structures with no points of entry/exit, and generally lacking cavities, crevices, and other external or internal features generally preferred by bats, such as roof spaces, soffits, fascias, weather boarding, spaces between roof felt/membrane and tiles/slates, window frames, cavity walls, flashing, and the like.

Chapter 5: Special Status Plants Measures

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5. SPECIAL STATUS PLANTS MEASURES

5.1 Objectives

Special status plants include those species with federal status (federally listed as threatened, endangered, or proposed and candidate species), state threatened, endangered, or candidate species, Oregon Natural Heritage Program Lists 1 and 2, and California Rare Plant Rank 1 and 2. KRRC will develop measures to avoid or minimize potential impacts for special status plants located within areas potentially subject to ground disturbance.

The 2012 EIS/R (Section 3.5) TER-4 described measures to reduce impacts on special status plants. The 2012 EIS/R recommended surveys to identify the locations of special status plants that may be affected by the dam removal project. KRRC has incorporated this measure into the Project and will be implemented as described in the following sections. Where occurrences of special status plants cannot be avoided, minimization measures such as propagation and establishment in new locations will be incorporated into the restoration plans. Other minimization measures may be developed in coordination with the USFWS, CDFW, and ODFW. This section describes the initial phase of this process.

5.2 Existing Information

PacifiCorp conducted focused surveys for special status plants from May through July 2002 at representative cross sections of all the major habitats and topographic features in the study area, particularly in areas with a high potential for supporting special status plants. Several sites were revisited later in 2002 and in 2003 (PacifiCorp 2004, Attachment A).

In addition to the findings of the PacifiCorp surveys, special status plant occurrences in the project area were identified through the following information sources: ORBIC, CNDDB, and the USFWS IPaC database.

KRRC obtained additional information on the occurrence of special status plants in the project area from USFWS (Yreka), BLM (Klamath Falls), and USFS (Klamath National Forest).

Table 5-1 presents the list of special status plants that have potential to occur in or near the limits of work. This is a preliminary list of species with potential to occur; KRRC may obatain additional information through further coordination with resource agencies.

5.3 Methods

KRRC conducted a field reconnaissance in July 2017. During the field reconnaissance, biologists visited proposed limits of work to assess the potential for suitable habitat for special status plants. The biologists considered existing information from biological survey data and reports completed at or near the project area (e.g., surveys conducted by PacifiCorp in 2001-2003), and data obtained from a desktop review of existing databases (CNDDB, ORBIC, and California Native Plant Society).

During the field reconnaissance, KRRC gathered qualitative information on habitats present and determined access for surveys. KRRC noted the potential presence of wetlands and other sensitive natural communities within the limits of work for future investigation during the spring and summer of 2019. Biologists also examined whether changes to existing conditions since the PacifiCorp surveys were conducted, including wildfires, development, agriculture and grazing, and logging activities.

Focused surveys are underway in 2018. KRRC completed the first survey in early to mid-May. KRRC will complete the second survey in mid-July. KRRC will conduct an additional survey in mid-April 2019 to encompass the range in bloom times for species with the potential to occur in the project area.

KRRC is conducting focused surveys for special status plants in areas where ground disturbing activities will occur for the Project. Surveys are following the CDFW "Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities," as described further below. In areas outside of ground disturbing activities but along reservoir shorelines and other areas where changes in hydrology and geomorphology will occur due to the Project, KRRC will focus surveys on the locations of known and potential occurrences of special status plants as shown in Table 5-1.

KRRC biologists will familiarize themselves with the morphological and habitat characteristics of the species with potential to occur within the project area. To the extent feasible, KRRC will visit reference populations prior to field surveys or field survey crews will include at least one member who has seen the target species growing in their natural habitat. Surveys will coincide with plant bloom times, as shown in Table 5-1.

In accordance with the CDFW protocol, KRRC is conducting floristic surveys where ground disturbing activities will occur for the Project, identifying every plant taxon that occurs to the taxonomic level necessary to determine rarity and listing status. Floristic surveys are underway in 2018 at proposed disposal sites (including a 100-meter buffer around each) and within 10 meters of access and haul roads. Within proposed disposal sites, biologists walk parallel transects spaced 5 to 10 meters apart; transect spacing is varied as needed based on visibility and type of habitat present.

KRRC records GPS coordinates of all observed special status plants found such that a protection plan may be developed in coordination with the regulatory agencies. If special status plants cannot be avoided during construction, the restoration plan will evaluate the potential for seed collection and propagation at local nurseries for replanting and/or as part of a seed mix to be used during restoration activities. Relocation of special status plants is not recommended by agency personnel.

5.4 Summary of Special Status Plant Survey Methods

In summary, special status plant surveys are underway in 2018 and entail the following:

- Detailed floristic surveys for special status plants within the areas where ground disturbing activities will occur for the Project following the CDFW “Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities”
- Focused surveys for the special status plants listed in Table 5-1 in areas such as reservoir shorelines where changes in hydrology and geomorphology will occur due to the Project.

5.5 Avoidance and Minimization Measures

- If any special status plants are found to occur within areas where ground disturbing activities will occur for the Project, and it is determined that the special status plants cannot be preserved in place, a combination of relocation, propagation, and establishment of new populations in designated conservation areas within the project area may be implemented, as determined in coordination with the resource agencies.
- The restoration plans being developed for both reservoir and non-reservoir areas will include provisions for the establishment of special status plants, if any are found within the project area.
- To minimize the potential for invasive plants to recolonize and infest disturbed areas, measures will be implemented to clean construction vehicles and equipment where feasible to remove pathogens, invasive plant seeds, or plant parts and dispose of them in an appropriate disposal facility.

5.6 References

PacifiCorp. 2004. Final Technical Report. Klamath Hydroelectric Project (FERC Project No. 2082), Terrestrial Resources. PacifiCorp, Portland, Oregon. February.

USBR and CDFW. 2012. Klamath Facilities Removal. Final Environmental Impact Statement/Environmental Impact Report (EIS/R). U.S. Bureau of Reclamation and California Department of Fish and Wildlife, December.

Table 5-1 Preliminary List of Special Status Plants with Potential to Occur in or near the Limits of Work

Species	Status	Habitat	Location of Documented Occurrence(s)	Bloom Time	Proposed Survey Effort
Greene's mariposa-lily *Calochortus greenei*	BLM, OC, ONHP List 1, CNPS List 1B	Occurs primarily in annual grassland, wedgeleaf ceanothus chaparral, and oak and oak-juniper woodlands.	Several locations around Iron Gate Reservoir	May through July	Within limits of work in suitable habitat
Bristly sedge *Carex comosa*	ONHP List 2	Marshes, lake shores, and wet meadows.	East shore of J.C. Boyle Reservoir in 2 locations (east of Dam and south of Highway 66); also west of Dam	May- September	Along reservoir margins and within limits of work in suitable habitat
Mountain Lady's Slipper *Cypripedium montanum*	ONHP List 4, CNPS List 4	Dry, open conifer forests, more often in moist riparian habitats	J.C. Boyle peaking reach (location details unknown)	March- August	Within limits of work in suitable habitat
Gentner's fritillary *Fritillaria gentneri*	FE, CNPS List 1B	Cismontane woodland, chaparral. Mixed hardwood-conifer vegetation dominated by Oregon oak.	Habitat present in the reach along Copco and Iron Gate Reservoirs. No known locations.	Late March to early April; April- May at higher elevations	Within limits of work in suitable habitat
Bolander's sunflower *Helianthus bolanderi*	BLM, ONHP List 3	Occurs in yellow pine forest, foothill oak woodland, chaparral, and occasionally in serpentine substrates or wet habitats.	South of Iron Gate Reservoir near proposed disposal site, J.C. Boyle peaking reach (location details unknown)	June-October	Within limits of work in suitable habitat
Bellinger's meadow-foam *Limnanthes floccosa ssp. bellingerana*	BLM, OC, ONHP List 1, CNPS List 1B	High elevation vernal pools located in shallow soiled rocky meadows in spots that are at least partially shaded in the spring.	J.C. Boyle peaking reach (location details unknown)	April-June	Within limits of work in suitable habitat
Detling's silverpuffs *Microseris laciniata* ssp. *detlingii*	CNPS List 2	Chaparral and grassy openings among Oregon white oak trees.	One location on west side of Iron Gate Reservoir	May-June	Within limits of work in suitable habitat

Species	Status	Habitat	Location of Documented Occurrence(s)	Bloom Time	Proposed Survey Effort
Egg Lake monkeyflower *Mimulus pygmaeus*	CNPS List 4	Occurs in damp areas or vernally moist conditions in meadows and open woods.	East of J.C. Boyle Reservoir in 2 locations (north of Highway 66 and southeast of Dam); west of Dam in two locations in damp mudflats; also west of canal near access road in one location	May- August	Along reservoir margins and within limits of work in suitable habitat
Holzinger's orthotrichum moss *Orthotrichum holzingeri*	CNPS List 1B.3	Found on vertical calcareous rock surfaces and at the bases of Salix bushes just above rock that is frequently inundated by seasonally high water in dry coniferous forests.	Just upstream of Iron Gate Reservoir on Jenny Creek.		Where in-stream work will occur at Jenny Creek at bridge
Red-root yampah *Perideridia erythrorhiza*	BLM, OC, ONHP List 1	Occurs in moist prairies, pastureland, seasonally wet meadows, and oak or pine woodlands, often in dark wetland soils and clay depressions.	Along 3 drainages into west side of J.C. Boyle Reservoir and in 2 locations west of canal near access road	Mid July - August	Along reservoir margins and within limits of work in suitable habitat
Howell's yampah (Howell's false caraway) *Perideridia howelii*	ONHP List 4	Moist meadows, stream banks.	One location along drainage southeast of J.C. Boyle Reservoir; one location along north side of Copco Lake north of road	July- August	Along reservoir margins and within limits of work in suitable habitat
Yreka phlox *Phlox hirsuta*	FE, CE, CNPS List 1B	Open areas on dry serpentine soils and is found at elevations ranging from 2,500 to 4,400 feet.	Not known to occur near limits of work. No suitable ultramafic soils occur within 0.5 miles of limits of work (NRCS 2017).	March- April	None- suitable soils not present within limits of work

Species	Status	Habitat	Location of Documented Occurrence(s)	Bloom Time	Proposed Survey Effort
Strapleaf willow *Salix ligulifolia*	ONHP List 3	Riverbanks, wetlands, floodplains	One location west of J.C. Boyle Dam in a boulder flood channel in dam release zone	March- June	Along reservoir margins and within limits of work in suitable habitat
Fleshy sage *Salvia dorrii* var. *incana*	CNPS List 3	Occurs in silty to rocky soils in great basin scrub, pinyon, and juniper woodland.	3 locations around Iron Gate Reservoir	May- July	Within limits of work in suitable habitat
Pendulous bulrush *Scirpus pendulus*	BLM, ONHP List 2, CNPS List 2	Occurs along streambanks and in wet meadows.	One location along Fall Creek	June-August	Along reservoir margins and within limits of work in suitable habitat
Lemmon's silene *Silene lemmonii*	ONHP List 3	Open pine woodlands	J.C. Boyle peaking reach to J.C. Boyle Reservoir (location details unknown)	Spring-Summer	Within limits of work in suitable habitat
Western yellow cedar *Callitropsis nootkatensis*	Petitioned for federal listing, CNPS List 4.3	Wet to moist sites, from the coastal rainforests to rocky ridgetops near the timberline in the mountains.	Not documented during PacifiCorp surveys or listed on CNDDB or ORBIC for the project area. May occur based on information from USFWS Yreka office (May 23, 2017).		Within limits of work in suitable habitat

Key:

BLM	Bureau of Land Management sensitive species -species that could easily become endangered or extinct.
CE	California Endangered
CNPS List 1A	California Native Plant Society (CNPS)-Presumed extinct in California.
CNPS List 1B	rare, threatened, or endangered in California and elsewhere.
CNPS List 2	rare, threatened, or endangered in California, but more common elsewhere.
CNPS List 3	on the review list -more information needed
CNPS List 4	on the watch list -limited distribution
FE	Federal Endangered
OC	Candidate listing by Oregon Department of Agriculture (ODA)
ONHP List 1	Oregon Natural Heritage Program (ONHP) threatened with extinction or presumed to be extinct throughout their entire range
ONHP List 2	threatened with extirpation or presumed to be extirpated from the State of Oregon
ONHP List 3	more information is needed before status can be determined, but may be threatened or endangered in Oregon or throughout their range
ONHP List 4	of conservation concern but not currently threatened or endangered

Chapter 6: Vegetation Communities and Wetlands Measures

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6. VEGETATION COMMUNITIES AND WETLANDS MEASURES

6.1 Objectives

This section describes the proposed approach for mapping vegetation communities and assessing wetlands prior to the start of construction activities. The purpose of vegetation community and wetlands mapping is to identify the location and extent of wetlands and other natural communities, including rare natural communities that may be affected by the Project. KRRC will also use vegetation community mapping to identify suitable habitat for special status species (plants and wildlife). KRRC will also identify communities dominated by invasive plant species to aid in developing procedures to avoid or minimize their spread to areas without invasive plant infestations.

Based on the information in the 2004 PacifiCorp report, the 2012 EIS/R (Section 3.5) identified potential impacts on 244.4 acres of wetland and riparian habitat and TER-5 to provide compensatory mitigation. However, the 2012 EIS/R also identified that PacifiCorp estimated that 272 acres of wetland and riparian habitat would become re-established in the event of dam removal (as defined in Appendix I). If the Project does not result in a net loss of wetland and riparian habitat, then KRRC will not prepare a compensatory mitigation plan. The Project will comply with regulatory requirements in delineating wetlands and evaluating potential impacts to acreage and functions. The Project's design and construction planning will incorporate avoidance and minimization measures to the maximum extent practicable. The restoration plans for the reservoir and non-reservoir areas will both include design for wetland and riparian habitat restoration as appropriate to result in no net loss of wetland or riparian habitat functions.

6.2 Existing Information

6.2.1 Vegetation Communities

PacifiCorp mapped existing vegetation cover types/wildlife habitat within a primary study area of 0.25 miles surrounding the reservoirs, facilities, and river reaches. Vegetation community maps are found in PacifiCorp (2004).

The vegetation classification system was based on the California Wildlife Habitat Relations System (CWHRS) and refined through coordination with the Terrestrial Resources Work Group, consisting of representatives from several state and federal agencies. The classification scheme, including the dominant species of each cover type, is described in PacifiCorp (2004) Additional data, including the species frequency and abundance for the sampled vegetation cover types, are provided in the PacifiCorp (2004).

Preliminary vegetation polygons were delineated by PacifiCorp in 2001 using aerial and infrared photography and other mapped information. The minimum mapping unit for upland types was approximately 1 acre (0.4 hectare [ha]). More unique types such as riparian areas and wetlands were delineated as small as possible (approximately 0.1 acre and 0.4 ha, respectively). Polygon delineations and vegetation cover maps were field verified in 2001 (PacifiCorp 2004).

Further characterization of each cover type was conducted in 2002 (PacifiCorp 2004). This characterization consisted of sampling randomly selected polygons (295 of the 2,900 polygons in the study area), with greater emphasis on wetlands and riparian habitats. Sampling consisted of estimates of areal foliar cover by cover class for each species in each of the vegetation layers (i.e., tree, shrub, and herb layer); the areal cover and height of each vegetation layer in the plot; the aspect; and the slope. The number of living trees was tallied and the tree DBH was recorded. The amount of dead wood in the plot was assessed by collecting data on coarse woody debris, snags, and wood cover for pieces greater than 4 inches (10 centimeters [cm]) in diameter.

Since the 2012 EIS/R was published, there have not been any significant changes in habitats within the limits of work. Based on a review of historical aerial photography conducted by CDM Smith in 2018, timber harvest has been conducted in several locations within 0.5 miles of the limits of work in the J.C. Boyle portion of the project area. These timber harvests have occurred since the PacifiCorp habitat and species surveys were conducted in 2001-2003. The analysis of historical imagery noted that logging and forest thinning occurred in late summer/fall of 2003 and between 2003 and 2005 in the vicinity of the J.C. Boyle Reservoir and east of the Klamath River canyon between the J.C. Boyle Dam and the powerhouse. Although these habitat alterations have the potential to reduce habitat suitability for some species, they are located outside of the limits of work and are not on PacifiCorp land. KRRC did not identify major wildfires or other significant habitat alterations in the project area since the PacifiCorp surveys.

The following sections describe the vegetation communities observed within the proposed limits of work and areas surrounding the reservoirs during the July 2017 site reconnaissance.

J.C. Boyle

The J.C. Boyle Reservoir is approximately 420 acres of open water situated within Klamath mixed conifer forest dominated by ponderosa pine (*Pinus ponderosa*), with Douglas-fir (*Pseudotsuga menziesii*) also common. North of Highway 66, the reservoir supports a broad, shallow emergent marsh along both edges supporting a large community of bulrush (*Schoenoplectus* spp.) and aquatic vegetation including pondweeds (*Potamogeton* spp.) and coontail (*Ceratophyllum demersum*) along the eastern shoreline. Sportsmen's Park is located just east of this marsh and provides limited access. South of Highway 66, the reservoir is relatively narrow with forested upland slopes and some flatter areas that support wetland patches of bulrush, cattail (*Typha* spp.), and rushes (*Juncus* spp.) along the shoreline.

Developed areas associated with the dam and power facilities consist of annual grasses dominated by cheatgrass (*Bromus tectorum*) and other non-native species. Vegetation around recreational areas consist primarily of scattered ponderosa pine and Douglas-fir.

The proposed J.C. Boyle disposal site is located adjacent to a high-power transmission line corridor. A portion of the site was likely used as a borrow site during dam construction. The majority of the area is heavily disturbed and consists of bare ground used for ATV recreation. KRRC also observed evidence of cattle grazing. Several depressions support dense stands of coyote willow (*Salix exigua*) in some areas, while others are sparsely vegetated with herbaceous vegetation including cudweed (*Gnaphalium palustre*), Bach's calicoflower (*Downingia bacigalupii*), and Bermuda grass (*Cynodon dactylon*).

A portion of the proposed disposal site is located within a deep ravine that supports a dispersed mixed chaparral/sagebrush scrub community consisting of antelope bitterbrush (*Purshia tridentata*), deerbrush (*Ceanothus integerrimus*), big sagebrush (*Artemisia tridentata*), gray rabbitbrush (*Chrysothamnus nauseosus*), greenleaf manzanita (*Arctostaphylos patula*), and serviceberry (*Amelanchier alnifolia*). Herbaceous species observed in this area include nettleleaf horsemint (*Agastache urticifolia*), parched willowherb (*Epilobium brachycarpum*), needle navarretia (*Navarretia intertexta*), lupine (*Lupinus argenteus*), yarrow (*Achillea millefolium*), bull thistle (*Cirsium vulgare*), cheatgrass, and other non-native grasses. KRRC noted a narrow drainage channel t the bottom of the ravine. The channel was dry during the July 2017 site reconnaissance.

Downstream of the J.C. Boyle Dam, the Klamath River runs through a narrow canyon with steep, forested slopes and exposed rock cliffs and talus slopes in many areas. Reed canarygrass (*Phalaris arundinacea*) dominates the Klamath River shoreline downstream of the dam. Water from the reservoir is conveyed through an approximately 2.2-mile long power canal located along a bench cut in the face of the river canyon. The canal is a concrete flume approximately 17-feet wide and 12-feet high and single-walled in places, supporting patches of arroyo willow (*Salix lasiolepis*) and other riparian vegetation on the uphill side of the channel in some areas along its route to the forebay.

Vegetation on the slopes surrounding the J.C. Boyle powerhouse, including the former access roads to the penstocks, consists of an open forest of Oregon oak and conifers with mixed chaparral/sagebrush vegetation.

Copco

The Copco No. 1 Dam is situated in a narrow canyon adjacent to exposed rock faces. The dam impounds an approximately 1,000-acre reservoir. Much of the reservoir shoreline is steeply sloped and consists of open Oregon oak (*Quercus garryana*) and western juniper (*Juniperus occidentalis*) woodland, with large expanses of annual and perennial grassland on the slopes north of the reservoir dominated by invasive yellow star-thistle (*Centaurea solstitialis*) and medusahead (*Taeniatherum caput-medusae*). Denser mixed oak-conifer forests are found along the slopes south of the reservoir. There is evidence of cattle grazing around the reservoir, and KRRC noted feral horses during the July 2017 reconnaissance.

Riparian habitat dominated by coyote willow and shining willow (*Salix lucida*) is primarily found where stream channels enter the reservoir. An area of seeps and springs supports a dense willow and hardwood forest along the slope on the northwest shore of the reservoir. Patches of emergent vegetation, including bulrush, cattail, and rushes, exist in areas where the shoreline topography supports areas of shallow water.

Copco No. 2 Dam is situated approximately 1/4-mile downstream of Copco No. 1 Dam, creating a narrow reservoir with steep sides. The north slope of this reach is developed with access roads to Copco No. 1 Dam, the powerhouse at the base of Copco No. 1 dam, and to Copco No. 2 Dam. The northern slope is vegetated with yellow star-thistle, non-native grasses, and scattered native forbs including giant blazing-star (*Mentzelia laevicaulis*). Exposed basalt outcrops form cliff faces on the northern slope. The southern slope is forested with willows, oaks, and conifers.

The proposed Copco disposal site is located on the slope north of Copco No. 2 Reservoir. The site is developed with a house and other structures. The topography of the site suggests it was used as a borrow site for dam construction. Vegetation at the site consists of yellow star-thistle, medusahead and other non-native grasses, weedy species such as mullein (V*erbascum thapsus*), and scattered sagebrush shrubs such as rabbitbrush. Two mature eastern arborvitae (*Thuja occidentali*s) trees and irrigated lawn surround the house.

Downstream of Copco No. 2 Dam, the river winds through a horseshoe-shaped canyon with steep exposed cliff faces along the northern slope. The large wooden Copco No. 2 penstock is located on a terrace above the south shore of the river. Vegetation along the southern bank is dominated by willows and white alder (*Alnus rhombifolia*). KRRC observed Himalayan blackberry (*Rubus armeniacus*), and poison oak (*Toxicodendron diversilobum*) in the understory.

Water leaking from the Copco No. 2 penstock supports wetland vegetation in several locations, including broadleaf cattail (*Typha latifolia*), water smartweed (*Polygonum amphibium*), and beggarstick (*Bidens frondosa*). Culverts drain these ponded areas down to the river. Open disturbed sites dominated by invasive yellow star-thistle are located along the penstock, including a large flat area at the eastern end that was likely created during the penstock construction.

Copco No. 2 powerhouse is situated along the southern bank of the river upstream of the Daggett Road crossing. Several residences and other structures are also located in this area, known as Copco Village. Vegetation is disturbed with irrigated lawns surrounding the structures.

The confluence of Fall Creek and the Klamath River is located just downstream of Copco Village and supports a willow riparian and emergent wetland vegetation community. The City of Yreka water supply line is located in this vicinity. Wetland vegetation includes hardstem bulrush and reed canarygrass. KRRC noted several weedy species including teasel (*Dipsacus fullonum*), curly dock (*Rumex crispus*), lambsquarters (*Chenopodium album*), and oxeye daisy (*Leucanthemum vulgare*) on the southern bank of the Klamath River in the vicinity of the City of Yreka water supply line.

Iron Gate

Iron Gate Reservoir consists of approximately 944 acres situated within open oak and juniper woodlands, similar to those found at Copco Lake. The reservoir shorelines are less steep than those of Copco Lake. Annual grasslands are dominated by invasive yellow star-thistle and medusahead, and there is evidence of cattle grazing in many areas. A single-lane bridge crosses the Klamath River downstream of the dam and provides access to the powerhouse and fish hatchery. Several structures, including two residences, are located on the north side of the river and are surrounded by irrigated lawns.

Several day-use sites and campgrounds are located around the reservoir. Vegetation within these areas consists primarily of Oregon oak, western juniper, willows, and chaparral/sagebrush scrub. KRRC onserved a few mature black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) and weeping willow (*Salix babylonica*). Dense willow riparian communities consisting of coyote and shining willow are associated with the mouths of Jenny, Scotch, and Camp creeks. Emergent wetland vegetation in these areas consists of hardstem bulrush, cattails, rushes, and other species.

The proposed Iron Gate disposal site consists of annual grassland dominated by yellow star-thistle and medusahead, with scattered forbs including barestem buckwheat (*Eriogonum nudum*), sunflower (*Helianthus* sp.), turkey mullein (*Eremocarpus setigerus*), and wild onion (Allium sp.). The site also supports open Oregon oak and western juniper woodlands, and chaparral communities dominated by wedgeleaf ceanothus (*Ceanothus cuneatus*) with three-leaf sumac (*Rhus trilobata*) also observed. The site appears to be used for target shooting and there is evidence of cattle grazing. The site may have been used as a borrow area during construction of the dam. A shallow drainage swale that runs south toward Bogus Creek was dry during the July 2017 site reconnaissance.

6.2.2 Invasive Species

As noted above, KRRC observed large infestations of invasive yellow star-thistle and medusahead adjacent to the Copco Lake and Iron Gate Reservoir and other disturbed areas. KRRC also observed Himalayan blackberry in localized areas, including along the Klamath River near the Copco No. 2 penstock. Reed canarygrass was dominant along most reaches of the Klamath River within the project area.

KRRC obtained additional information on invasive species in the J.C. Boyle project area from the BLM National Invasive Species Information Management System (NISIMS) database. Spatial data show large infestations of medusahead around the J.C. Boyle Reservoir, yellow star-thistle in the vicinity of the J.C. Boyle powerhouse, Scotch thistle (*Onopordum acanthium*) around the J.C. Boyle Dam, and common St. Johnswort (*Hypericum perforatum*) along the Klamath River canyon between the J.C. Boyle Dam and powerhouse. Other invasive species mapped in the J.C. Boyle area include diffuse knapweed (*Centaurea diffusa*), bull thistle, Canada thistle (*Cirsium arvense*), Scotch broom (*Cytisus scoparius* var. *scoparius*), Dyer's woad (*Isatis tinctorial*), and smallflower tamarisk (*Tamarix parviflora*).

6.2.3 Wetlands and Other Waters

Wetlands and riparian communities were mapped and field verified in 2002 during the vegetation community mapping described above (PacifiCorp 2004). PacifiCorp further characterized wetlands and riparian communities in 2002 to collect information on the species composition, general structural characteristics, and relative condition of existing wetland and riparian plant communities. This assessment considered the distribution of channel geomorphic types and hydrologic data. Riparian/wetland transects were established and sampled in 2002 and 2003. Data included plant cover, height, and tree and shrub regeneration estimates within 1-m by 4-m plots. Qualitative information on recreation, livestock, and wildlife use and erosion/deposition was also collected. These methods are described in PacifiCorp (2004).

PacifiCorp evaluated pre-construction and post-dam construction wetland and riparian conditions. The study concluded that, in general, the distribution of wetland and riparian habitat consisted of long, thin bands running along the historic Klamath River channel. In comparison, somewhat wider, but more widely scattered patches of these vegetation types exist along the present-day project reservoir shorelines. The analysis concluded that the area of wetland and riparian habitat is somewhat greater along the J.C. Boyle Reservoir under current conditions and that there is less area along the Copco Lake and Iron Gate Reservoir as compared to historical conditions (PacifiCorp 2004). KRRC anticipates that wetland and riparian areas similar to those that previously existed will become re-established along the restored Klamath River following restoration. In addition, KRRC expects the tributary riparian habitats to extend farther downstream as the currently drowned stream channels are restored. In addition to simple area considerations, the functions of wetlands and riparian areas along the river would be different from those on the fringes of a reservoir. As part of the permitting process, KRRC biologists will conduct a functional assessment of existing wetlands potentially affected by the Project and those expected to be restored by the Project.

KRRC did not conduct wetland surveys or focused delineations during the July 2017 site reconnaissance. Emergent wetlands are found along the fringes of the reservoirs in many places, and willow riparian habitat was observed to be primarily associated with streams and drainages that flow into the reservoirs. Each reservoir has several tributary streams and ephemeral drainages that could potentially contain wetlands.

At the J.C. Boyle disposal site, KRRC observed several depressions to support coyote willow, sedges, and rushes, indicating the potential presence of wetlands in some areas. KRRC noted a narrow drainage channel at the bottom of the deep ravine in the J.C. Boyle disposal area. The channel was dry during the July 2017 site reconnaissance. The reservoir is relatively narrow and shallow and contains many areas where the reservoir edge slopes gently toward the former river channel. These shallow reservoir areas have developed emergent wetland vegetation.

There were no potential wetlands within the disposal site at the Copco Dams. As described above, the Copco Lake is relatively steep-sided, but there are places where a narrow fringe of emergent wetland vegetation has become established. On the north side of the Copco Lake there are only a couple of streams that support riparian vegetation at the reservoir edge. There is more riparian vegetation along the south side of the Copco Lake, but it is also mixed with residential development and is not as strongly associated with tributary stream channels.

Downstream of the Copco No. 2 Dam, a large wooden penstock is located on a terrace above the south shore of the river. Water leaking from the Copco No. 2 penstock supports wetland vegetation in several locations, including broadleaf cattail (*Typha latifolia*), water smartweed (*Polygonum amphibium)*, and beggarstick (*Bidens frondosa*). Culverts drain these ponded areas down to the river. Open disturbed sites dominated by invasive yellow star-thistle are located along the penstock, including a large flat area at the eastern end that was likely created during penstock construction.

Narrow patches of emergent wetland vegetation along the edges of Iron Gate Reservoir consists of hardstem bulrush, cattails, rushes, and other species. Dense willow riparian communities consisting of coyote and shining willow are associated with the mouths of Jenny, Scotch, and Camp creeks on Iron Gate Reservoir. Road crossings of some of these riparian areas along Iron Gate are within the limits of work.

A shallow drainage swale that runs south toward Bogus Creek through the Iron Gate disposal site was dry during the July 2017 site reconnaissance. KRRC will evaluate the Iron Gate disposal site closely for wetland characteristics.

6.3 Methods

Surveys of vegetation communities, including wetlands and riparian habitats, and special status plants will initially focus on verifying the existing information collected by PacifiCorp and described above. Outside the limits of work, surveys will entail spot-checking of PacifiCorp mapping. KRRC will conduct more detailed surveys of wetlands and special status plants within the limits of work.

6.3.1 Field Reconnaissance

KRRC conducted a field reconnaissance in July 2017. During the field reconnaissance, KRRC biologists visited proposed limits of work to gather qualitative information on habitats present, determine access for future surveys, and identify proposed survey transects and/or survey points on aerial photos. Biologists noted areas with the potential to support wetlands and other sensitive natural communities within the limits of work. KRRC biologists also looked for evidence of changes to existing conditions since the PacifiCorp surveys were conducted, including wildfires, development, agriculture and grazing, and logging activities.

6.3.2 Vegetation Communities

Eight vegetation cover types were mapped by PacifiCorp (2004), and each cover type was further sub-classified. The results of the 2004 mapping are available in the PacifiCorp Terrestrial Resources report.

During the field reconnaissance survey, KRRC noted that current conditions did not match the 2004 PacifiCorp mapping data in some places. KRRC will update vegetation community maps as needed to reflect existing conditions. KRRC will conduct initial verification through comparison with current aerial photography to produce updated maps.

Field verification will include visual observation of representative portions of each vegetation community within 0.25 miles of the limits of construction around the dams and facilities, access and haul roads, and disposal sites. Surveyors will traverse the areas on foot and/or by boat to verify that the vegetation classification described in the PacifiCorp 2004 report is still accurate. Biologists will use binoculars in areas with limited access such as along steep slopes adjacent to roads.

KRRC will produce a crosswalk table that compares the classification system used in the 2004 report to other classifications (e.g., Manual of California Vegetation) to align the PacifiCorp data with current regulatory requirements. KRRC will also identify communities dominated by invasive plant species.

6.3.3 Wetlands

KRRC will delineate wetlands within the limits of construction around the dams and facilities, access and haul roads, and disposal sites in accordance with the 1987 U.S. Army Corps of Engineers (USACE) Wetland Delineation Manual and applicable Regional Supplements (i.e., Western Mountains, Valleys, and Coast Region and Arid West). Additionally, KRRC will use the Oregon Rapid Wetland Assessment Protocol (ORWAP) to assess functional values of wetlands.

PacifiCorp's mapping of wetlands and riparian habitats adjacent to reservoirs and/or associated with streams but outside the direct limits of work will be field verified by traversing the areas on foot and/or by boat, using binoculars as needed. KRRC will map previously unidentified wetlands and riparian habitats observed adjacent to reservoirs but outside the limits of work and described consistent with the PacifiCorp vegetation classification system described above. KRRC will map the boundaries of wetlands outside of the limits of work based on observed changes in vegetation, topography, and hydrology, but these areas will not be formally delineated.

6.4 Survey Plan Summary

KRRC's mapping of vegetation communities and wetlands will be complete by 2019 and will entail the following:

- Desktop verification of the PacifiCorp vegetation community mapping based on comparison with current aerial photography for the project area. KRRC will produce new maps for field verification.
- Field verification of PacifiCorp mapping of a representative portion of each vegetation community within 0.25 miles of the limits of construction around the dams and facilities, access and haul roads, and disposal sites.
- Map areas dominated by invasive species within the project area.
- Delineation of wetlands and riparian habitats within areas that will be affected by ground disturbing activities in accordance with regulatory requirements.

- Field verification of PacifiCorp mapping of wetlands and riparian habitats adjacent to reservoirs and/or associated with streams but outside the areas that will be affected by ground disturbing activities.
- Map previously unidentified wetlands and riparian habitat noted adjacent to reservoirs but outside areas that will be affected by ground disturbing activities.

6.5 Avoidance and Minimization Measures

The Project will comply with regulatory requirements in delineating wetlands and sensitive vegetation communities and evaluating potential impacts to acreage and functions. The project design and construction planning will incorporate avoidance and minimization measures to the maximum extent practicable.

- KRRC will incoirporate the results of the wetland delineation into the project design to avoid and minimize direct impacts on wetlands to the maximum extent practicable. Potential measures might include redesign of the construction footprint where ground disturbing activities will occur or location of access and staging areas, or redesign of fill slopes to avoid wetland areas.
- KRRC's contractor will fence wetland areas adjacent to the areas where ground disturbing activities will occur with orange plastic snow fencing to demarcate work areas and prevent inadvertent impacts.
- The restoration plans developed for both reservoir and non-reservoir areas will include provisions for the establishment of wetland and riparian areas and other sensitive vegetation communities within the project area to result in no net loss of habitat acreage and functions.
- KRRC will monitor wetlands and other sensitive vegetation communities established in restored areas for up to five years or as required by permit requirements. KRRC will identify specific performance measures in the restoration plans and approved by the regulatory agencies.

To reduce potential impacts on water quality in wetlands and other surface waters during construction (for example, the wetlands around the confluence of Fall Creek and the Klamath River), KRRC will implement the following construction best management practices.

- KRRC's contractor will implement Pollution and erosion control measures to prevent pollution caused by construction operations and to reduce contaminated stormwater runoff.
- KRRC's contractor will keep oil-absorbing floating booms onsite and will respond immediately to aquatic spills during construction.
- KRRC's contractor will keep vehicles and equipment in good repair, without leaks of hydraulic or lubricating fluids. If such leaks or drips do occur, KRRC's contractor will clean them up immediately. KRRC's contractor will confine equipment maintenance and/or repair to one location at each project construction site. KRRC's contractor will control runoff in this area to prevent contamination of soils and water.
- KRRC's contractor will implement dust control measures, including wetting disturbed soils.

- KRRC's contractor will implement a Storm Water Pollution Prevention Plan to prevent construction materials (fuels, oils, and lubricants) from spilling or otherwise entering waterways or water bodies.

6.6 References

California Department of Fish and Wildlife (CDFW). 2017. Notification of Lake or Streambed Alteration. Available at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=3773&inline.

Oregon Department of State Lands (ODSL). 2017. Oregon Rapid Wetland Assessment Protocol (ORWAP). Available at: http://www.oregon.gov/dsl/WW/Pages/ORWAP.aspx.

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USACE Environmental Laboratory. 1987. U.S. Army Corps of Engineers Wetlands Delineation Manual. Technical Report YL-87-1. U.S. Army Corps of Engineers, Waterways Experiment Station. Vicksburg, MS.

USBR and CDFW. 2012. Klamath Facilities Removal. Final Environmental Impact Statement/Environmental Impact Report (EIS/R). U.S. Bureau of Reclamation and California Department of Fish and Wildlife, December.

KLAMATH RIVER RENEWAL CORPORATION

Attachment A

Northern Spotted Owl Figures

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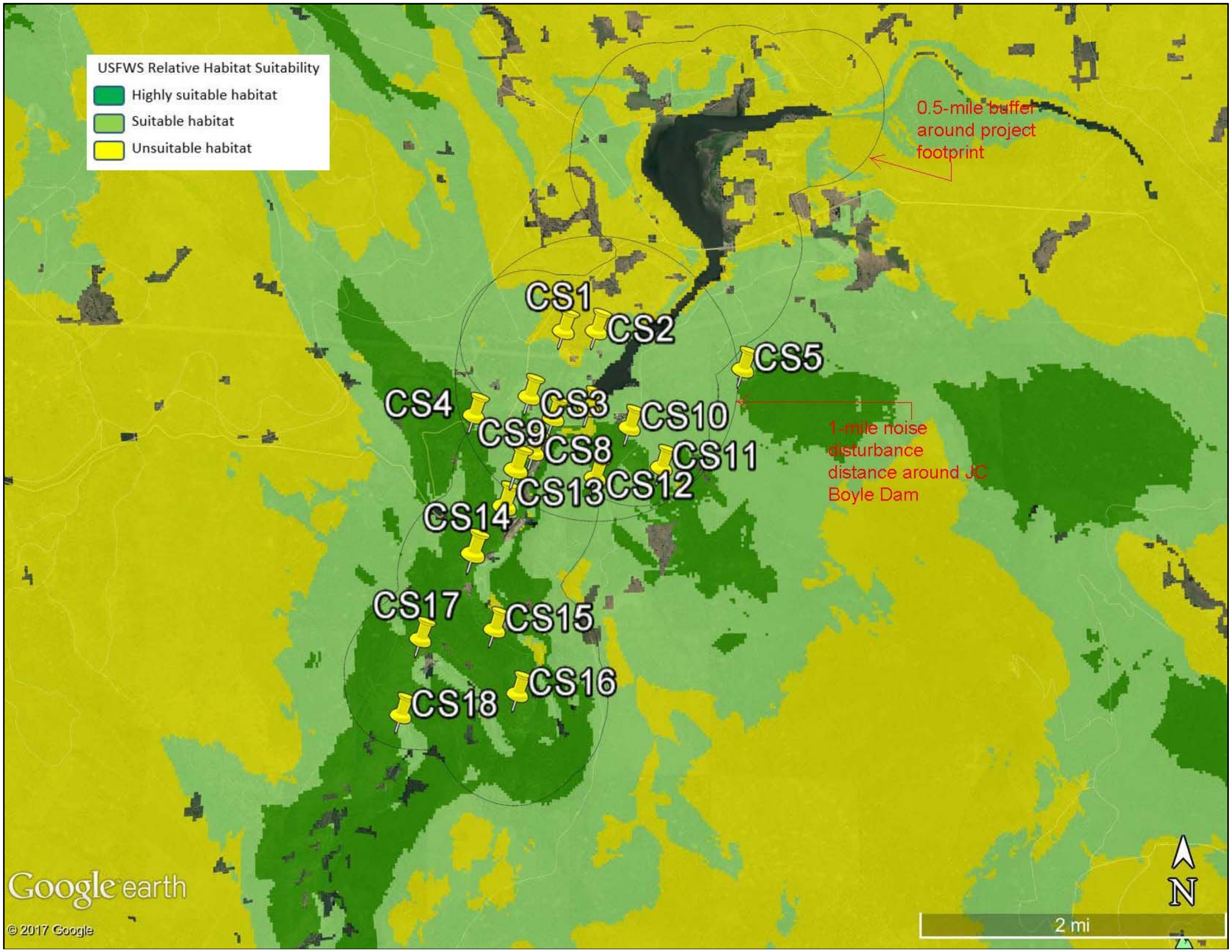
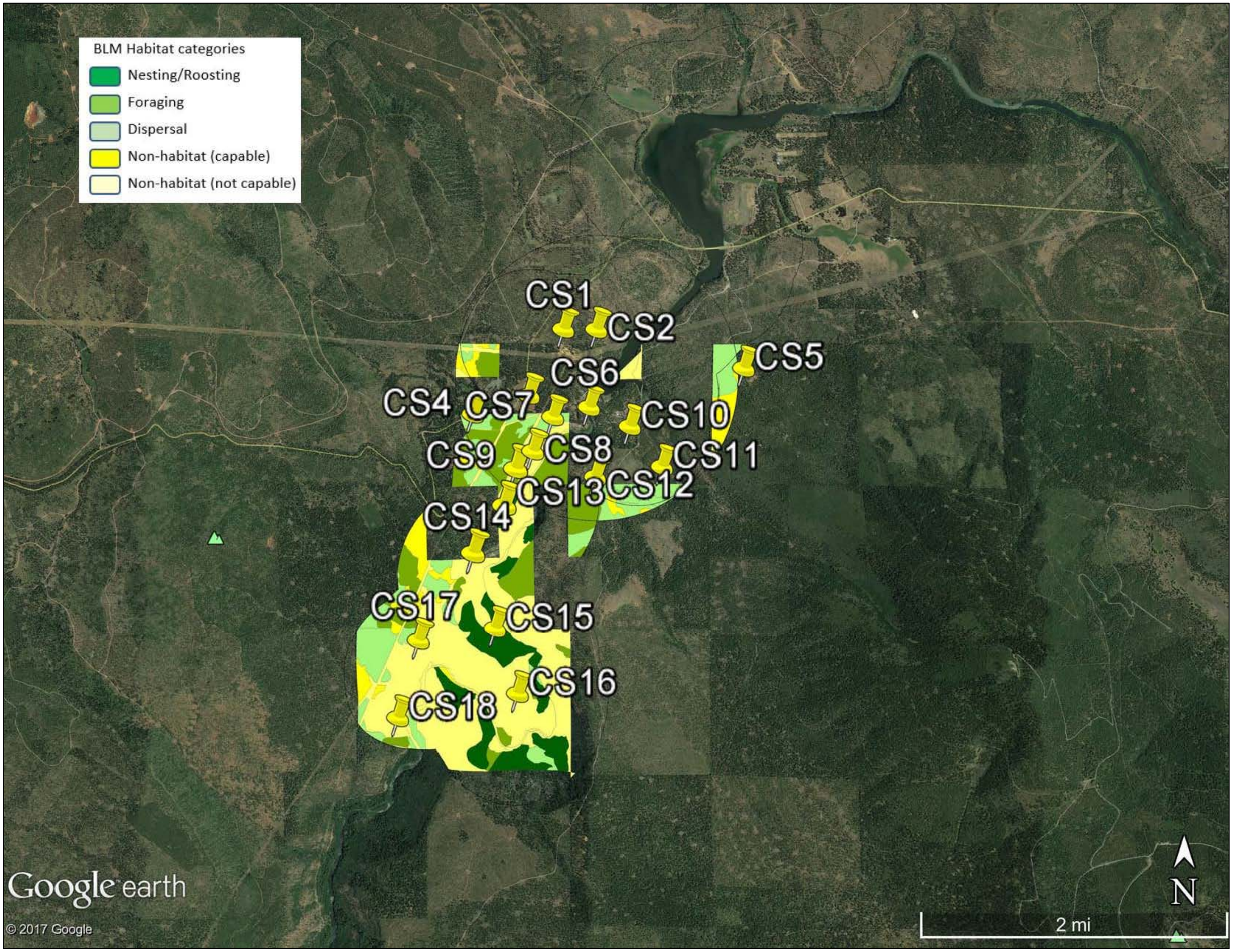


USFWS Habitat Layer

FIGURE 1: PRELIMINARY NSO CALLING STATIONS (USFWS HABITAT LAYER)

JC Boyle Project Area

Sheet 1 of 3

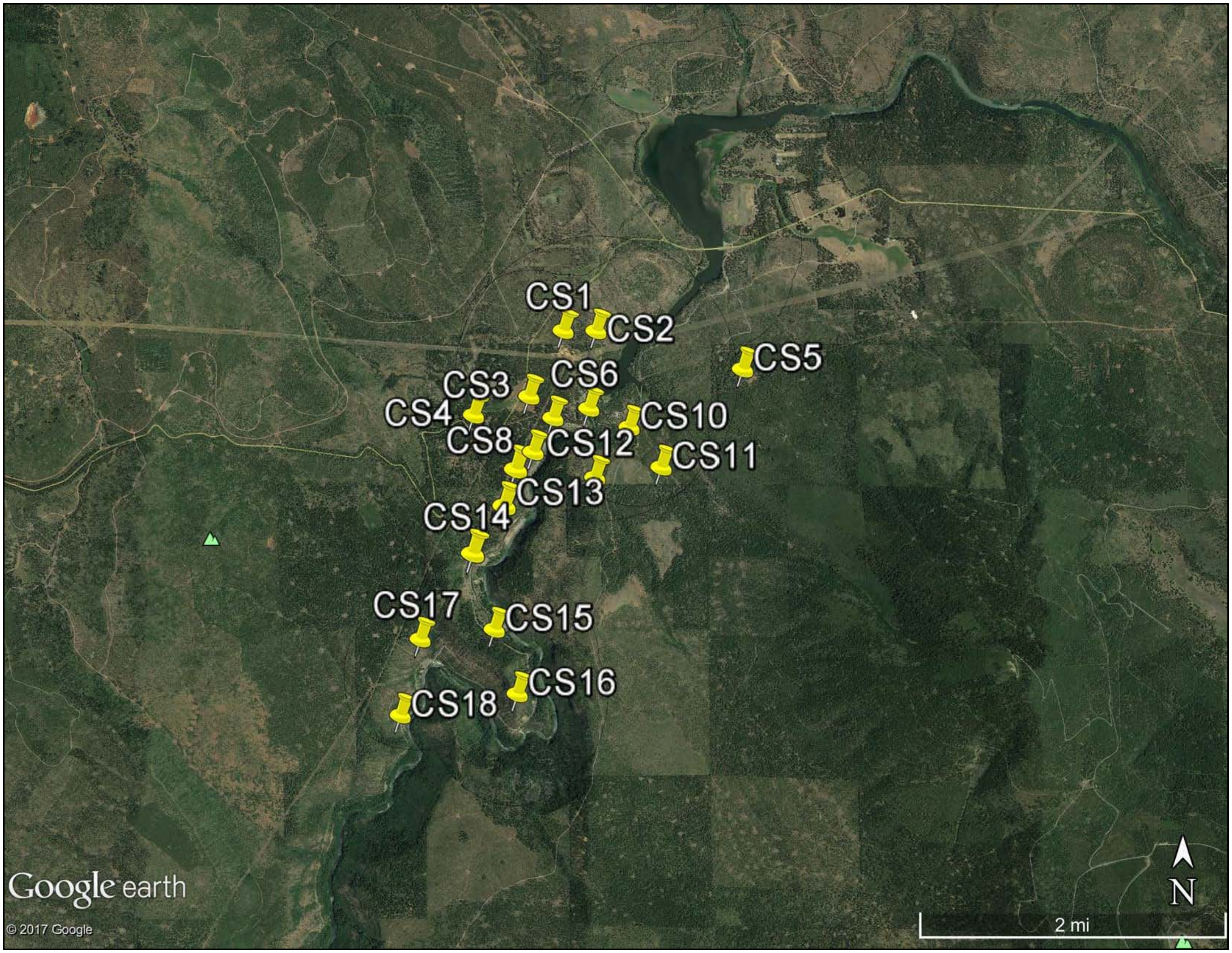


BLM Habitat Layer

Klamath River Renewal Corporation
Klamath River Renewal Project

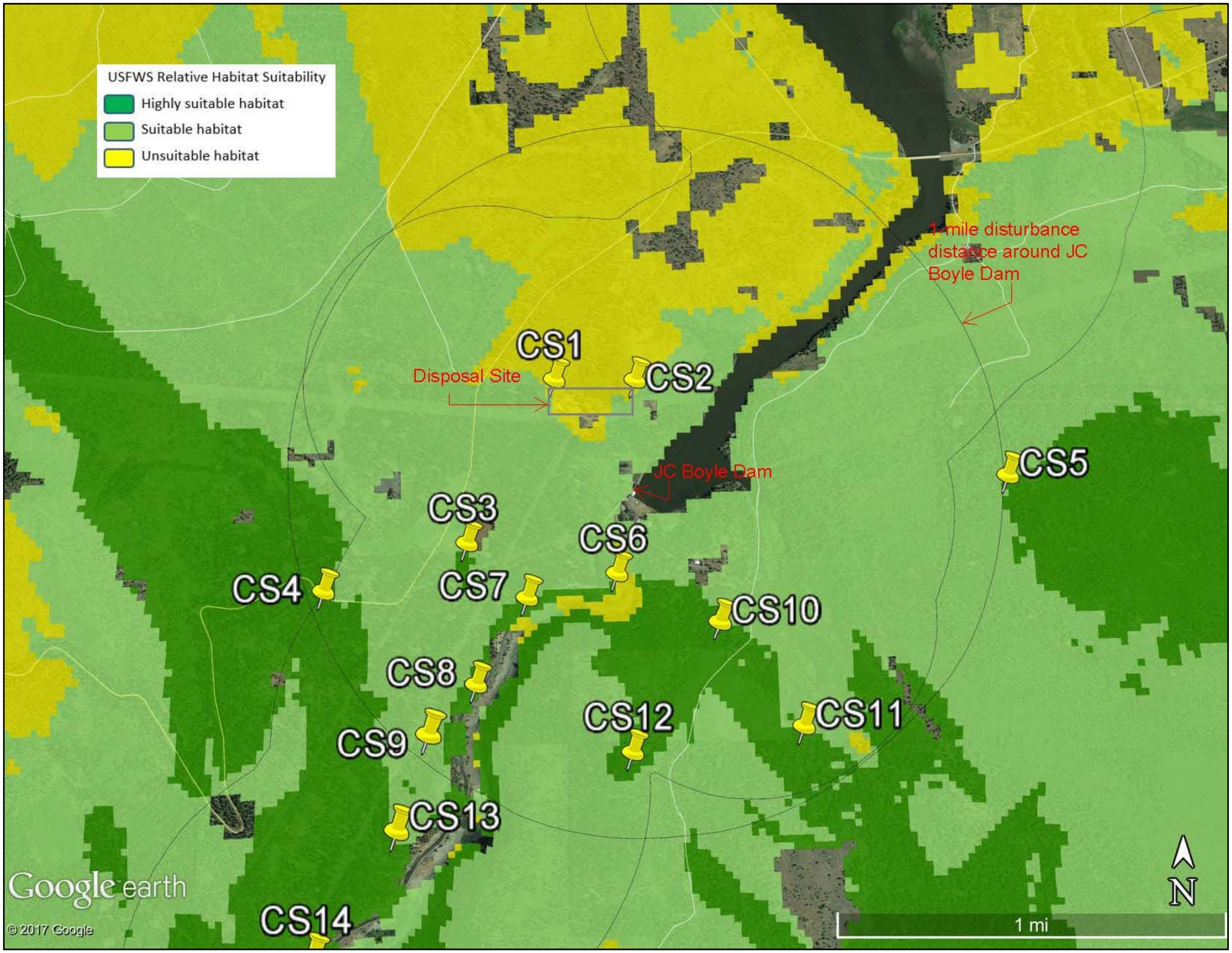
FIGURE 1: PRELIMINARY NSO CALLING STATIONS (BLM HABITAT LAYER)

JC Boyle Project Area
Sheet 2 of 3



Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 1: PRELIMINARY NSO CALLING STATIONS
JC Boyle Project Area
Sheet 3 of 3

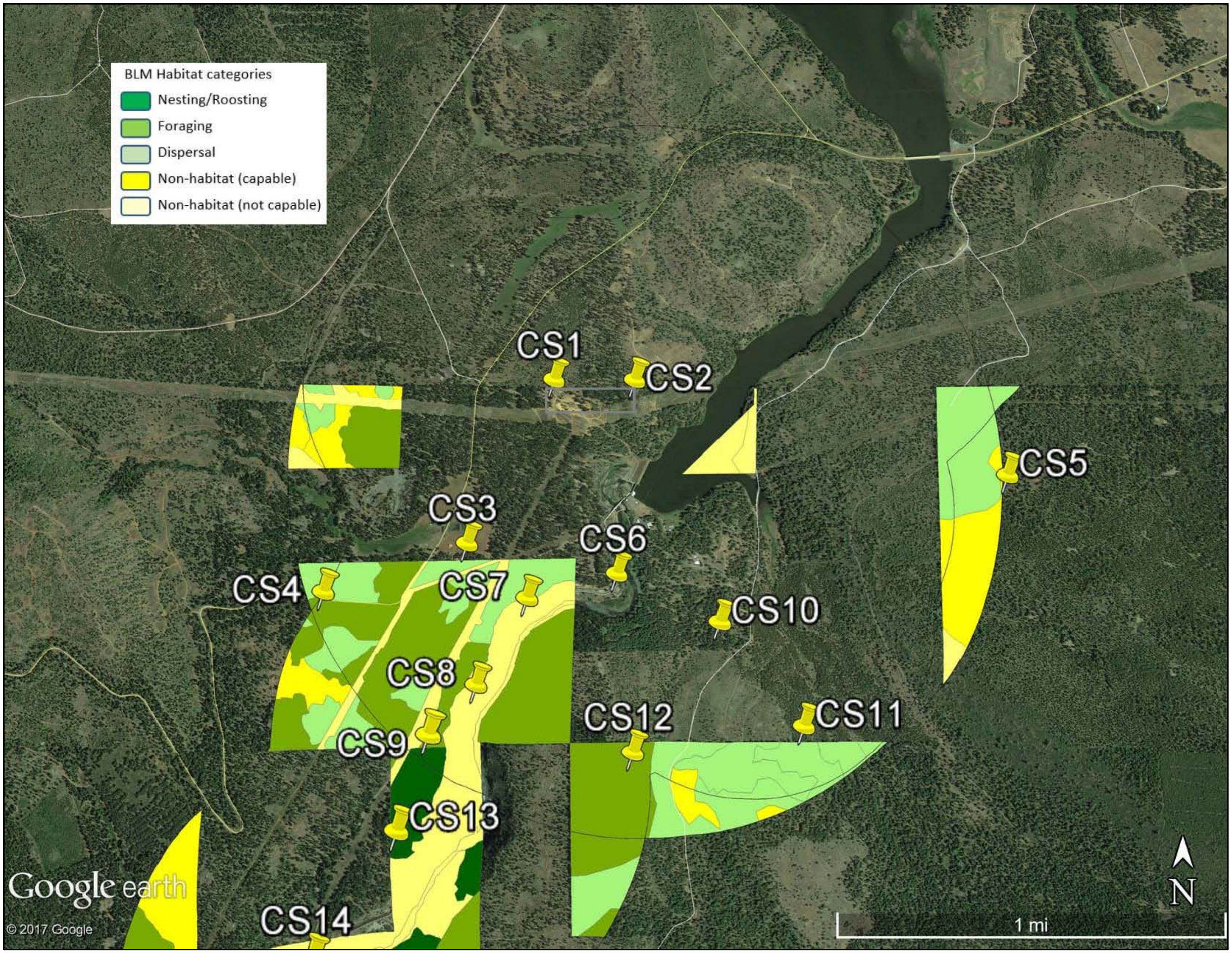


USFWS Habitat Layer

Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 2: PRELIMINARY NSO CALLING STATIONS (USFWS HABITAT LAYER)

JC Boyle Dam
Sheet 1 of 3



BLM Habitat Layer

FIGURE 2: PRELIMINARY NSO CALLING STATIONS (BLM HABITAT LAYER)

JC Boyle Dam
Sheet 2 of 3

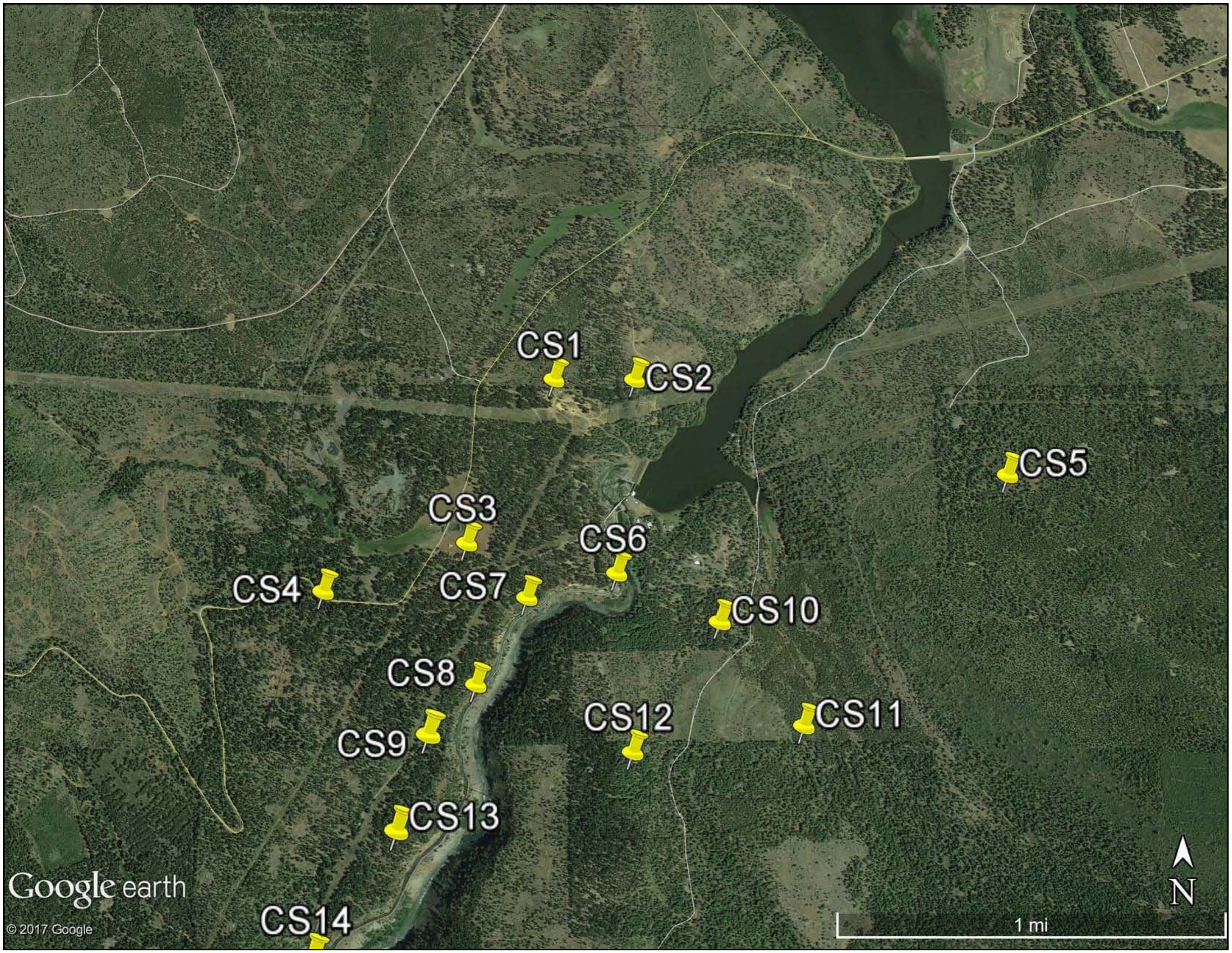
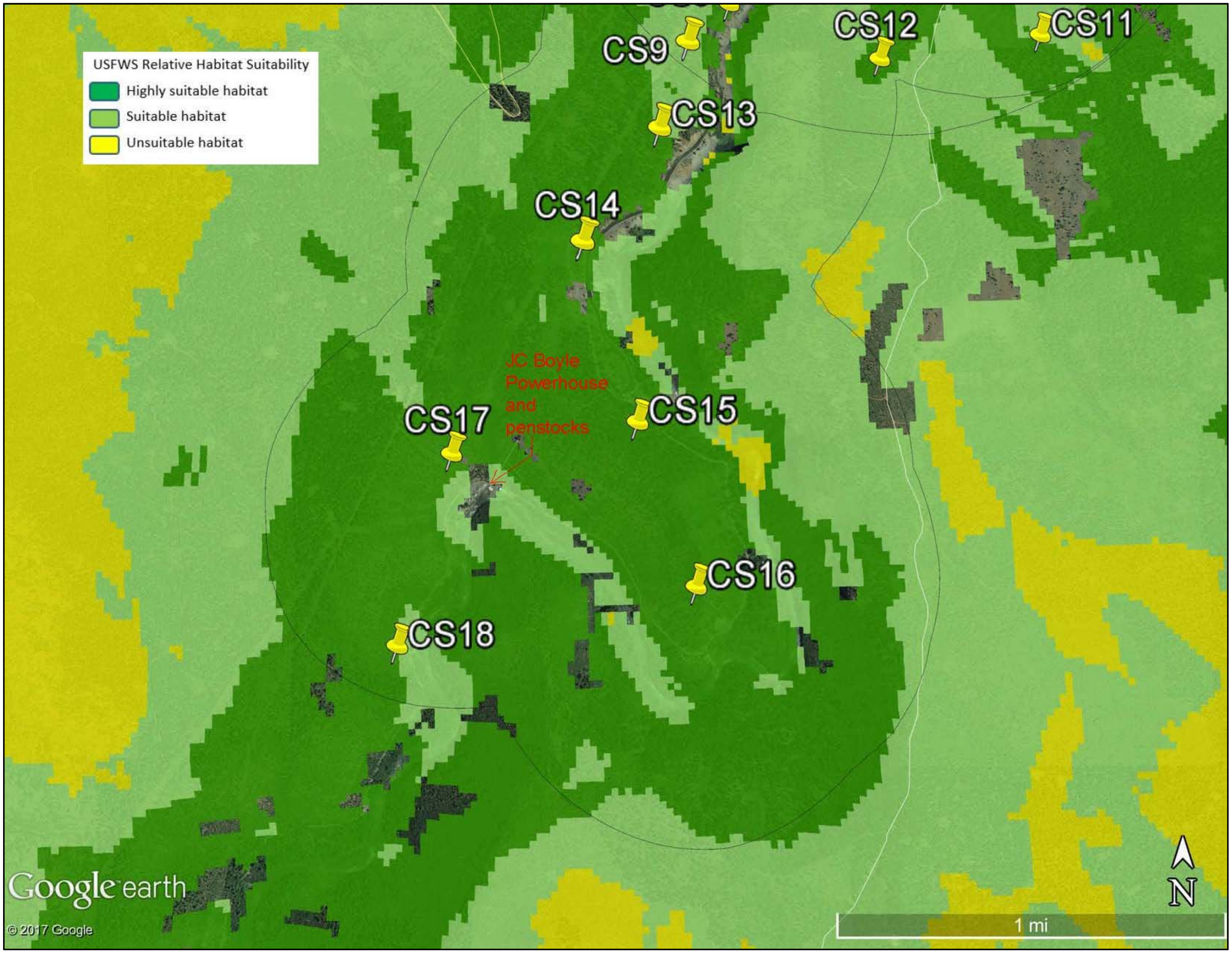


FIGURE 2: PRELIMINARY NSO CALLING STATIONS

JC Boyle Dam
Sheet 3 of 3

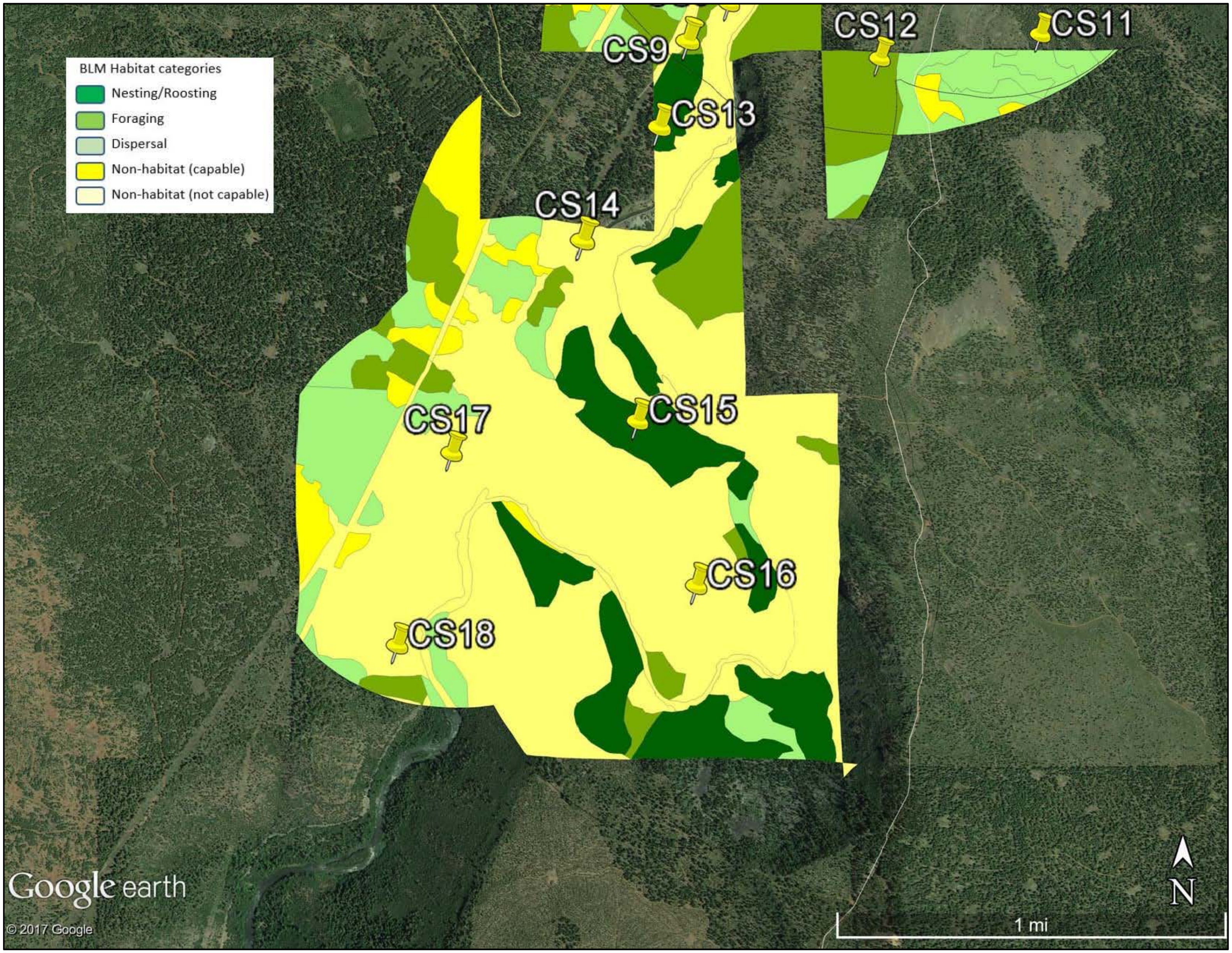


USFWS Habitat Layer

FIGURE 3: PRELIMINARY NSO CALLING STATIONS (USFWS HABITAT LAYER)

JC Boyle Powerhouse and Penstocks

Sheet 1 of 3



BLM Habitat Layer

Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 3: PRELIMINARY NSO CALLING STATIONS (BLM HABITAT LAYER)

JC Boyle Powerhouse and Penstocks
Sheet 2 of 3

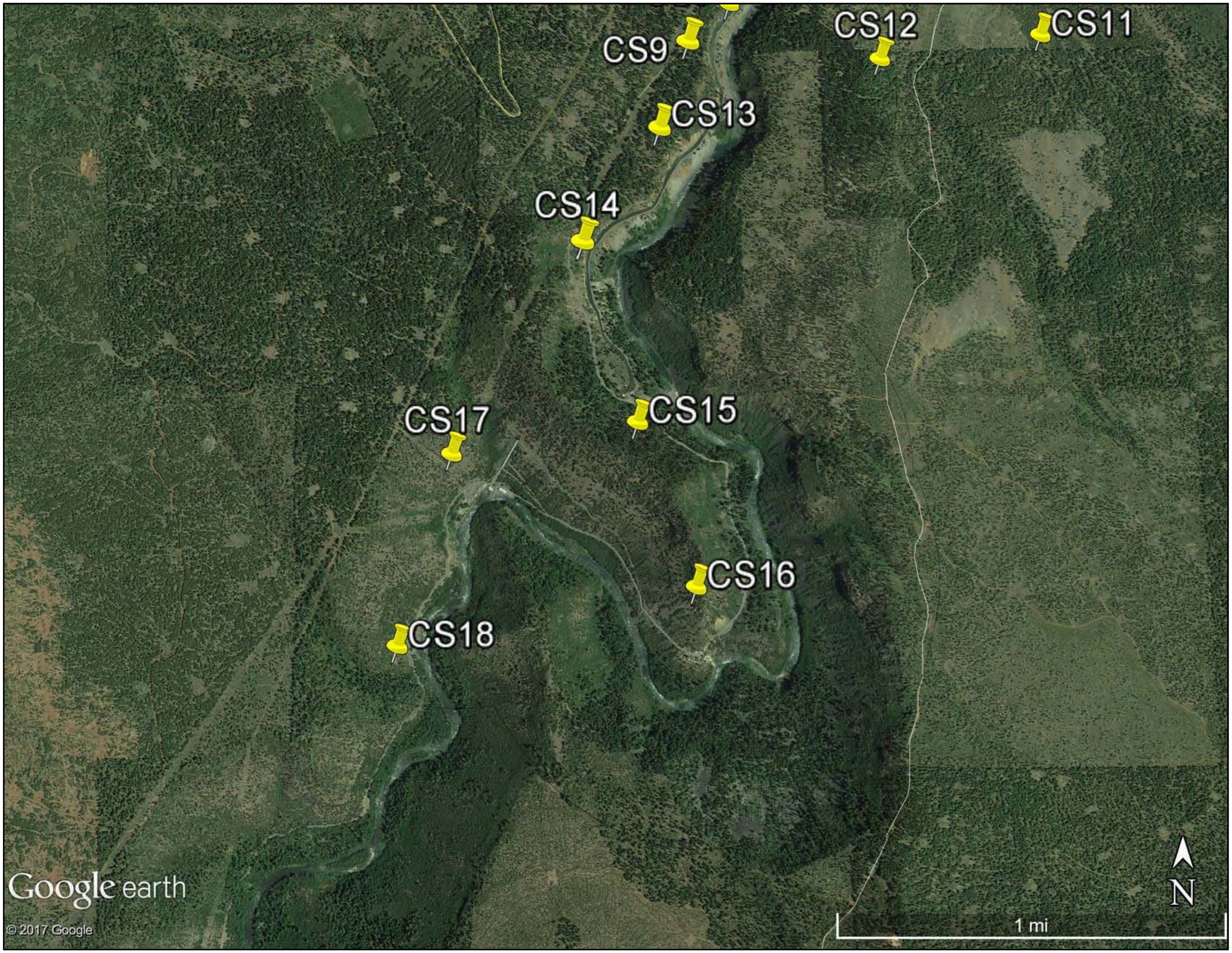
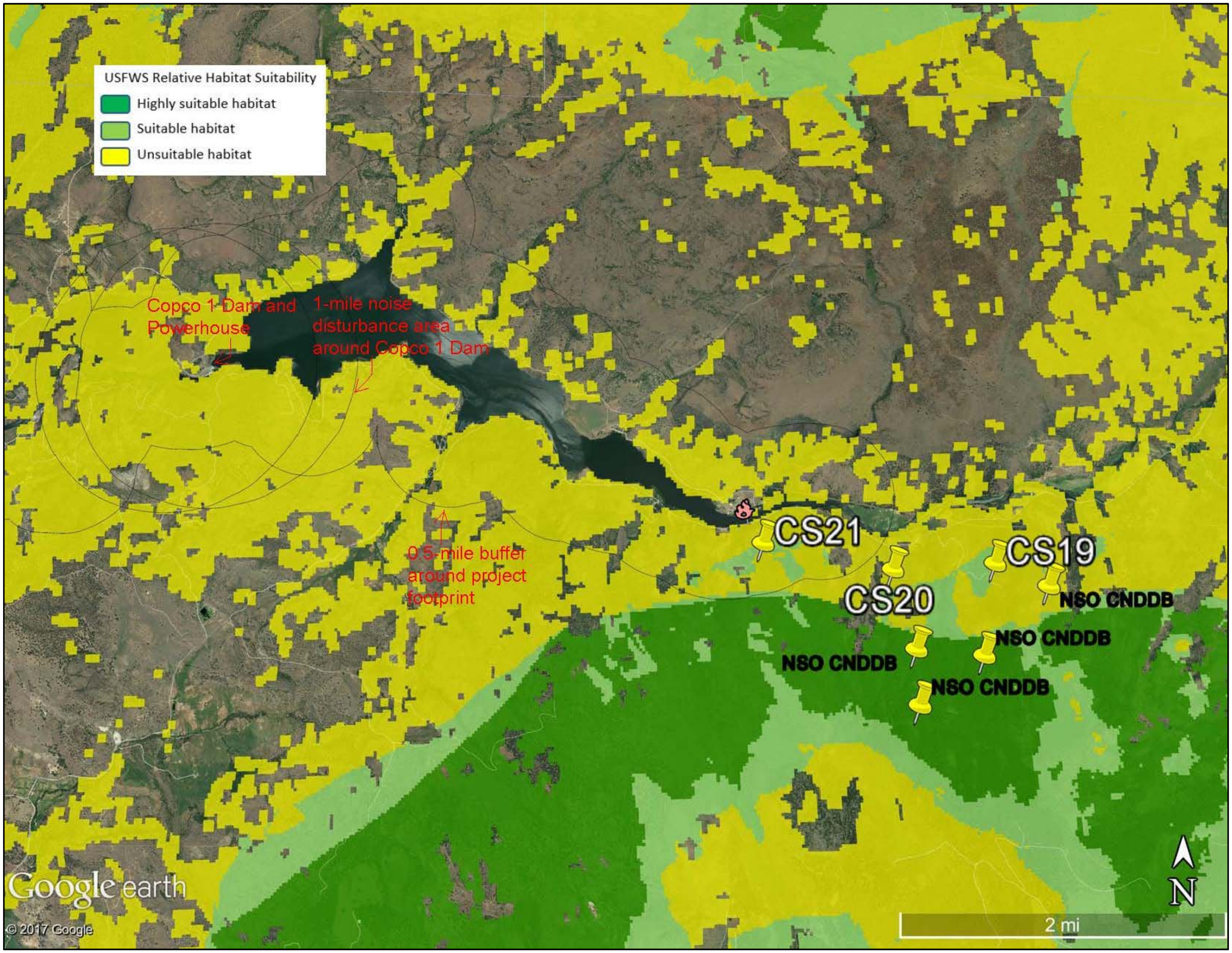


FIGURE 3: PRELIMINARY NSO CALLING STATIONS

JC Boyle Powerhouse and Penstocks

Sheet 3 of 3



USFWS Habitat Layer

Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 4: PRELIMINARY NSO CALLING STATIONS (USFWS HABITAT LAYER)

Copco Reservoir
Sheet 1 of 2

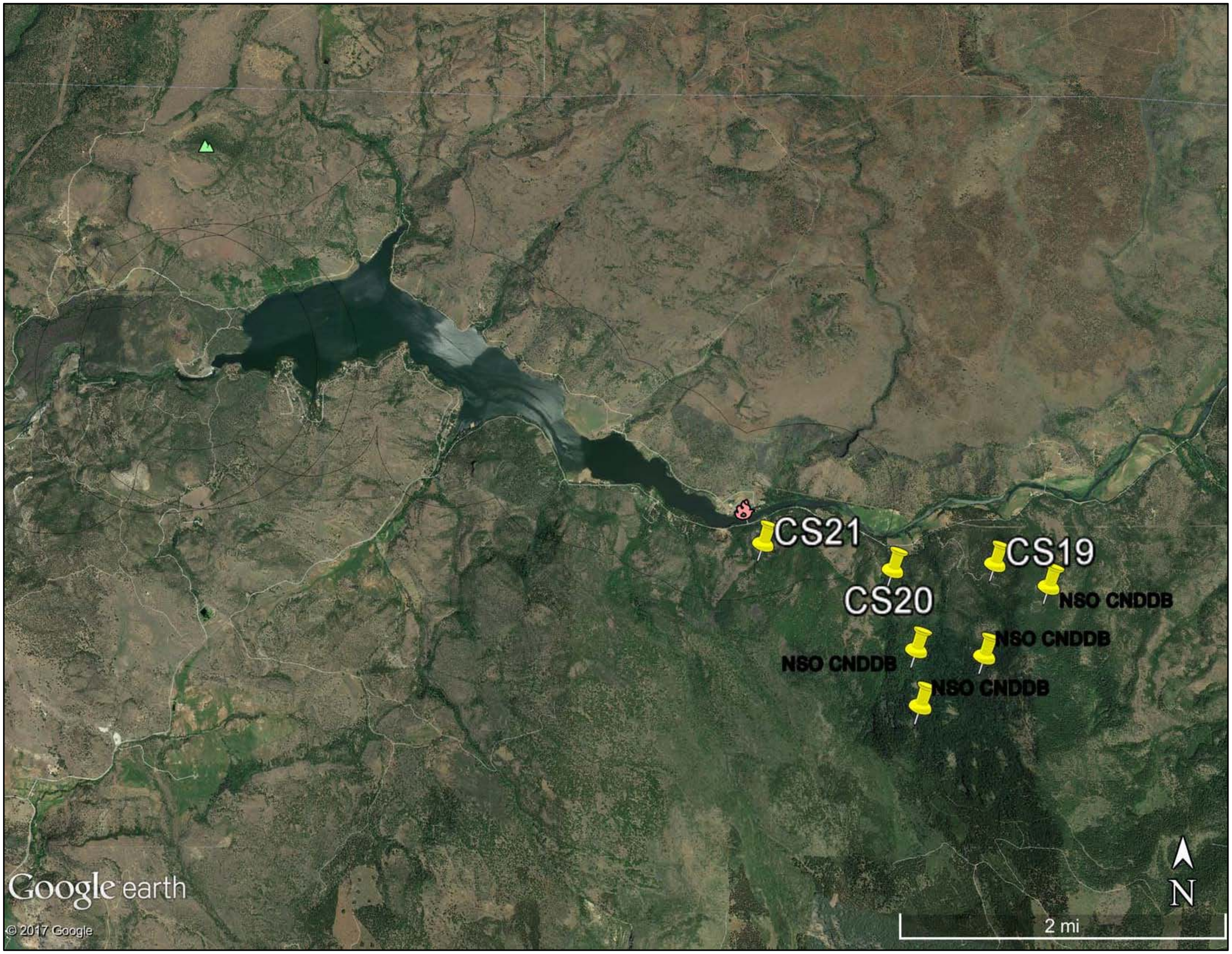
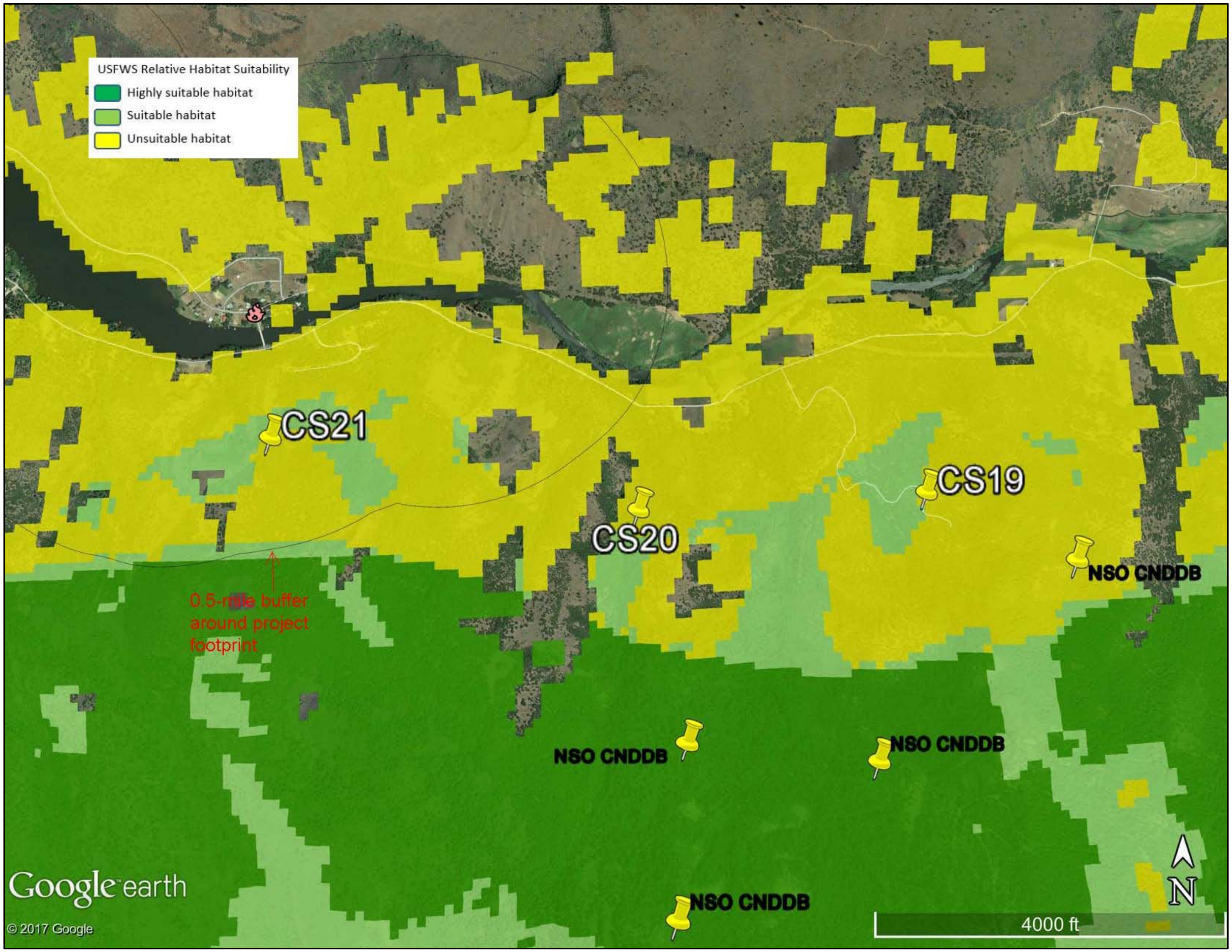


FIGURE 4: PRELIMINARY NSO CALLING STATIONS

Copco Reservoir

Sheet 2 of 2



USFWS Habitat Layer

FIGURE 5: PRELIMINARY NSO CALLING STATIONS (USFWS HABITAT LAYER)

Copco Reservoir – Upstream End
Sheet 1 of 2

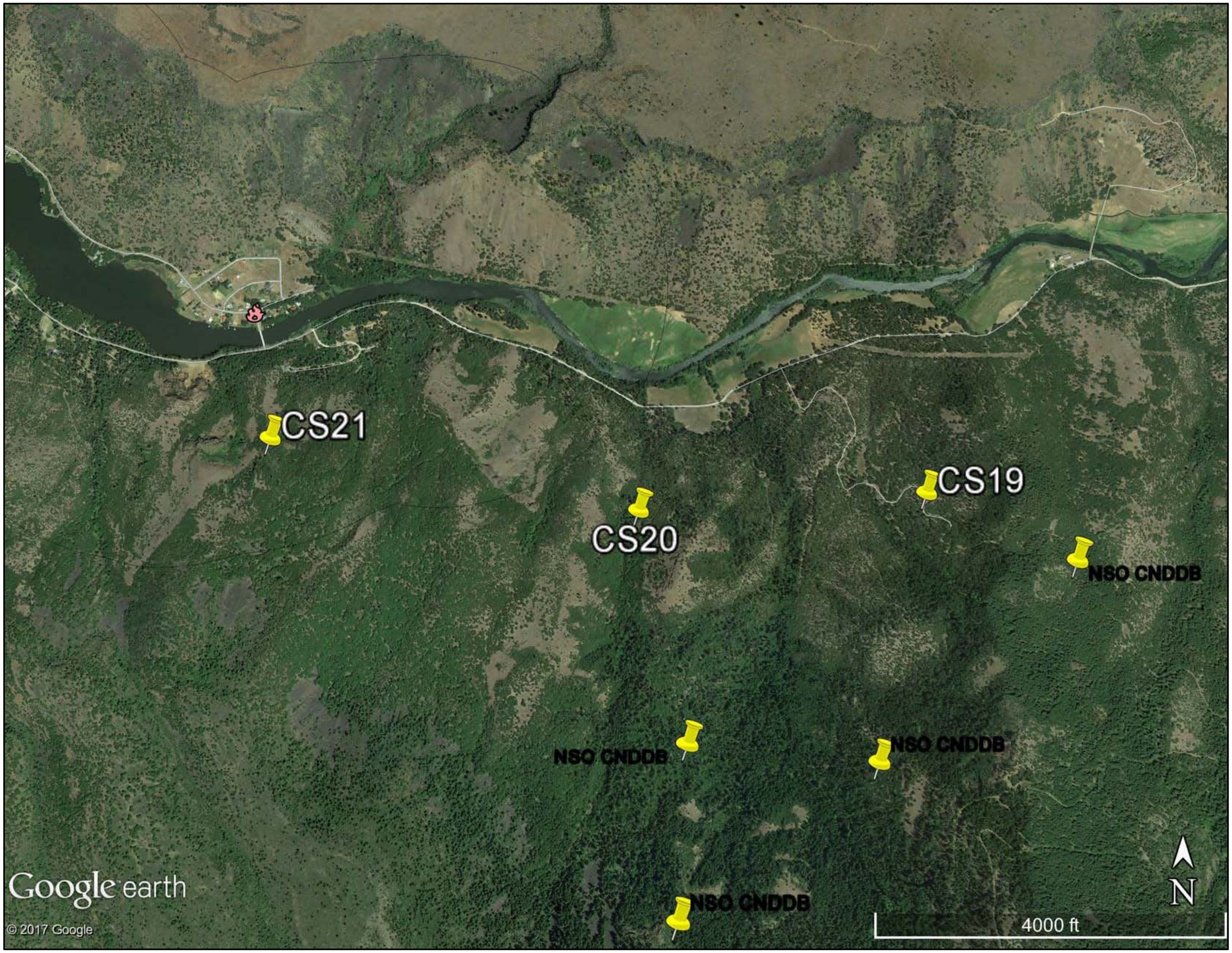


FIGURE 5: PRELIMINARY NSO CALLING STATIONS

Copco Reservoir – Upstream End

Sheet 2 of 2

KLAMATH RIVER RENEWAL CORPORATION

Attachment B

Viewshed Analysis Figures and Eagles Table

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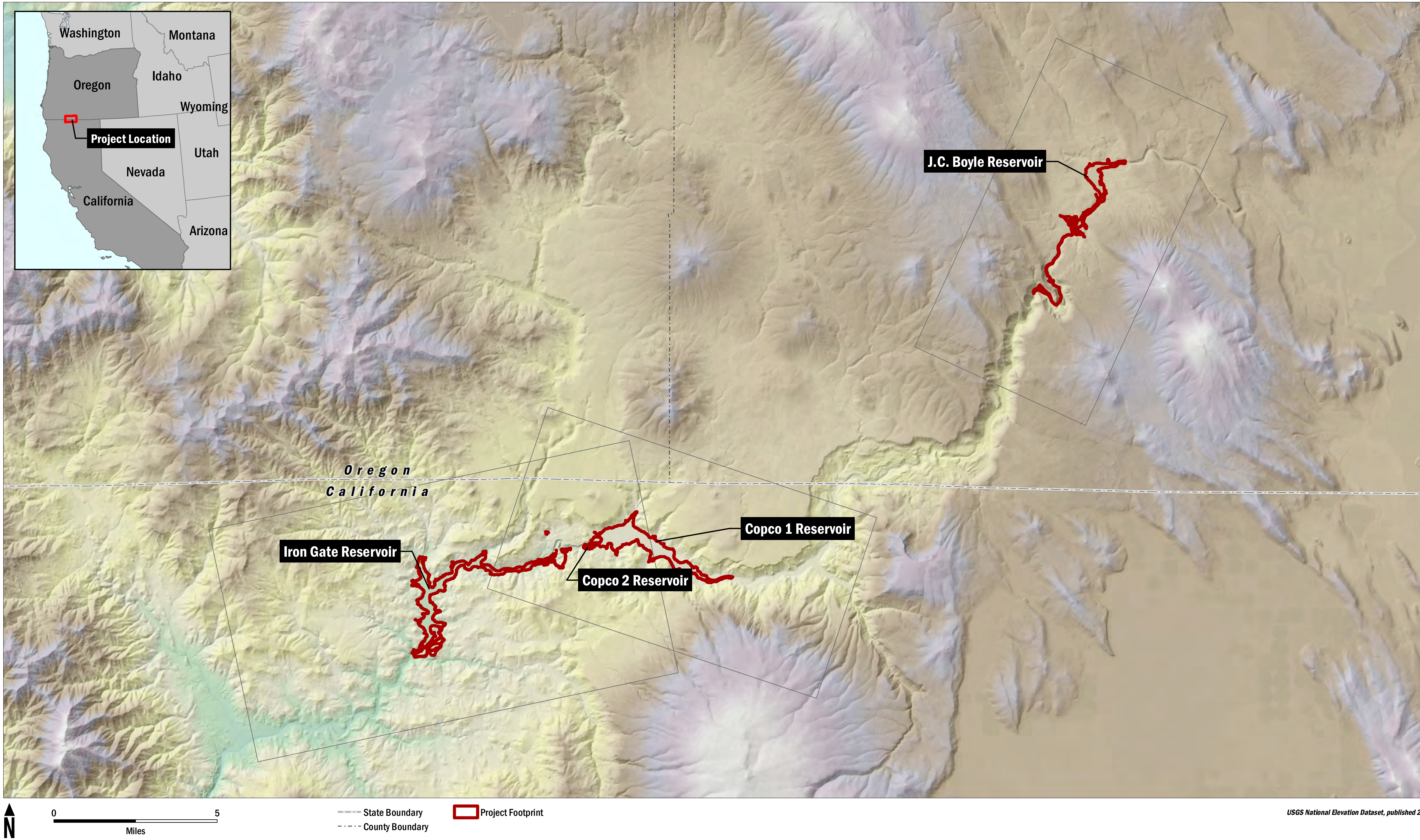
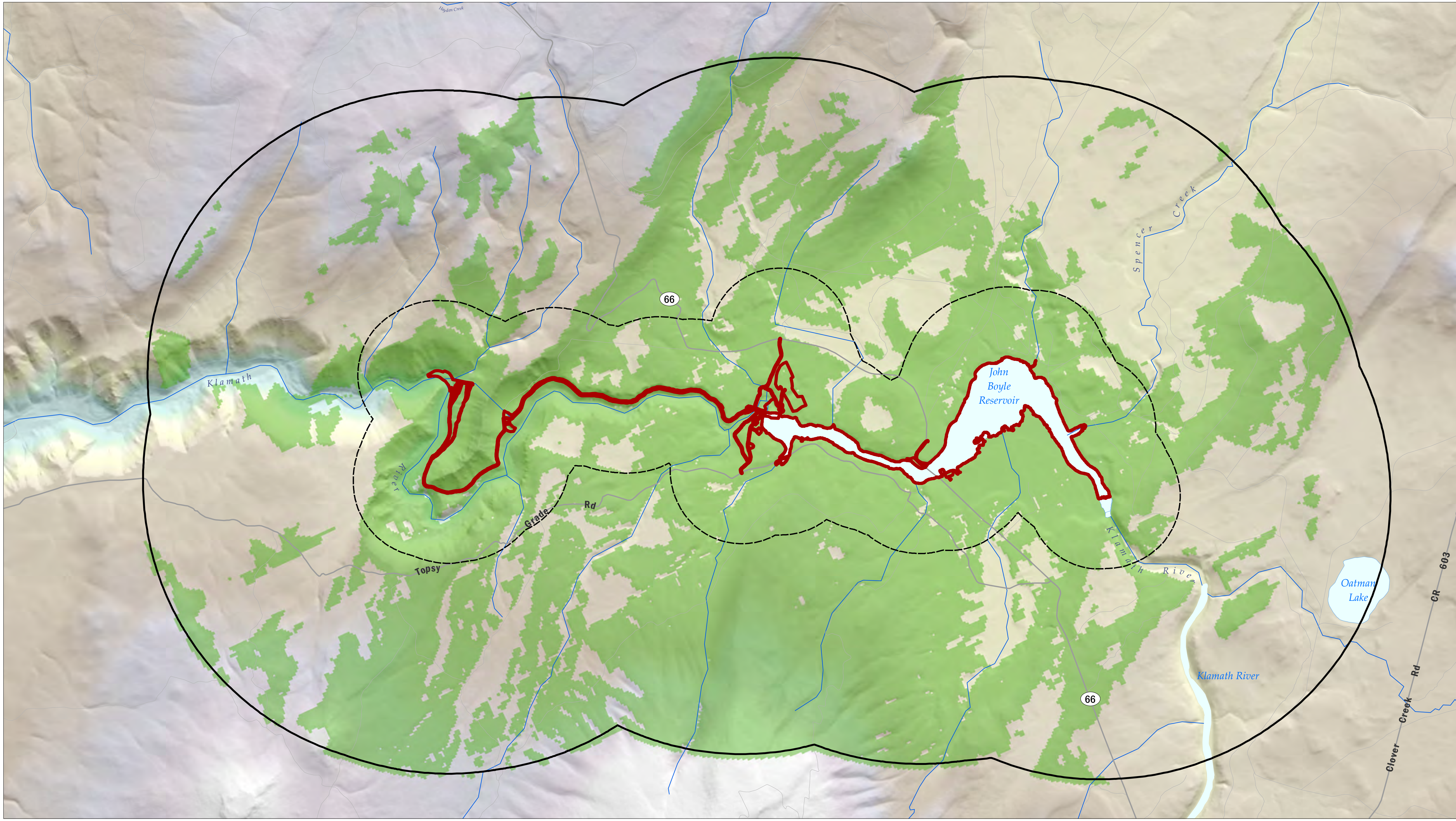


AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

FIGURE 1: PRELIMINARY PROJECT FOOTPRINT VIEWSHED

Overview

AECOM Oakland CA 8/30/2017 USER caitlin.jensen PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\01_Field Maps\Biology\Viewshed\Fig1_ProjectFootprint_Viewshed_Mapbook.mxd



USGS National Elevation Dataset, published 2013

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

0.5-Mile Buffer
2-Mile Buffer
Project Footprint
Viewshed from Project Footprint

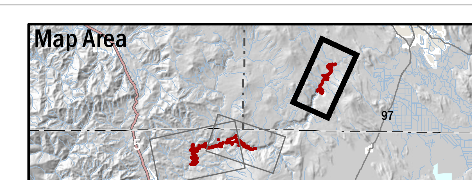
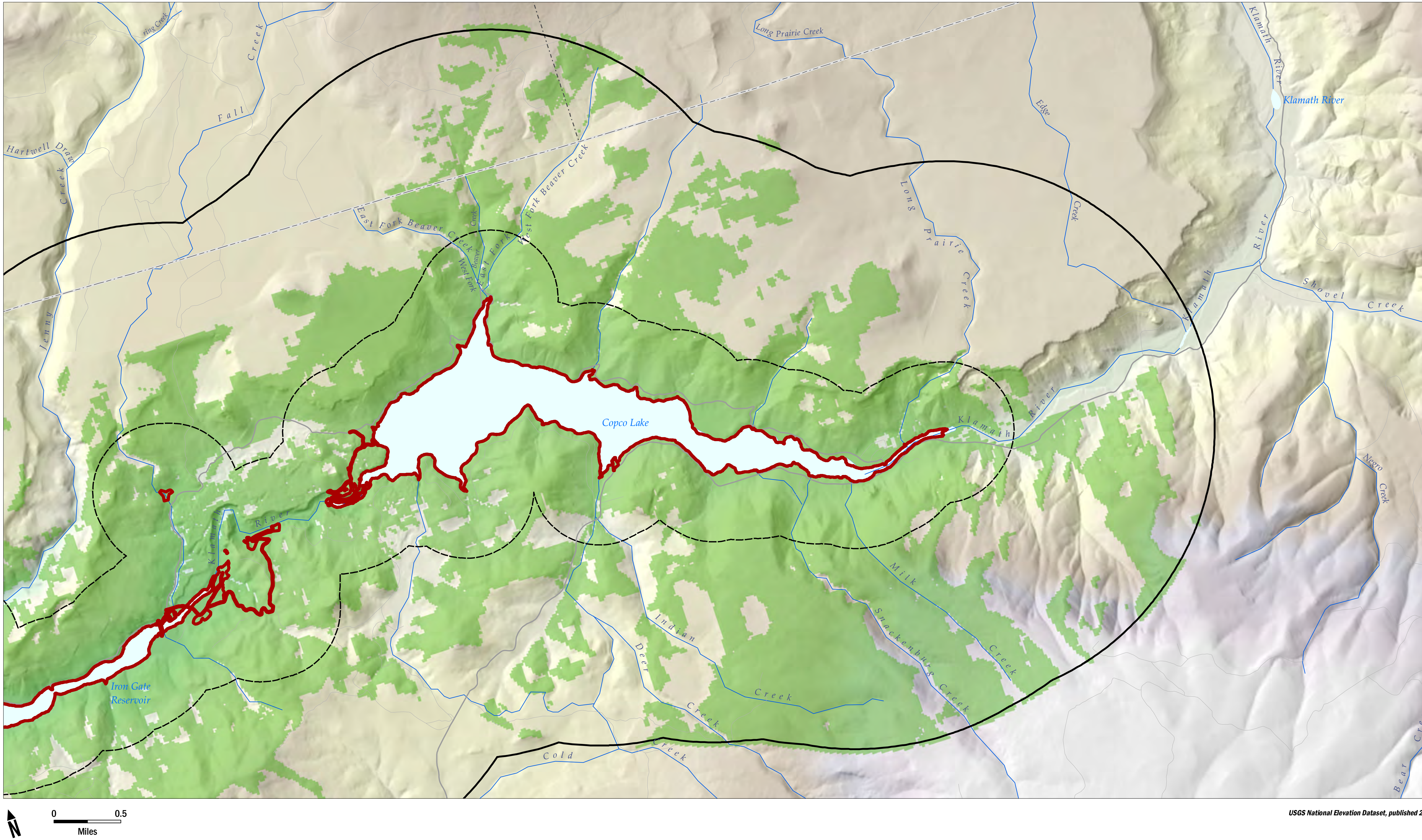


FIGURE 1: PRELIMINARY PROJECT FOOTPRINT VIEWSHED

J.C. Boyle Reservoir

Sheet 1 of 3

AECOM Oakland CA 8/30/2017 USER caitlin.jensen PATH \\Oakland\Oakland\Projects\Secure\Water\Klamath Dam\400-Technical\440 GIS\02_Maps\02_Map_Production_and_Reports\01_Field Maps\Biology\Viewshed\Fig1_ProjectFootprint_Viewshed_Mapbook.mxd



USGS National Elevation Dataset, published 2013

AECOM

Klamath River Renewal Corporation

Klamath River Renewal Project

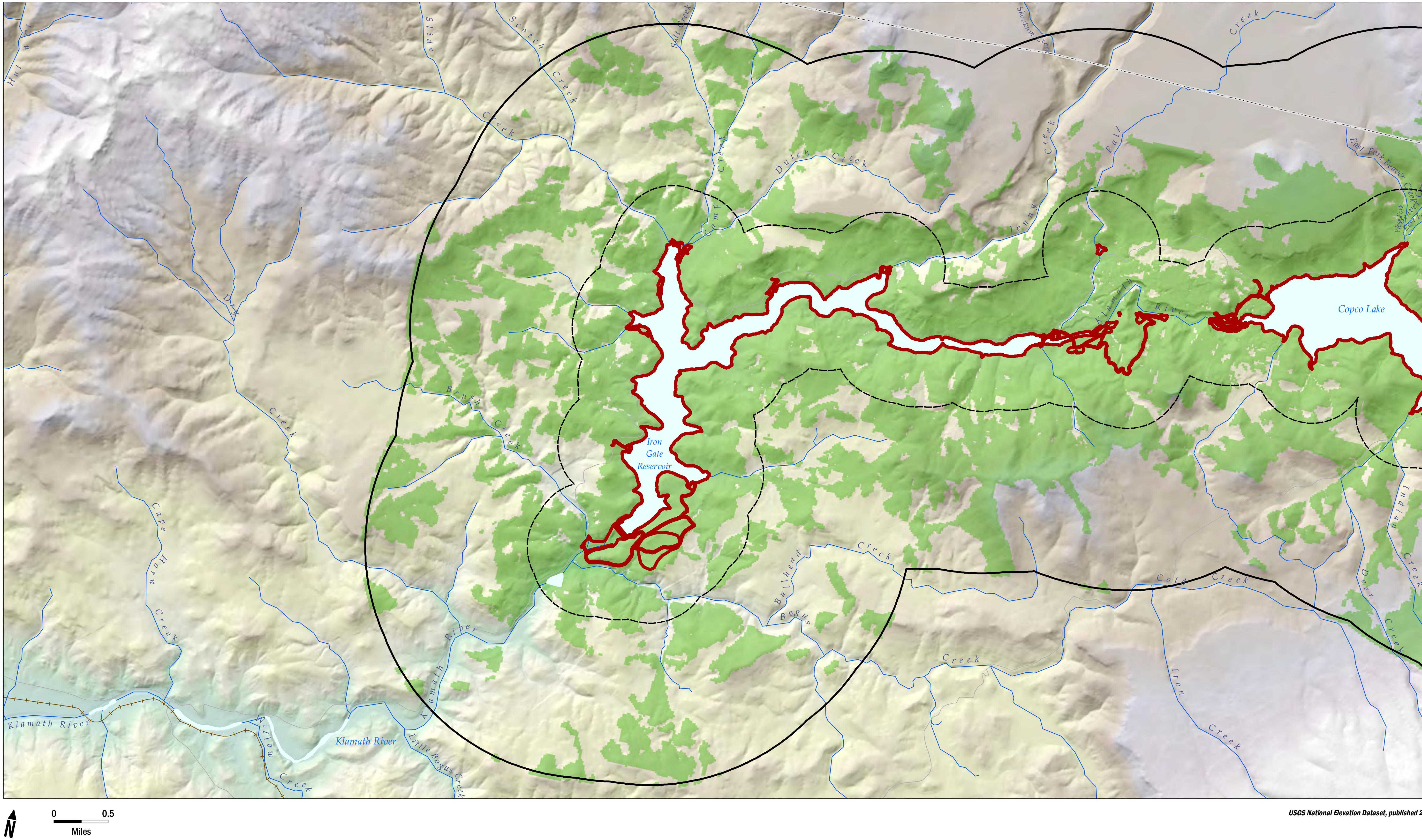
- 0.5-Mile Buffer
- 2-Mile Buffer
- Project Footprint
- Viewshed from Project Footprint

Map Area

FIGURE 1: PRELIMINARY PROJECT FOOTPRINT VIEWSHED

Copco 1 and 2 Reservoirs

Sheet 2 of 3



USGS National Elevation Dataset, published 2013

AECOM
Klamath River Renewal Corporation
Klamath River Renewal Project

0.5-Mile Buffer
2-Mile Buffer
Project Footprint
Viewshed from Project Footprint

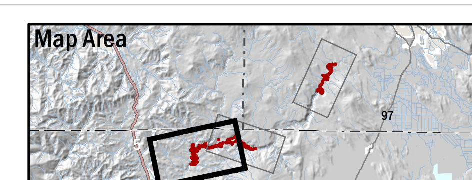


FIGURE 1: PRELIMINARY PROJECT FOOTPRINT VIEWSHED

Iron Gate Reservoir

Sheet 3 of 3

Table 5A-12. Number of bald eagles detected during field surveys.

Habitat Type*	Iron Gate-Shasta	Iron Gate Reservoir	Fall Creek	Copco Bypass	Copco Reservoir	J.C. Boyle Peaking Reach	J.C. Boyle Bypass	J.C. Boyle Reservoir	Keno Canyon	Keno Reservoir	Link River	Total
Plot Surveys	*(n=18)*	*(n=38)*	*(n=16)*	*(n=4)*	*(n=37)*	*(n=72)*	*(n=22)*	*(n=20)*	*(n=18)*	*(n=23)*	*(n=18)*	*(n=286)*
Unidentified Habitat						1						**1**
Flyover					5	3	1			1		**10**
Lacustrine Unconsolidated Bottom		1			1			1				**10**
Montane Hardwood Oak					2							**2**
Ponderosa Pine								1				**1**
Riparian/Wetland Forest		1								1		**2**
Riparian/Wetland Scrub-shrub								1				**1**
Sagebrush								1				**1**
Facility Surveys	*(n=1)*	*(n=3)*	*(n=4)*	*(n=3)*		*(n=1)*	*(n=2)*		*(n=1)*		*(n=3)*	*(n=18)*
All Habitats				1								**1**
Reservoir Surveys		*(n=6)*			*(n=6)*			*(n=5)*		*(n=6)*	*(n=1)*	*(n=24)*
All Habitats					4			1		3		**8**
Total		**2**		**1**	**12**	**4**	**1**	**5**		**5**		**37**

*Detections were not recorded in habitat types not included in table.

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Appendix K Road and Bridge Structure Data and Long-Term Improvements

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Access Roads and Haul Routes of Significance

Name of Road	Dam	County / State	Divided	Surface	Condition	Posted Speed (mph)	Haul or Access	Notes	Recommended Improvements	Temporary Traffic Control (Y/N)
The Dalles California Highway (US 97)	J.C. Boyle	Klamath, Oregon	Undivided	HMA	Good	65	Haul	Two lane State highway system, AC paved road with a soft shoulder. Proposed haul route to transport materials from J.C. Boyle Dam.	Improvements and upgrades to this highway for mobilization or hauling of materials are not anticipated for the Project. Pavement rehabilitation is unlikely during or post-construction.	Y (during pavement rehab only)
Green Springs Highway (OR66)	J.C. Boyle	Klamath, Oregon	Undivided	HMA	Fair	35-45	Haul	Soft shoulder for most part and a few locations with HMA.	Improvements and upgrades to this highway for mobilization and hauling are not anticipated for the Project. Pavement rehabilitation is unlikely during or post-construction.	Y (during pavement rehab only)
Keno Worden Road	J.C. Boyle	Klamath, Oregon	Undivided	HMA	Fair	35	Haul	Most of the segment is a soft gravel shoulder. Steep side slopes in some areas. Rolling terrain. Overhead utility poles found along a portion the road.	Improvements and upgrades to this highway for mobilization and hauling are not anticipated for the Project. Pavement rehabilitation is unlikely during or post-construction.	Y (during pavement rehab only)
Topsy Grade Road	J.C. Boyle	Klamath, Oregon	Undivided	AB with some asphalt	Good	n/a	Haul	Gravel road from OR66 becoming HMA for a portion alongside the Topsy Campground.	It is anticipated that the section of roadway between the Topsy Recreation Site and OR66 will be used for mobilization and material hauling. Improvements and upgrades to this roadway are not anticipated for the Project. Pavement rehabilitation may be required during or post-construction. Temporary traffic control will be used for any pavement rehabilitation.	Y (during repair/regrading)
J.C. Boyle Dam Access Road from OR66	J.C. Boyle	Klamath, Oregon	Undivided	Gravel	Fair	n/a	Haul		Improvements such as regrading uneven or rutted areas will be required on parts of the road. At the intersection with OR66, tree removal and widening of the intersection on the access road approach will improve corner sight distance for mobilization and hauling activities.	N
J.C. Boyle Right abutment access road	J.C. Boyle	Klamath, Oregon	Undivided	AB	Poor	n/a	Haul		None.	N
J.C Boyle Disposal Access Road	J.C. Boyle	Klamath, Oregon	Undivided	Dirt	Fair	n/a	Haul		Regrade uneven or rutted areas of road surface. Minor widening in parts to allow two-way traffic.	N
Power Canal Access Road to powerhouse	J.C. Boyle	Klamath, Oregon	Undivided	AB	Poor	n/a	Access	Very narrow road immediately adjacent to concrete flume. Side slopes on river side are very steep or nearing vertical. To be used for access only, not hauling. Not recommended as a two-way haul route unless concrete flume has been completely removed. Used for construction access only after the power canal has been completely removed.	Minor periodic roadway maintenance such as re-grading may be required to address roadway deterioration during construction.	N
J.C. Boyle Powerhouse Road	J.C. Boyle	Klamath, Oregon	Undivided	AB	Fair	n/a	Haul	Access road from forebay to powerhouse.	None.	N
Interstate 5 (I-5)	Copco 1,2, Iron Gate	Siskiyou, California	Divided	Asphalt	Very good	70	Haul	Rolling and mountainous terrain .	None.	N
Copco Road from I-5 to Ager Road	Copco 1,2 and Iron Gate	Siskiyou, California	Undivided	HMA	Good	n/a	Haul	From I5 to Ager Road.	Improvements and upgrades to this highway for mobilization and hauling are not anticipated for the Project. Pavement rehabilitation may be required during or post-construction.	Y (during pavement rehab only)
Copco Road from Ager Road to Lakeview Road	Copco 1,2 and Iron Gate	Siskiyou, California	Undivided	HMA	Poor	35	Haul	From Ager Rd to Lakeview Rd. Poorly striped. No striped shoulder.	Improvements and upgrades to this highway for mobilization and hauling are not anticipated for the Project. Pavement rehabilitation may be required during or post-construction.	Y (during pavement rehab only)
Copco Road from Lakeview Road to Daggett Road	Copco 1,2 and Iron Gate	Siskiyou, California	Undivided	HMA	Poor	35	Haul	From Lakeview Rd to Daggett Road. Poorly striped. No striped shoulder.	Improvements and upgrades for this road prior to dam removal are not anticipated. Pavement rehabilitation may be required during or post-construction.	Y (during pavement rehab only)
Copco Road from Daggett Road to Copco Access Road	Copco 1	Siskiyou, California	Undivided	asphalt then transitions to AB at 1.2 Mi. E. of Daggett Road	Fair	n/a	Haul	Very low traffic.	Improvements and upgrades prior to dam removal are not anticipated for the Project. Road surface maintenance may be required during or post-construction.	Y (during road surface maintenance only)

Access Roads and Haul Routes of Significance

Name of Road	Dam	County / State	Divided	Surface	Condition	Posted Speed (mph)	Haul or Access	Notes	Recommended Improvements	Temporary Traffic Control (Y/N)
Copco Road between Copco 1 Access Road to Copco Road Bridge/Ager Beswick Road	Copco 1	Siskiyou, California	Undivided	Dirt/ HMA	Poor	n/a	Access	Road surface is primarily dirt and has very low traffic volume. One mile of road is asphalt pavement.	It is anticipated that this portion of Copco Road will not be used for dam or powerhouse removal but will be used for construction access to various post construction improvements, such as culvert replacement and installing rock slope protection. Improvements and upgrades prior to dam removal are not anticipated. Road surface maintenance may be required during or post construction.	N
Copco Access Road between dam and Copco Road	Copco 1	Siskiyou, California	Undivided	Dirt	Fair	n/a	Haul	Dirt road with a hairpin bend. Landslides have occurred on the hillside above the hairpin bend. The lower side of access road is very steep with no barrier protection.	It is anticipated that this segment of the dirt/gravel road will need to be regraded by clearing and grubbing the available space between the toe of the higher hillside and the existing edge of the dirt/gravel road to provide a wider road section for construction and hauling trucks. One-way traffic with turnouts are assumed for the access road. Turnarounds for haul trucks will be at the powerhouse and at the disposal site of the staging area.	Y
Copco 1 Ager Beswick Road Barge Access	Copco 1	Siskiyou, California	Undivided	HMA	Fair-good	25	Access	Two-way undivided County road from Copco Bridge to Ager Rd intersection.	The road is not anticipated to be used for hauling but may be used for mobilization of a barge-mounted crane from the existing boat ramp at Mallard Cove on the southern shore. Upgrades and improvements to this road prior to dam removal are not anticipated for the Project. Access to the boat ramp is likely to require minor improvements to the access road off of Ager Beswick Road to enable placing a barge-mounted crane in the reservoir. The boat ramp is also likely to require extension into the reservoir to be able to remove the barge following removal of the spillway structure.	N
Daggett Road	Copco 2	Siskiyou, California	Undivided	Dirt/AB	Poor	n/a	Haul	Located just behind a gate off of Copco Road. This is a pinch point on the Daggett Road that connects to Copco Road. This is a potential haul route to transport demolished materials from Copco 2 powerhouse.	"One way" roadside sign along with advance warning signs will be needed to provide warning to truck drivers. Periodic road maintenance will be required during construction on Daggett Road leading to Copco 2 powerhouse. Approach roadways to Daggett Road Bridge will be realigned to new, relocated Daggett Road Bridge.	Y ("one-way" signs)
Lakeview Road between Copco Road and Disposal Site	Iron Gate	Siskiyou, California	Undivided	Gravel	Fair	20	Haul	One way hauling traffic.	Improvements and upgrades for mobilization and hauling are not anticipated. Minor road surface maintenance may be required during or post-construction.	Y (during roadway maintenance)
Powerhouse access road	Iron Gate	Siskiyou, California	Undivided	Gravel (before gate)/ asphalt (past gate)	Good	n/a	Haul	From the bridge it is a gravel road up to the gate, after the gate it is an AC paved road to the Iron Gate Powerhouse. A large stockpile area is available on the right side of Lakeview Road bridge that can be used during construction. Access road can be used for hauling material from the Iron Gate powerhouse.	Roadway maintenance to ensure adequate accessibility during construction. This road will not be needed following hauling and demobilization activities.	Y (during roadway maintenance)
Left abutment access road	Iron Gate	Siskiyou, California	Undivided	Gravel	Fair	n/a	Haul	Runs between Lakeview Road and left abutment of dam. The road is swing gate controlled and can be used as a haul route to remove materials from the Iron Gate dam structure to disposal site.	Periodic maintenance to ensure accessibility during construction. Road will be removed after dam removal activities.	N
Upstream Left abutment access road	Iron Gate	Siskiyou, California	Undivided	Gravel	Fair	n/a	Haul	The original haul route from the upstream borrow area to the dam would be reopened for construction. This would allow two-way traffic to the north side of the disposal area.	Periodic maintenance to ensure accessibility during construction. Road will be removed after dam removal activities.	N
Access Road from Long Gulch Recreational Facility to Lakeview Road (Disposal Site)	Iron Gate	Siskiyou, California	Undivided	Gravel	Fair	n/a	Haul	One way hauling traffic.	Maintenance to ensure adequate accessibility during construction. This road will not be needed following hauling and demobilization activities.	N
Access Road from Overlook Point Recreational Facility to Copco Road	Iron Gate	Siskiyou, California	Undivided	Gravel	Fair	n/a	Haul	One way hauling traffic.	Maintenance to ensure adequate accessibility during construction. This road will not be needed following hauling and demobilization activities.	N

Intersection Field Observations					
Intersection	**Dam**	**Control**	**Notes**	**Improvements**	**Temporary Traffic Control (Y/N)**
Dalles California highway (US 97) / Keno Worden Road	J.C. Boyle	1-way stop	T-intersection; approximately 200ft from level rail road crossing controlled by flashing lights and gates.	None.	N
Keno Worden Road / Green Springs Hwy (OR66)	J.C. Boyle	1-way stop	T-intersection; continue on Route 66 from Keno Worden Road to go J.C. Boyle Dam.	None.	N
Green Springs Hwy (OR66 - Oregon) / Topsy Grade Rd	J.C. Boyle	2-way stop	Topsy Grade Rd paved approximately 150ft before intersection. Adequate signage and striping.	None.	N
Green Springs Hwy (OR66) / Dam Access Road	J.C. Boyle	1-way stop	Located on the north side of dam. Inadequate intersection signage and configuration, near curve in mainline. Needs improvements.	Minor widening and tree removal to improve sight distance and accommodate truck turning. Provide temporary advance warning signs to notify of trucks entering/exiting OR66 at the intersection.	Y (during widening and tree removal)
Copco Road / Copco 1 access road	Copco 1	None	AB intersection, not stop controlled, low volume of traffic.	None.	N
Copco Road / Quail Lane	Copco 1	None	Intersection to Copco Br. No stop sign, no striping, low volume intersection, low speed.	None.	N
Copco Road / Ager Beswick Road	Copco 1	n/a	Intersection to Copco Br. No stop sign, no striping, low volume intersection, low speed.	None.	N
Patricia Ave / Ager Beswick Road	Copco 1	1-way stop	Poor striping and pavement markings, tree blocking sight distance.	Remove Tree	N
Copco Road / Daggett Road	Copco 2	n/a	Poor AC pavement on Daggett Rd at intersection, low volume, no stop sign, no stop bar, OK sight distance. Should add stop control prior to dam removals. Gate located 200ft from intersection.	Provide stop sign and stop bar.	Y
Copco Road / Fall Creek Road	Copco 2	n/a	AB intersection, not stop controlled, low volume.	Regrade to conform with new Fall Creek Bridge immediately east of intersection.	Y (during regrading and bridge construction)
Copco Road / Lakeview Road	Iron Gate	n/a	No signage, poor AC pavement at intersection, should add stop control prior to dam removals.	Provide stop sign and stop bar.	Y (area near bridge replacement, may need flaggers during new bridge construction)
Lakeview Road / Powerhouse Access	Iron Gate	1-way stop	AB Intersection, no striping. 5 legs at intersection. Should reconfigure and improve stop control prior to construction.	Provide stop sign at powerhouse access road approach.	Y (area near bridge replacement, may need flaggers during new bridge construction)

Structure Field Observations													
Bridge Name	**Dam**	**Road**	**Bridge No.**	**As-Builts**	**Year Built**	**Haul or Access**	**Deck Width**	**Lane 1 Width**	**Lane 2 Width**	**Span**	**Notes**	**Recommended Improvements**	**Temporary Traffic Control (Y/N)**
Spencer bridge	J.C. Boyle	Green Springs Hwy (OR66), Oregon	19789	Yes	2005	Haul	42.54'	12'	12'	3 spans @ 557.74' total	Reinforced concrete deck on continuous steel plate girders, excellent condition. Also include 8' shoulder on each side.	Assess eastern embankment and abutment after reservoir drawdown. May need outer layer riprap repair based on assessment of erosion following the drawdown.	N
Timber bridge	J.C. Boyle	JC Boyle Dam Access	n/a	Partial		Access	18'	16'	None	100'	Wood deck on rolled beams, fair condition	No construction access improvement. Private bridge. Demolish post-construction.	N
Concrete bridge	J.C. Boyle	Unnamed Road over Spencer Creek									Noted the gabion walls next to the bridge are in good condition. No railing on the bridge.	None, not impacted by the project.	N
Unknown cattle bridge	Copco 1	Private Access									Unknown cattle bridge - 2.3mi upstream from Copco bridge	None.	N
Copco Road bridge	Copco 1	Copco Rd - Ager Beswick Rd	2C0039	Yes	1988	Haul	24.67'	12'	12'	202.5'	4' deep CIP PS concrete box	Drawdown and post-project flows have potential to cause erosion at the abutments or central pier. Further evaluation during the detailed design phase. Erosion protection may be required at the abutments or pier.	Y (during construction of improvements)
Daggett Road bridge	Copco 2	Daggett Rd		Partial	1983	Haul	14'	12'		42', 72', 58' 61'	Timber deck on steel girders	Construction access improvements on private road. Existing structure will be replaced by a bridge of similar length and width as existing structure. The new structure will be constructed adjacent to the existing bridge on a revised alignment and the old bridge removed after completion of the new structure.	N
Fall Creek Bridge	Copco 2	Copco Rd	2C0198	No	1969	Access	25'	12'	12'		AC on deck in poor condition, wood railing in poor condition. Connection only to power plant/grid station.	Construction access improvement on County Road. Structure will be replaced by a single span bridge of similar length and width as the existing structure.	Y (Staging involves constructing half of bridge, using half of existing bridge for one-way reversible traffic control in Stage 1. Move traffic with one-way reversible traffic control on new half of bridge while constructing final half in Stage 2.)
Lakeview Road bridge	Iron Gate	Lakeview Rd	2C0255	No, but have Inspection Report	1960	Haul	14.4'	12'		9 spans @ 24.9' Total = 272'	Reinforced concrete deck on steel simply supported beams. Bents are timber pile extensions with timber or steel caps. Overall width is 17'. Posted load limits	Construction access improvements on County Road. Structure will be replaced for construction access. The new bridge will be similar in length and width and constructed on a revised alignment adjacent to the existing bridge.	Y (traffic control during pavement conform work at approach roadways)
Camp Creek Bridge (replace existing culvert)	Iron Gate	Copco Road	n/a	No	n/a	Haul	n/a	n/a	n/a	n/a	Existing 10' Arched CMP pipe culvert to be replaced by a bridge.	Permanent long term improvement. Due to difficulty in knowing when erosion would occur, it is expected that replacement of the culvert with a bridge will be necessary. A temporary structure and detour road upstream of the culvert would be constructed to maintain traffic during the works.	Y
Jenny Creek bridge	Iron Gate	Copco Rd	2C0280	Yes, but only GP & FP	2008	Haul	27.33'	12'	12'	113.5'	PC PS deck bulb tee girders, AC in good condition, MBGR in good condition	Permanent long term improvement. The abutments are built on material deposited after the dam construction and the dam removal may cause significant erosion that could possibly undermine the abutments. A new bridge would be constructed on the upstream side of the existing structure, on a modified alignment, to preclude damage to the structure after drawdown.	Y (during pavement conform work at approach roadways to new bridge)
Brush Creek bridge	Iron Gate	Copco Rd	2C0224	Yes	1976	Haul	24.5'	12'	12'	25'	18" concrete slab bridge	None, this bridge is located on the haul route (Copco Rd) and potential for some minor pavement rehabilitation post-project condition. Post project erosion is not expected to impact abutments.	Y (during pavement rehab)
Dry Creek bridge (Fish Hook)	Iron Gate	Copco Rd	2C0144	No	1960	Haul	30.75'	14'	14'	24.5'	Timber deck and girders with AC overlay	Construction access improvement on County Road. Temporary bridge for construction duration and associated traffic. Existing bridge to remain as is.	Y
Pedestrian bridge - private	Klamath River	None		No		n/a					Deteriorated, not in use. Should be removed.	Demolish. The bridge spans the Klamath River just upstream of the confluence with Cedar Gulch. The bridge is a cable suspension structure of unknown origin, with no connection to any approach roads. The bridge is in very poor condition. The bottom chord of the bridge is not high enough to pass the anticipated 100-year flood following removal of the dams.	N
Campground Pedestrian bridge	Klamath River	None		No		n/a					Well maintained. In flood plain	Demolish. The bottom chord of the bridge is not high enough to pass the anticipated 100-year flood following removal of the dams. An evaluation of the structure will be performed during the detailed design phase to determine whether removal or replacement will be required.	N

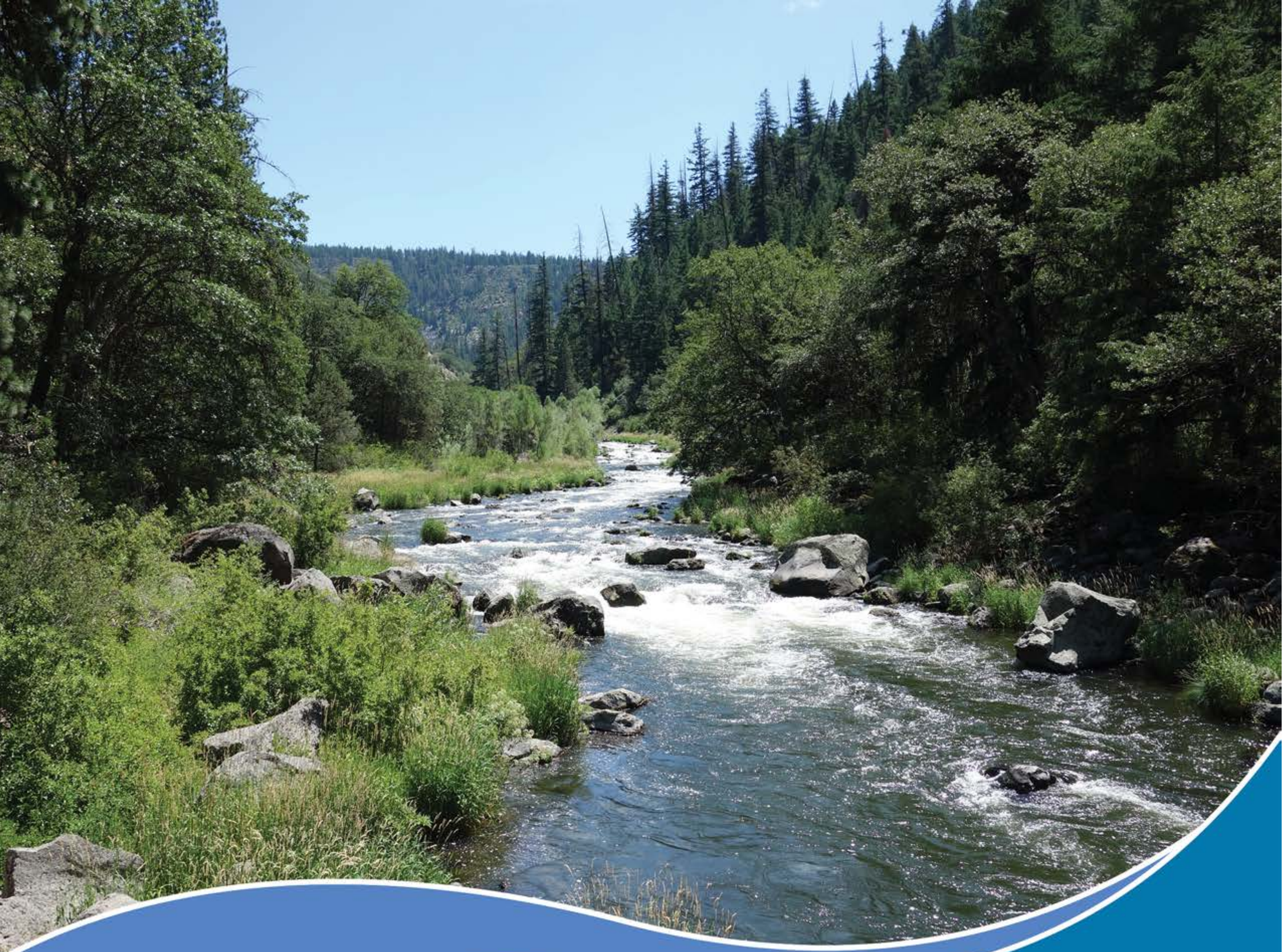
Structure Field Observations													
Bridge Name	**Dam**	**Road**	**Bridge No.**	**As-Builts**	**Year Built**	**Haul or Access**	**Deck Width**	**Lane 1 Width**	**Lane 2 Width**	**Span**	**Notes**	**Recommended Improvements**	**Temporary Traffic Control (Y/N)**
Railroad bridge	Klamath River	None		No		n/a					Central Oregon and Pacific RR Bridge	Possible scour mitigation post-project.	N
Cottonwood Creek Bridge	Klamath River	Copco Rd	2C0257	No	1980	Haul	32'	12'	12'	89'	Purple permit capacity for all trucks	None.	N

Culvert Field Observations

Description	Dam	Road	No. of Pipes	Culvert Size(s)	Type of Pipe	Notes	Recommended Improvements	Temporary Traffic Control (Y/N)
Topsy Grade Road at Unnamed Creek	J.C. Boyle	Topsy Grade Rd	3	24" each	Unknown (possibly CMP)	PacifiCorp staff confirmed there is a pipe culvert connecting both sides of the road and conveying water through the culvert. As built plans indicate 3-24" culverts. Pipe type unknown.	Potentially some minor post project improvements including removal of sediment and/or debris, redirection of flows through the culvert to the original downstream side, and erosion protection of downstream embankment. Needs for these improvements will be confirmed following drawdown and associated monitoring.	Y (during erosion protection installation)
Unnamed Road at Unnamed Drainage	J.C. Boyle	Unnamed	2	36" each	CMP	Both sides of culverts silted. Located well above lake water level.	Possible rock slope protection on downstream embankment. Culvert clean up to remove silt and some vegetation. Need for these minor improvements would be confirmed following drawdown.	Y (during erosion protection installation culvert cleanup)
Copco Road at Beaver Creek	Copco 1	Copco Rd	1	60"	CMP	Length of pipe is about 30 feet long with 1.5 feet cover under the Copco Rd. The gravel/dirt road is about 13 feet wide and is in a fairly stable condition.	Culvert is located above reservoir level and is not expected to be built on reservoir sediments. Minor improvements such as, the addition of riprap armor to the face of the embankments may be required if erosion of reservoir sediments affects this culvert. Improvements to be confirmed following drawdown of Copco Lake and associated monitoring.	Y (during erosion protection installation)
Copco Rd at East Fork Beaver Creek	Copco 1	Copco Rd	1	60"	CMP	Length of pipe is about 30 feet long with 1.5 feet cover under the Copco Rd. The gravel/dirt road is about 13 feet wide and is in a fairly stable condition.	Culvert is located above reservoir level and is not expected to be built on reservoir sediments. Minor improvements such as, the addition of riprap armor to the face of the embankments may be required if erosion of reservoir sediments affects this culvert. Improvements to be confirmed following drawdown of Copco Lake and associated monitoring.	Y (during erosion protection installation)
Copco Road at Raymond Gulch	Copco 1	Copco Rd	1	60"	CMP	Length of pipe is about 20 feet long with 0.5 feet cover under the Copco Rd. The gravel/dirt road is about 11 feet wide and is in a fairly stable condition.	Culvert is located above reservoir level and is not expected to be built on reservoir sediments. Minor improvements such as, the addition of riprap armor to the face of the embankments may be required if erosion of reservoir sediments affects this culvert. Improvements to be confirmed following drawdown of Copco Lake and associated monitoring.	Y (during erosion protection installation)
Patricia Avenue at West Fork Unnamed Creek	Copco 1	Patricia Ave	1	36"	CMP	The culvert is located beneath Patricia Avenue. The AC paved road is about 20 feet wide and is in a good condition. Posted speed limit is 25mph.	Culvert is located above reservoir level and is not expected to be built on reservoir sediments. Minor improvements such as, the addition of riprap armor to the face of the embankments may be required if erosion of reservoir sediments affects this culvert. Improvements to be confirmed following drawdown of Copco Lake and associated monitoring.	Y (during erosion protection installation culvert cleanup)
Patricia Avenue at East Fork Unnamed Creek	Copco 1	Patricia Ave	1	36"	CMP	The culvert is located under Patricia Avenue. The AC paved road is about 20 feet wide and it is in good condition. Posted speed limit is 25mph.	Culvert is located above reservoir level and is not expected to be built on reservoir sediments. Minor improvements such as, the addition of riprap armor to the face of the embankments may be required if erosion of reservoir sediments affects this culvert. Improvements to be confirmed following drawdown of Copco Lake and associated monitoring.	Y (during erosion protection installation culvert cleanup)
Culvert at Deer Creek	Copco 1	Ager Beswick Rd	Unknown	Unknown	Unknown	The location is covered with heavy vegetation, so unable to take measurement of the culvert. The AC paved road is about 22 feet wide and in very good condition. Posted speed limit is 30mph.	Culvert is located above reservoir level so no impact is anticipated and no improvement required.	N

Culvert Field Observations

Description	Dam	Road	No. of Pipes	Culvert Size(s)	Type of Pipe	Notes	Recommended Improvements	Temporary Traffic Control (Y/N)
Culvert at Indian Creek	Copco 1	Ager Beswick Rd	Unknown	Unknown	Unknown	The location is covered with heavy vegetation, so unable to take measurement of the culvert. The AC paved road is about 22 feet wide and in very good condition. Posted speed limit is 30mph.	Culvert is located above reservoir level so no impact is anticipated and no improvement required.	N
Daggett Road at Fall Creek	Copco 2	Daggett Rd	1	10ft	CMP	Length of pipe is about 32 feet long with 3 feet cover under Daggett Road. The gravel road is about 16 feet wide and is located just behind a gate off of Copco Road. This is a pinch point on the Daggett Road that connects to Copco Road. This is a potential haul route to transport materials from the Copco 2 Power House.	One way control roadside sign with advance warning signs may be needed to provide caution to truck drivers.	Y
Copco Road at Scotch Creek	Iron Gate	Copco Rd	1	10ft	CMP	10ft pipe visually seen but not able to access due to heavy vegetation. Road width at culvert is 22ft.	Some erosion is anticipated in the vicinity of the culvert following drawdown of the reservoir due to incision into reservoir sediments. Culvert will likely need to be replaced and provided with a suitable erosion protection to account for the potential drop in creek bed elevation. A temporary structure and detour road would be constructed immediately upstream of the culvert to maintain traffic during replacement.	Y
Copco Road 200' east of Scotch Creek drainage	Iron Gate	Copco Rd	2	18", 12"	CMP		Assessment of the condition of these pipes would be performed after completion of dam removals and hauling to assess whether any damage occurred during construction. Rehabilitation or replacement would be performed if necessary.	Y (during pipe replacement/repair)
Small cross culverts between Brush Creek and Scotch Creek	Iron Gate	Copco Rd	Multiple	12"-18"	CMP	Pipes spaced every 200' to 300'.	Assess post project for damage due to construction traffic loads over pipe. May require pipe repair or replacement.	Y (during pipe replacement/repair)
Copco Rd at Camp Creek - replace culvert with bridge - see structures table	Iron Gate	Copco Rd	1	10'	CMP arched	Water in culvert.	Significant erosion is anticipated in this area following drawdown of the reservoir due to incision into reservoir sediments. Due to difficulty in knowing exactly when the erosion would occur, it is expected that replacement of the culvert with a bridge will be necessary. Replace with a single span bridge along existing alignment. Provide temporary detour road upstream during replacement.	Y (during replacement)



Definite Plan for the Lower Klamath Project

Appendix L - Cultural Resources Plan

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Prepared for:

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Acronyms and Abbreviations

ACHP Advisory Council on Historic Preservation
ADI Areas of Direct Impacts
AIR Additional Information Request
APE Area of Potential Effects
BCE Before the Common Era
BLM Bureau of Land Management
BMF Bedrock Milling Features
CA California
CDFG California Department of Fish and Game
CEQA California Environmental Quality Act
CRWG Cultural Resource Working Group
CRHR California Register of Historical Resources

EIS/R Environmental Impact Statement/Report
ETH Ethnographic
FIC Field Inventory Corridor
HABS Historic American Building Survey
HAER Historic American Engineering Record
HPMP Historic Properties Management Plan
HIS Historic
KHHD Klamath Hydroelectric Historic District
KRRC Klamath River Renewal Corporation
MUL Multiple
NAGPRA Native American Graves Protection and Repatriation Act
NAHC Native American Heritage Commission
NEPA National Environmental Policy Act
NRHP National Register of Historic Places
NHPA National Historic Preservation Act
OARRA Oregon Archaeological Records Remote Access
OR Oregon
PA Programmatic Agreement
PRE Prehistoric
RM River mile
SCR Sensitive Cultural Resources
SHPO State Historic Preservation Officers
SOHS Southern Oregon Historical Society
SWRCB State Water Resource Control Board
TCP Traditional Cultural Property
TCR Tribal Cultural Resources
TCRe traditional cultural riverscape
THPO Tribal Historic Preservation Officers
UNK Unknown
USACE United States Army Corps of Engineers
USFS United States Forest Service
USGS United States Geologic Survey

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Chapter 1: Introduction

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1. INTRODUCTION

Klamath River Renewal Corporation (KRRC) is preparing the necessary documentation of compliance with all local, state, federal and tribal laws, including those for cultural and tribal resources. This Cultural Resources Plan (Plan) provide the Federal Energy Regulatory Commission (FERC) with a framework for understanding the cultural resources studies that KRRC has completed, those that are currently ongoing, and others that are anticipated to achieve regulatory requirements under Section 106 of the National Historic Preservation Act of 1966 (NHPA) as codified in 36 CFR Part 800. As requested in FERC's July 2017 Additional Information Request (AIR), the Plan also provides the status of informal consultation completed to date by KRRC and PacifiCorp, acting as FERC's non-federal representative under 36 CFR § 800.2(c)(4), in an effort to identify and evaluate cultural resources and develop measures to avoid, minimize, or mitigate potential adverse effects to historic properties (AIR #28). This consultation effort includes affected federally recognized and non-federally recognized tribes with regard to the identification and National Register of Historic Places evaluation of Traditional Cultural Properties; the Klamath Riverscape as a cultural landscape and/or Traditional Cultural Property (TCP); and the management, disposition, and treatment of human remains (AIR #29). The Plan also lays out how KRRC intends to coordinate Section 106 compliance with the cultural resource requirements of the California Environmental Quality Act (CEQA) and the California State Water Resources Control Board's (SWRCB) tribal consultations required under California Assembly Bill (AB) 52. AB 52 compliance is a requirement for the SWRCB's consideration of KRRC's application for a water quality certification under Section 401 of the Clean Water Act.

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Chapter 2: Plan Overview

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2. PLAN OVERVIEW

KRRC developed this Cultural Resources Plan to guide the multifaceted phases of cultural resources compliance actions planned for the Lower Klamath Project (Project). Foremost among these tasks is identification of historic properties in the Project's Area of Potential Effects (APE). Historic properties are cultural resources listed or eligible for listing in the National Register of Historic Places (NRHP). The Advisory Council on Historic Preservation (ACHP) regulations define the APE as the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist. The scale and nature of an undertaking influences the geographic scale of an APE, which may be different for different kinds of effects caused by the undertaking (36 CFR § 800.16(d)). Once defined, the APE will become the primary focus of the Project's cultural and tribal resources studies.

Additional resource identification efforts, effects determinations, and potential mitigation measures also are needed to meet Section 106 requirements, including an assessment of the completeness of previous cultural resource inventories conducted within the APE and particularly in the Areas of Direct Impacts (ADI) from dam removal. Anticipated effects to cultural and tribal resources include, but are not limited to, removal of historic project facilities, including the four dams; disturbances associated with road construction, disposal sites and staging activities; erosion and exposure associated with reservoir drawdown and enhanced river flows; and potential vandalism and theft to re-exposed sites. Cultural resources identification efforts for the Project, including pre-drawdown surveys for portions of the ADI not previously inventoried are underway. Planning efforts are also occurring for drawdown, dam removal, and post-drawdown events. These include developing field inventory and site monitoring procedures to ensure the consideration of effects on anticipated (based on the historic record) and unanticipated cultural and tribal resources.

Previous cultural resources surveys conducted by PacifiCorp in the early 2000s for the Klamath Hydroelectric Project (FERC License No. 2082) relicensing encompassed existing developments on the main stem Klamath River, including the four developments that will be removed by the Project. The PacifiCorp cultural resources study (PacifiCorp 2004) documented hundreds of cultural resources sites within a then-defined Field Inventory Corridor (FIC), although not all identified cultural resources have official NRHP eligibility determinations. The eligibility of many cultural resources within the ADI for the Project requires reevaluation because their eligibility under the Klamath Hydroelectric Project relicensing was never formalized through consultation with the California and Oregon State Historic Preservation Officers (SHPOs), or because other components of the sites were not considered in the original evaluations. New cultural and tribal resources sites identified through ongoing and future survey efforts will also require NRHP evaluation determinations, particularly for those resources within the ADI. Following evaluation and effects assessment, the Project anticipates developing mitigation measures for historic properties that will be adversely affected by the Project.

PacifiCorp completed a NRHP evaluation report of the Klamath Hydroelectric Project, comprised of seven generation facilities and their related resources located along the Klamath River and its tributaries in

Klamath County, Oregon, and Siskiyou County, California. That report included the four developments planned for removal (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate) as part of the Project. The Fall Creek powerhouse, located on a tributary of the Klamath River, just north of Copco No. 2 was also evaluated at that time. A historic context statement (Kramer 2003a) and Determination of Eligibility Report (Kramer 2003b) were developed for the Klamath River Hydroelectric Project District (P-47-004015), noting its NRHP eligibility under Criterion A for its association with the industrial and economic development of southern Oregon and northern California (Kramer 2003b). The California and Oregon SHPOs have not concurred with this eligibility recommendation. Updating these recommended evaluations and achieving their formal eligibility determinations remains an important element to be completed as part of this Cultural Resource Plan.

As part of the 2004 relicensing effort, PacifiCorp sponsored tribal ethnographic studies, prepared by the Klamath, Shasta, Karuk, and Yurok Tribes, which combined ethnography with extensive oral interviews to identify traditional cultural properties/sensitive cultural resources (TCPs/SCRs). PacifiCorp also provided for an investigation of the feasibility of nominating Klamath River corridor as a traditional cultural riverscape/traditional cultural property (TCRe/TCP). The NRHP evaluation of the TCPs, SCRs, and the TCRe was not formalized through consultation with the California and Oregon SHPOs and the associated federal agencies and remains a task for implementation under the Project.

KRRC will prepare a draft Historic Properties Management Plan (HPMP) for the Project which will include management, treatment, protection, and mitigation measures for historic properties, as described in greater detail in Section 8 below and consistent with FERC's "Guidelines for the Development of Historic Properties Management Plans for FERC Hydroelectric Projects" (2002). The HPMP will include an Inadvertent Discovery Plan, which will outline protocols regarding unanticipated finds, as well as a Monitoring Plan to provide general protocols for monitoring historic properties and other select areas that will benefit from monitoring during and following dam removal. Measures to manage, treat, protect, and mitigate historic properties developed under the Section 106 consultation process will be coordinated with the applicable measures developed under the SWRCB's AB 52 consultations.

Finally, both Native American and European American human burial sites have been previously identified in the Project's limit of work. These include individual graves, burials in prehistoric village sites, and prehistoric and historic-period cemeteries along the Klamath River corridor. Adverse effects to human burial sites have been identified as a key concern of tribes, and possible downstream erosion and enhanced river flows may cause degradation of soil and exposure of human burials. Before dam removal occurs, a Plan of Action and protocols for treatment of human burials will be developed by KRRC.

Since the Project meets many of the requirements of 36 CFR § 800.14, a Programmatic Agreement (PA) will be completed during the Section 106 process. The PA will be developed in consultation with the Cultural Resources Working Group (CRWG) and FERC.

Chapter 3: Ongoing Consultations

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3. ONGOING CONSULTATIONS

3.1 Informal Consultation (NHPA)

FERC designated KRRC as its designated non-federal representative, pursuant to Section 106 of the NHPA (54 U.S.C § 300101 et seq.) and the ACHP's regulations at 36 C.F.R. § 800.2(c)(4). In January 2018, KRRC initiated informal consultation with affected tribes and other tribal organizations as FERC's designated non-federal representative, pursuant to Section 106 of the NHPA (54 U.S.C § 300101 et seq.) and the ACHP regulations at 36 C.F.R. § 800.2(c)(4). Twenty-five federally and non-federally recognized Tribes located in northern California and southern Oregon received invitation letters to participate in the informal consultation process and included tribes previously identified by FERC during its tribal consultation efforts as well as by the California Native American Heritage Commission (NAHC) List and Oregon Commission on Indian Services. The invitation was extended to federally recognized tribes consistent with 36 CFR 800.2(c)(2) and non-federally recognized tribes pursuant to 36 CFR 800.2(c)(5). Currently eight tribes have accepted participation in the ongoing informal consultation with KRRC: Karuk Tribe, Klamath Tribes, Modoc Tribe of Oklahoma, Quartz Valley Indian Reservation, Shasta Indian Nation, Shasta Nation, Cher'Ae Heights of the Trinidad Rancheria, and the Yurok Tribe. KRRC held a project introduction meeting with the participant Tribes on April 6, 2018 in Yreka, California. This meeting provided a project overview, reviewed the previous cultural resource studies, discussed the informal consultation process, and provided an overview and invitation to the tribes to participate in the CRWG (see below). Additional meetings and consultation efforts pursuant to Section 106 with tribes and other interested parties will continue.

Among the topics requiring tribal consultation are the delineation of the APE, the identification and evaluation of TCPs, the proposed Klamath Cultural Riverscape, and the management and disposition of cultural and human remains. KRRC is preparing a cultural resources work plan to guide the Section 106 process through the course of the Project. This work plan includes the written definition of a preliminary APE; a discussion of the integration of the proposed Klamath Cultural Riverscape into the APE; draft protocols for inadvertent discoveries; and an outline for a Plan of Action and appropriate treatment of human remains, funerary objects, sacred objects, and objects of cultural patrimony.

3.2 California Consultations

KRRC is participating in related tribal cultural resources consultation efforts being conducted by the SWRCB for the Project. SWRCB is conducting their consultation as part of CEQA review for KRRC's application for a Water Quality Certification for the Project pursuant to Assembly Bill 52 (AB 52). AB 52 requires California state and local agencies to consider a proposed action's impacts to Tribal Cultural Resources (TCRs) as part of the agency's review of the proposed action under the CEQA. A TCR is defined as a site, feature, place, cultural landscape, sacred place, or object with cultural value to a California Native American tribe. California Native American tribes are those tribes registered with the California NAHC, regardless of whether the tribes are federally-recognized. KRRC's tribal resources lead has participated in meetings and teleconferences held between the SWRCB and the tribes engaged in the AB 52 consultation. As this California AB 52 tribal consultation process will overlap in part with the Section 106 consultation, KRRC will make efforts to coordinate and integrate the two processes to the extent feasible and as appropriate.

Chapter 4: Cultural Resources Working Group

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4. CULTURAL RESOURCES WORKING GROUP

KRRC has established a CRWG to provide a collaborative and interactive process for data sharing, participation, and discussion among the applicants, tribes, and resource agencies during the Section 106 consultation process. The CRWG is comprised of representatives from federal agencies with administered lands in the project APE (U.S. Forest Service and Bureau of Land Management; Figure 4-1), as well as California and Oregon SHPOs and tribes (Table 4-1). Other invited parties include the Bureau of Reclamation and United States Army Corps of Engineers (USACE) who have currently elected not to participate. KRRC expects membership of the CRWG to expand as consultation proceeds.

The goals of the CRWG include: (1) definition of the project APE; (2) preparation of a Programmatic Agreement and other guidance documents; (3) overall guidance on the scope and level of effort required for inventory and evaluation of historic, archaeological, and tribal resources; (4) assessment of effects to Historic Properties; (5) identification and implementation of mitigation measures. In addition, KRRC will consult with the CRWG in the development of a HPMP.

The CRWG held an initial meeting on September 5, 2017, the purpose of which was to provide working group members with background information on the Project, status of cultural resources inventory and evaluation efforts, and allow for the identification and discussion of the CRWG's goals and objectives. Subsequent to that meeting, KRRC developed a preliminary APE for the Project.

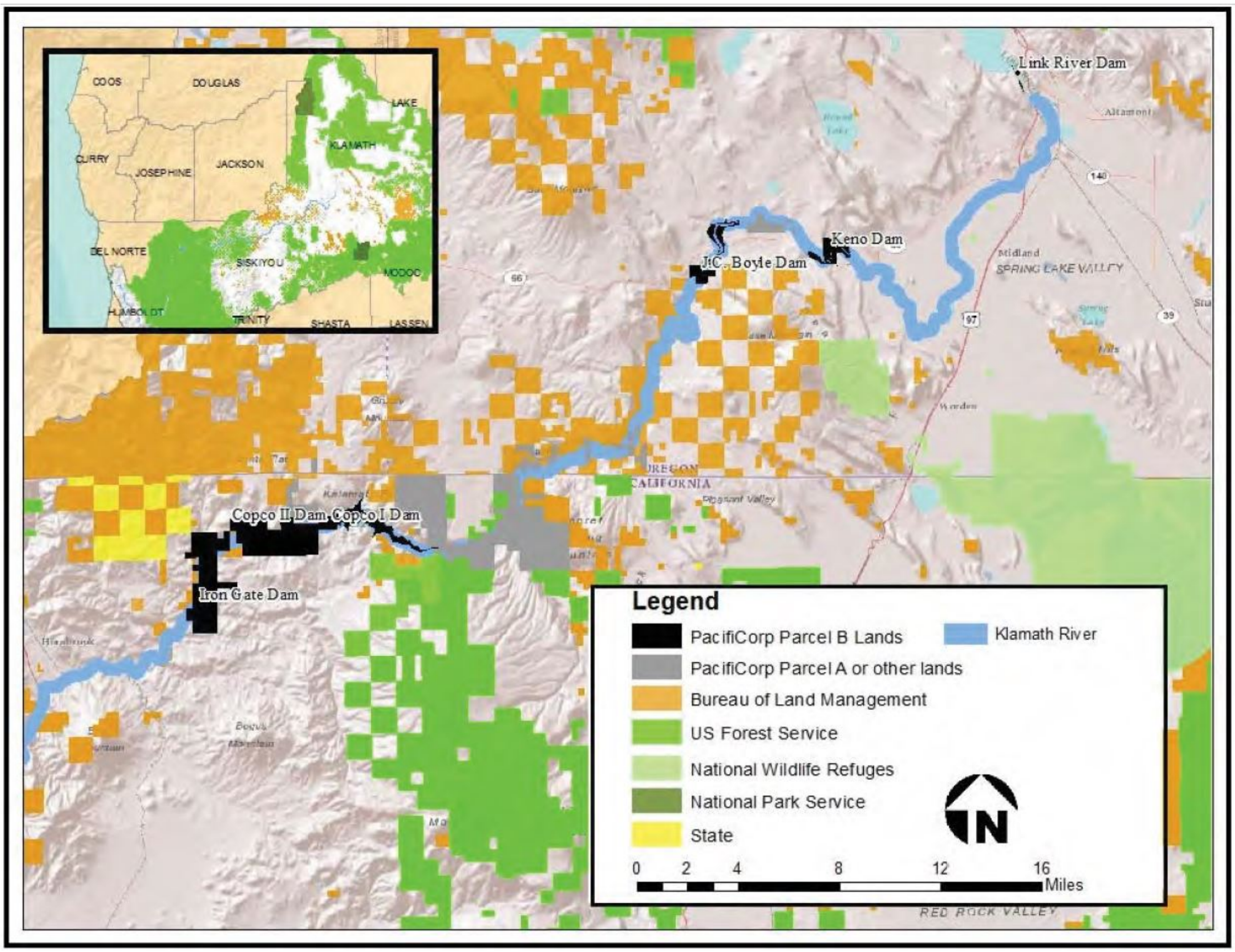
KRRC hosted a second meeting on December 14, 2017 to review the KRRC's draft APE. A third CRWG meeting occurred on March 15, 2018 to provide an update on Section 106 consultation, the project schedule, anticipated field work dates, next steps in SHPO consultation, and outlining the process for developing the Section 106 agreement document. KRRC plans to hold the next CRWG meeting in August 2018.

Table 4-1 Current Participants - Cultural Resources Working Group

Agency/Entity	Status
KRRC	Applicant
PacifiCorp	Applicant
AECOM	Technical Representative
CDM Smith	Technical Representative
USDA Forest Service, Klamath National Forest	Federal
Bureau of Land Management, Klamath Falls, Oregon and Redding, California Field Offices	Federal
California Office of Historic Preservation	State of California

Agency/Entity	Status
Oregon State Historic Preservation Office	State of Oregon
Cher'Ae Heights of Trinidad Rancheria	Tribe
Karuk Tribe	Tribe
Klamath Tribes	Tribe
Modoc Tribe of Oklahoma	Tribe
Quartz Valley Indian Reservation	Tribe
Shasta Indian Nation	Tribe
Shasta Nation	Tribe
Yurok Tribe	Tribe

KRRC also anticipates outreach to local municipalities, museums and historical societies, and other entities that may have an interest in the consideration and treatment of historic properties. KRRC will send letters to these parties to seek and consider their views concerning the identification, evaluation, and treatment of historic properties.



Source: 2012 EIS/R (USBR and CDFW 2012)

Figure 4-1 Land ownership in the project vicinity

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Chapter 5: Definition of the Area of Potential Effects

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5. DEFINITION OF THE AREA OF POTENTIAL EFFECTS

Implementing regulations of the NHPA require federal undertakings to determine the scope of identification efforts (36 CFR § 800.4(a)). This is accomplished in part by determining and documenting the APE (36 CFR § 800.4(a)(1)). The APE means the "geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist." Furthermore, the APE "is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking" (36 CFR § 800.16(d)). Inclusion of land within an APE does not mean that an undertaking would affect any or all cultural resources in that area. Defining an APE provides both the lead federal agency and consulting parties with a basis for understanding the geographic extent of anticipated impacts of a proposed project, which is necessary to determine whether the project may adversely affect historic properties.

As the lead federal agency for the Project, FERC defines the APE, in consultation with other federal agencies, tribes, SHPOs, THPOs, KRRC, PacifiCorp, and other consulting parties. KRRC and PacifiCorp, in collaboration with the CRWG members and tribes are in the process of developing a preliminary APE and will continue to refine the APE as a part of the Section 106 process. The KRRC is currently receiving comments from the participants in the Section 106 process and will engage in additional consultation to address agency/entity concerns.

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Chapter 6: Resource Identification

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6. RESOURCE IDENTIFICATION

6.1 Records Search Update

As part of the Klamath Hydroelectric Relicensing (FERC 2007) and Klamath River Dam Removal (USBR 2012) studies, PacifiCorp (2004) and Cardno ENTRIX (2012) completed cultural resources records searches to collect information of previous archaeological research and historical information. These earlier record searches provided baseline resource data for the respective project areas through 2012. In 2017, KRRC completed an updated records search and literature review for the Project to add information for the intervening 5-year period, or through 2017. The cumulative results of the 2017 KRRC records searches are summarized first, followed by State-specific summaries.

The 2017 KRRC records search area extended from the outlet of the Klamath River at the southern end of Upper Klamath Lake in Klamath County, Oregon (RM 255) downstream to the confluence of Klamath River and Humbug Creek in Siskiyou County (RM 174), for a total of 81 river miles. The section of river below Iron Gate Dam (the downstream-most Project development) was included in the initial records search since this area lies within the altered 100-year floodplain following dam removal, where cultural resources have the potential to be affected. The records search area encompassed a 0.5-mile wide zone, extending on either side of the shorelines of Lake Ewauna, Link River, J.C. Boyle Reservoir, Copco Lake, and Iron Gate Reservoir, or from the center point of the Klamath River in areas where a flowing river exists. The records search identified 502 previously recorded cultural resources, comprised of a broad range of archaeological sites, built environment resources, isolated finds, and a few locations of an undetermined resource type (Table 6-1).

In response to the delineation of a preliminary APE, KRRC initiated an expanded records search in 2018 for an area encompassing a 0.5-mile wide zone on either side of the Klamath River from below Humbug Creek to the mouth of the river at the Pacific Ocean, in California. KRRC will incorporate results of the 2018 expanded records search for California into future reports and are not reflected in the discussion and tables provided below.

The 2017 records search identified 290 previously recorded archaeological sites, including 170 sites in Oregon and 120 sites in California. Collectively, these sites consist of 162 prehistoric resources, 19 of which have documented ethnographic associations or uses. Also recorded are 83 historic-period archaeological sites and 44 sites with both prehistoric and historic-period components. These latter sites, termed multiple component sites, include at least eight locations that have documented ethnographic use. The final archaeological site consists of a resource of unknown temporal association.

Table 6-1 Summary of Previously Recorded Cultural Resources for Oregon and California (2017 Records Search).

Resource Type	Component Type					
	Prehistoric	Historic	Multiple	Ethnographic Only	Unknown	Total
Archaeological Site	162	83	44	–	1	290
Ethnographic	–	–	–	1	–	1
Built Environment	–	24	3	–	–	27
Isolated Find	158	17	–	–	1	176
Undetermined	–	–	–	–	8	8
Total	320	124	47	1	10	502

One resource has been recorded as an ethnographic location that figures prominently in an important legend in Shasta Indian oral history.

A group of 27 built environment resources, comprised of manufactured structures, features, and facilities, have been previously recorded, including 15 in Oregon and 12 in California. The built environment resources include intact structures, such as log cabins and sheds; power facilities, including powerhouses; bridges; boardwalks; cemeteries; a lumberyard; a commercial sawmill; and other constructed features.

Eight resources of undetermined resource type or age have been reported in California. While the physical location for these sites has been recorded, other information such as the types of artifacts and/or features present is unavailable.

The final resource type consists of a group of 176 isolated finds, which typically represent locations with five or fewer artifacts or single features. These finds include 108 isolates in Oregon and 68 isolates in California. The isolated finds encompass 158 prehistoric resources, 17 historic-period isolates, and 1 feature of unknown age.

6.1.1 Oregon Records Search

Within the State of Oregon, the 2017 records search area included the length of the Klamath River from its outlet at Upper Klamath Lake at Link River Nature Trailhead (RM 255) south to the Oregon/California Stateline (RM 214), for a total length of roughly 41 river miles. This river stretch also included the Link River and Lake Ewauna. The records search area encompassed a 0.5-mile wide zone, extending on either side of the shorelines of Lake Ewauna, Link River, and J.C. Boyle Reservoir, or from the center point of the Klamath River in areas where the river remains free flowing.

In April 2017, KRRC reviewed records on file at the Oregon SHPO to determine the extent of previously recorded cultural resources and past investigations within Oregon records search area. This records search was conducted using the Oregon Archaeological Records Remote Access (OARRA) GIS database maintained by the Oregon SHPO. This database contains all cultural resources reports and resource forms approved by SHPO and provides information on the location of previously recorded archaeological sites, cultural resource surveys, National Register properties, and cemeteries. In addition, KRRC also reviewed the separate Oregon SHPO online Oregon Historic Sites Database to collect information regarding built environment resources located within the records search area.

In July 2017, KRRC conducted a records search at the BLM Klamath Falls Resource Area office in Klamath Falls, Oregon. KRRC examined cultural resources files for government lands in Klamath County, Oregon, for recent project reports and copies were made of relevant reports and resource records. In October 2017, KRRC visited the Southern Oregon Historical Society (SOHS) Library in Medford, Oregon to examine the John C. Boyle papers, maps, and photograph collection pertaining to the Klamath River area.

In addition to these office visits, KRRC researched online newspaper archives, including the National Digital Newspaper Program archives provided by the Library of Congress and National Endowment for the Humanities (chroniclingamerica.loc.gov); GeneaologyBank newspaper archives provided by NewsBank, Inc. (geneaologybank.com); the California Digital Newspaper Collection repository provided by University of California, Riverside (cdnc.ucr.edu); and newspaper archives provided by Ancestry.com. KRRC also reviewed copies of the Klamath County Historical Society Klamath Echoes for relevant site and historic context information.

In May 2017, KRRC requested and received cultural sources data from PacifiCorp, including GIS shapefiles with previous survey and resource locations, as well as a copy of the final cultural resources technical report for Klamath Hydroelectric Relicensing Project (PacifiCorp 2004).

Previous Cultural Resources Studies

The 2017 Oregon records search and literature review identified 119 previous cultural resources investigations as having been conducted within the records search area, with five of these studies (Kramer 2003a, 2003b; Cardno ENTRIX 2012; PacifiCorp 2004; Daniels 2006) completed specifically for the Project. Collectively, these reports provide a broad range of reference materials derived from pedestrian surveys, archaeological testing and evaluation, prehistoric and historic-period context documents, and professional studies. Most reports (n=79) detail the results of cultural resources surveys or survey/excavation work conducted across the records search area. Twenty-three reports consist of archaeological, ethnographic, or historical overviews that include the Klamath River area. An additional 10 reports describe archaeological excavations and one report focuses on an archaeological survey and provides a cultural overview. Also included are two archaeological research designs, one scope of work, one Ph.D. dissertation, and two professional papers.

Previously Recorded Cultural Resources

The 2017 Oregon records search identified 296 previously recorded cultural resources, consisting of 170 archaeological sites, 18 built environment resources, and 108 isolated finds (Tables 6-2). By component type, these resources include 206 prehistoric, 65 historic-period, 24 multiple (prehistoric and historic-period), and 1 resource of unknown temporal association.

Table 6-2 Oregon - Previously Recorded Resources by Resource Type and Component

Resource Type	Component Type				
	Prehistoric	Historic	Multiple	Unknown	Total
Archaeological Site	113	35	21	1	170
Built Environment	–	15	3	–	18
Isolated Find	93	15	–	–	108
Total	206	65	24	1	296

Archaeological Sites

Archaeological sites represent roughly 57 percent of the previously recorded resources in Oregon. The sites consist of 113 prehistoric, 35 historic-period, 21 multiple components, and 1 unknown component property. The prehistoric component sites include housepit villages; lithic scatters; bedrock milling features (BRMs); lithic scatters with associated cultural features; one toolstone quarry; peeled trees; village sites and lithic scatters with human burials; a rockshelter with human burials; a cremation site; and rock art sites.

The historic-period archaeological sites include late-nineteenth or early-twentieth century properties associated with the development of agriculture including abandoned ditches or other features such as homesteads; logging; public works (hydroelectric); transportation (railroad berms); and recreation. Agricultural-related sites include settlements (homesteads) with or without features, irrigation ditches, rock walls, cairns, and artifact scatters. Logging-related sites include a portable sawmill location and artifact scatters. Homesteads include the remains of Hoover's 41 Ranch and artifact scatters. The former locations of a dam and powerhouse near Keno represent public works sites. Transportation-related sites consist of an abandoned segment of the Weyerhaeuser Railroad grade and other railroad berms. Also related to transportation is Robber's Rock, a large boulder, historically used as a hiding spot for stagecoach thieves.

The multiple component sites comprise both prehistoric and historic-period archaeological components. Prehistoric components associated with these sites include housepit villages, a housepit village with a documented historic-period boat landing, lithic scatters, and a rock art panels with both prehistoric and historic elements. Historic-period components comprise historic homesteads or ranches and artifact scatters, and water conveyance ditches.

One peeled tree represents an unknown component of either prehistoric or historic-period use.

Information regarding the NRHP eligibility of the archaeological sites is based on recommendations provided by Cardno ENTRIX (2012), or by eligibility information noted on site records that were updated since preparation of the Cardno ENTRIX study. Overall, 38 archaeological sites are considered NRHP-eligible, 53 sites are potentially eligible for listing, 8 sites are not eligible, and 71 sites are either unevaluated or have undetermined NRHP eligibility status.

Built Environment Resources

The Oregon records search identified 18 properties with built environment resources, including 15 historic-period and 3 multiple component locations. Collectively, the built environment resources are associated with the historic themes of commerce, settlement, transportation, public works, and recreation or tourism.

The commerce-themed resources include the Weyerhaeuser Company Mill Complex, a water tower, and a lumberyard. Settlement-related sites include a log cabin, a shed, a split rail fence, the Frain Ditch, the Way Ranch Complex, the Topsy/Frain School, Way Cemetery, Spencer Cemetery, and grave and structural remains at Hoover's 41 Ranch. Transportation-related resources include a bridge and an associated boat dock. Public works resources include two hydroelectric powerhouses, comprised of the westside and eastside plants at Klamath Falls. Recreation or tourism is represented by a group of boardwalks for wildlife viewing. The final built environment resource consists of a New Age rock medicine wheel.

NRHP eligibility information for these resources indicates that eight are NRHP-eligible properties, including the Way Station/Ranch Complex, Topsy/Frain School, Frain Ranch, the westside and eastside powerhouses, a lumberyard with nine features near Lake Ewauna, Hoover's 41 Ranch, and the Weyerhaeuser Company Mill Site. Three built environment resources have been assessed as not eligible, including a bridge and dock, a water tower, and boardwalks associated with wildlife viewing. Four built environment resources are unevaluated and three other resources are classified as undetermined concerning NRHP eligibility.

Isolated Finds

The Oregon records search identified 108 isolated finds, consisting of 93 prehistoric and 15 historic-period resources. Prehistoric isolates include 5 ground stone tools, 1 ground stone tool with debitage, 1 exposure of multiple ground stone tools, 27 single flakes, 36 locations with multiple flakes, 18 flaked stone tools, 4 flaked stone tools with debitage, and 1 flaked stone tool with a battered stone tool. The ground stone tools include pestles, a mano, a metate fragment, bowl mortar fragments, and unspecified objects. The flaked stone tools include chert cores, flake tool, and scrVCrs; obsidian projectile points and fragments, bifaces and fragments, and a flake tool; and one uniface of unspecified material. Debitage comprises obsidian, chert, and basalt flakes.

The historic-period isolates consist of one metal watering can, two bottle glass fragments, one automobile body, one blazed tree, one dump of oyster shell, seven debris scatters or dumps, and two areas containing multiple dumps possibly associated with logging.

6.1.2 California Records Search Results

Within the State of California, the 2017 KRRC records search area included the length of the Klamath River from the Oregon/California Stateline (RM 214), downstream to Humbug Creek (RM 174), for a total length of roughly 40 river miles. The section of river below Iron Gate Dam (the downstream-most project development) was included in the records search since this 18-mile-long area lies within the altered 100-year floodplain following dam removal, where the Project has the potential to affect cultural resources. The records search area included a 0.5-mile wide zone, extending on either side of the shorelines of Copco Lake and Iron Gate Reservoir, or from the center point of the Klamath River in areas where the river remains free flowing.

In 2017, KRRC completed two records searches for the Project in California. In April 2017, KRRC conducted a review of the records housed at the Northeast Information Center at California State University, Chico. Research included gathering archaeological site forms, survey and excavation reports, maps, and other records. Survey and site locations were hand-plotted onto United States Geologic Survey (USGS) topographic maps at the Northeast Information Center. Archival research of historic registers included the California Historic Landmarks, NRHP, California Register of Historical Resources (CRHR), and California Points of Historical Interest, California Inventory of Historic Resources, and the California State Historic Resources Inventory. Also in April 2017, KRRC visited the Klamath National Forest office and the Siskiyou County Museum, both in Yreka, California. Klamath National Forest Heritage Program Manager Jeanne Goetz conducted a search of records for Forest Service lands within or near the records search area and provided appropriate archaeological site record forms.

In addition to these office visits, KRRC searched online newspaper archives, including the National Digital Newspaper Program archives provided by the Library of Congress and National Endowment for the Humanities (chroniclingamerica.loc.gov); GeneaologyBank newspaper archives provided by NewsBank, Inc. (geneaologybank.com); the California Digital Newspaper Collection repository provided by University of California, Riverside (cdnc.ucr.edu); and newspaper archives provided by Ancestry.com.

KRRC contacted the NAHC in June 2017, to secure a review of the Sacred Lands file for a 0.5-mile wide area on either side of the Klamath River corridor, extending from the California-Oregon state line downstream to the Pacific Ocean. In a June 14, 2017 letter, the NAHC stated that there was a positive result, with the recommendation to contact the Karuk Tribe, the Yurok Tribe, and Shasta Nation. The NAHC also provided a consultation list of tribes with traditional lands or cultural places located within the boundaries of Del Norte, Humboldt, and Siskiyou counties.

Previous Cultural Resources Studies

The 2017 California records search and literature review identified that 58 previous cultural resources investigations have been conducted within the records search area, with 5 of these studies (Kramer 2003a, 2003b; Cardno ENTRIX 2012; Durio 2003; PacifiCorp 2004) completed specifically for the Project. Fourteen of these studies are archaeological, ethnographic, or historical overviews, while eight reports describe archaeological excavations. Two studies involved cultural resources monitoring, while the remaining 34 projects involved archaeological survey or inventory. Overall, an estimated 8,189 acres of federal, state, and/or private land have been surveyed within the records search area, although survey acreage information was not available for all projects covered in the reports.

Previously Recorded Cultural Resources

The 2017 California record searches identified 206 previously recorded cultural resources, consisting of 120 archaeological sites, 1 ethnographic property, 9 built environment resources, 68 isolated finds, and 8 resources of an undetermined resource type (Tables 6-3). By component type, these resources include 114 prehistoric, 59 historic-period, 23 multiple (prehistoric and historic-period), 1 ethnographic property, and 9 resources whose temporal association is unknown.

Table 6-3 California - Previously Recorded Resources by Resource Type and Component

Resource Type	Component Type					
	Prehistoric	Historic	Multiple	Ethnographic	Unknown	Total
Archaeological Site	49	48	23	0	–	120
Ethnographic	–	–	–	1	–	1
Built Environment	–	9	–	–	–	9
Isolate	65	2	–	–	1	68
Undetermined	–	–	–	–	8	8
Total	114	59	23	1	9	206

Archaeological Sites

Archaeological sites represent roughly 60 percent of the previously recorded resources. The sites consist of 49 prehistoric, 48 historic-period, and 23 multiple components. Identified prehistoric period sites include housepit villages; campsites; lithic scatters; lithic scatters with associated cultural features; toolstone quarries; a possible vision quest site with multiple features; and a human burial site.

The historic-period archaeological sites consist of late-nineteenth or early-twentieth century properties associated with the development of agriculture, including settlements or features such as homesteads; logging; mining; commercial; public works (hydroelectric); and transportation. Agricultural-related sites include settlements (homesteads) with or without features, irrigation ditches, rock walls, piled rock in agricultural fields, and artifact scatters.

Logging-related sites focus on elements of the former Klamathon townsite, including the town and lumber mill and the associated Pokegama log chute and ditch flume. Mining related sites, located in the Klamath River area below Hornbrook, include two quartz mines and four placer mines with ditches and/or tailings. The collective Beswick Hotel, ranch, and Klamath Hot Springs area represent the single commercial property. An extensive refuse scatter associated with the Copco No. 1 Village is the sole public works site. Finally, transportation-related sites consist of an abandoned segment of the Klamath Lake Railroad, a collapsed trestle and segment of railroad grade, a segment of Topsy Road, a road leading to Horseshoe Ranch, and a segment of the California-Oregon Stage Road.

The multiple component sites include both prehistoric and historic-period components. Prehistoric components associated with these sites include housepit villages, a housepit village with a documented historic-period cemetery, lithic scatters, a toolstone quarry, and a rockshelter. Historic-period components comprise mining camps and/or tailing, agricultural-related resources such as historic ranches and artifact scatters, and a possible commercial property associated with a former saloon.

A group of eight sites, termed the Pollock Sites, represent unknown site components. Currently, the only information available for these sites relates to their location, which is noted along the Klamath River between Klamathon and Humbug Creek.

Information regarding the National Register eligibility of the archaeological sites is based on recommendations provided by Cardno ENTRIX (2012), or by eligibility information noted on new or updated site records that were not part of the Cardno ENTRIX study. Of the 120 archaeological sites, one property is listed in the National Register as a contributor to a district, one site is determined individually eligible, three sites are contributors to a district determined eligible, 29 sites appear eligible for listing, two sites might become eligible for listing when more historical research is performed; four sites have been found ineligible; and the remaining 80 sites have not been evaluated for NRHP eligibility.

Ethnographic Resource

The records search identified one resource that figures prominently in an important legend in Shasta Indian oral history. This resource appears eligible for listing in the National Register.

Built Environment Resources

The 2017 California records search identified nine historic-period built environment resources associated with the historic themes of commerce, settlement, transportation, and public works. The single commerce-themed resource includes a former service station converted to residence (Klamath Kamp). Two settlement-related sites have been recorded, consisting of a post-1930s duplex residence with associated structures and the Frank Wood cabin, a late 1890s to 1950s era homesite. Transportation-related sites consist of a one-lane, wooden and steel beam truss bridge over the Klamath River (Ash Creek Bridge), and a two-lane, concrete, T-beam Bridge over the Klamath River (Bridge 02-0015). Public works sites include four recorded elements of the Klamath Hydroelectric Project, including Copco No. 1 hydroelectric powerhouse and dam; Copco No. 2 hydroelectric powerhouse; Fall Creek hydroelectric powerhouse; and the Copco No. 2 wooden stave penstock. The Fall Creek Powerhouse coincides with the reported location of an ethnographic Shasta Indian village; however, this component of the site has not been archaeologically recorded.

Besides these nine built environment resources, standing historic-period structures have been identified at several archaeological sites, including a ranch house and bunkhouse at the Beswick Hotel site (CA-SIS-513-H) and a shed at Copco II Ranch (CA-SIS-2239-H). The historic Spannaus Barn was noted at prehistoric/ethnographic site CA-SIS-2574, but was not recorded as an element of the site.

NHRP eligibility information for these nine sites indicates that the two Klamath River bridges have been determined eligible for listing. The four hydroelectric-related sites were noted by Cardno ENTRIX (2012) as appearing eligible for separate listing, but these sites have also been documented as contributing elements to the Klamath Hydroelectric Historic District (Kramer 2003b), which has yet to be concurred upon by the California and Oregon SHPOs. Also recommended as NRHP-eligible is the Frank Wood cabin. The final two resources, composed of a residence and a former service station, have been noted as not eligible for the NRHP.

Isolated Finds

The 2017 California records search identified 68 isolated finds, including 65 prehistoric resources, 2 historic-period isolates, and 1 isolated feature of unknown age. Prehistoric isolates include one small rock cairn, one bedrock milling feature, one location with two possible cupule boulders, one incised cobble, one piece of possible ground stone, one unifacial mano, one cobble mortar, one basalt maul, three obsidian biface fragments, one chert biface fragment, one basalt core, nine chert cores, one jasper core, two chert flake tools, one chert barbed projectile point, one chert projectile point midsection, one chert scraper, and four obsidian unifaces. Forty-one isolate locations were found to contain debitage, ranging from 1 flake to as many as 13 flakes in a single location. Debitage includes obsidian, chert, and basalt. Eleven isolates contain both tools and debitage.

The historic-period isolates consist of one rusted horseshoe and the remains of a wagon. The isolate of unknown age is described as a rocky depression.

6.1.3 Archaeological Districts

FERC Relicensing Study Proposed Archaeological Districts, California and Oregon

As part of the Klamath Hydroelectric Project relicensing study (FERC 2007), five areas of multiple prehistoric sites were identified along the same section of the Klamath River that was considered as a potential National Register District (PacifiCorp 2004:3-198-199; FERC 2007:3-544). This district included four groups of multiple sites in Oregon located at the head of Link River and the mouth of Upper Klamath Lake, Teeter's Landing, Spencer Creek/mouth of upper Klamath River Canyon, and near Frain Ranch. In California, a cluster of three villages near Fall Creek, in the Copco Lake area, comprised the fifth potential district group (Table 6-4). The National Register eligibility of these districts has not been finalized.

A historic-period archaeological district was also considered for the Frain Ranch, in Oregon (PacifiCorp 2004:3-200). Due to their association with early homesteading and the beginning of ranching and agriculture within the upper Klamath River, four Frain ranch area sites were envisioned for this district. The National Register eligibility of this district has not been finalized.

Table 6-4 FERC Relicensing Study Proposed Archaeological Districts

District Type	Area
Prehistoric	Link River area and mouth of Upper Klamath Lake, OR
	Teeter's Landing, OR
	Spencer Creek/mouth of upper Klamath River Canyon, OR
	Near Frain Ranch, OR
	Fall Creek Villages, near Copco Lake, CA
Historic	Frain Ranch, OR

Upper Klamath River Stateline Archaeological District, California

The newly designated Upper Klamath River Stateline Archaeological District (Bureau of Land Management 2016) is located along the upper Klamath River, in California. The district encompasses three pre-contact village sites (contributing) and one lithic scatter (non-contributing). Archaeological research indicates site use in the district extended from circa 1,000 years Before the Common Era (BCE) or earlier to possibly as late as 1840 BCE (BLM 2016). The district was determined eligible for the National Register at the local level of significance under Criterion D in the areas of Prehistoric Archaeology, Native American Ethnic Heritage, Commerce, Economics, Religion, and Politics/Government. The California SHPO and the Keeper of the National Register have concurred with the district's eligibility.

Klamath River Canyon Archaeological District, Oregon

An archaeological study conducted in the upper reaches of the Klamath River Canyon in 2008 by Central Washington University (McCutcheon and Dabling 2008) examined the NRHP eligibility of 19 prehistoric and historic-period sites located along the river corridor between the California/Oregon Stateline and J.C. Boyle Dam. NRHP eligibility recommendations were provided using information gathered during field visits, preparation of updated site records, and the assessment of a site's research potential and integrity; no new subsurface testing was conducted, although previous excavations had been conducted at some of the sites. Thirteen of the 19 sites were recommended NRHP eligible under Criterion D, while the remaining six sites were assessed as unevaluated resources, requiring additional data to make a determination. Recommendations included consideration of an Archaeological District nomination for the NRHP-eligible resources as a way to provide a broader context to evaluate the archaeological record of the Klamath River Canyon (McCutcheon and Dabling 2008). Documentation and nomination of such a district has not been completed.

Klamath River Hydroelectric Project District

The Klamath Hydroelectric Project comprises seven hydroelectric generation facilities and their related resources located along the Klamath River and its tributaries in Klamath County, Oregon and Siskiyou County, California. Beginning at the Link River Dam, in Klamath Falls, Oregon, the project boundary continues southwest along the Klamath River to include the Keno Dam Complex and the J.C. Boyle Complex in Oregon. Within California, the Klamath Hydroelectric Project boundary includes the Fall Creek, Copco No. 1 and Copco No. 2 complexes, and terminating at Iron Gate Dam. The Klamath Hydroelectric Project facilities were constructed between 1903 and 1958 by the California Oregon Power Company (COPCO) and its predecessors and are now owned and operated by PacifiCorp under FERC License Nos. 2082 (Kramer 2003a, b) and 14803.

The proposed Klamath River Hydroelectric Project District (P-47-004015) includes the hydroelectric facilities and various diversion dams; support structures; linear elements such as flumes, canals, and tunnels; and other related buildings and structures. A historic context statement (Kramer 2003a) and Determination of Eligibility (Kramer 2003b) developed for the Klamath Hydroelectric Project notes its eligibility to the National Register as a District under Criterion A for its association with the industrial and economic development of southern Oregon and northern California (Kramer 2003b). The California and Oregon SHPOs have not concurred with this eligibility recommendation. Table 6-5 identifies key features of the hydroelectric complexes located in Oregon and California that are part of the Klamath River Renewal Project and their National Register eligibility recommendation.

Table 6-5 Summary of National Register Eligibility Recommendations for the Klamath Hydroelectric District Facilities/Components

Facility/Description	Date	National Register Eligibility Recommendation and Reference	
		Kramer 2003b	EIS/R 2012
J.C. Boyle Complex			
Dam	1956-1958	Historic Contributing	Historic Contributing
Communications Building	Ca. 1995	Non-Contributing	Non-Contributing
Fire Protection Building	Ca. 1995	Non-Contributing	Non-Contributing
Red Barn	Ca. 1958, altered 1978	Non-Contributing	Non-Contributing
Maintenance Shop	1991	Non-Contributing	Non-Contributing
Residence 1	Ca. 1985	Non-Contributing	-
Residence 2	Ca. 1985	Non-Contributing	-
Water Conveyance Features	1958		Potentially Contributing
Steel Pipe	1958	Historic Contributing	Historic Contributing
Flume Headgate	2002	Non-Contributing	Non-Contributing
Open flume/Concrete	1958	Historic Contributing	Historic Contributing
Headgate Structure	1958	Historic Contributing	Historic Contributing
Forebay/spillgates	1958	Historic Contributing	Historic Contributing
Spillway House	Ca. 1958	Historic Contributing	Historic Contributing
Tunnel	1958	Historic Contributing	Historic Contributing
Surge Tank	1958	Historic Contributing	-

Facility/Description	Date	National Register Eligibility Recommendation and Reference	
		Kramer 2003b	EIS/R 2012
Penstocks	1958	Historic Contributing	Historic Contributing
Powerhouse	1958	Historic Contributing	Historic Contributing
Substation	1958	Historic Contributing	Historic Contributing
Residential Site	Ca. 1950/1995	Non-Contributing	-
Armco Warehouse	1957	Historic Contributing	Historic Contributing
Copco No. 1 Complex			
Dam	1912-1918, 1921-1922	Historic Contributing	Historic Contributing
Gatehouse 1	1918	Historic Contributing	Historic Contributing
Gatehouse 2	1922	Historic Contributing	Historic Contributing
Gate Hoist System/Rails	1918	Historic Contributing	Historic Contributing
Single and Double Penstocks	1912-1918	Historic Contributing	Historic Contributing
Powerhouse	1918	Historic Contributing	Historic Contributing
Copco Guesthouse (remains)	1917, 1980s	Historic Contributing	-
House/Garage 1	ca.1922	Historic Contributing	-
House/Garage 2 (21600 Copco Rd)	ca.1922	Historic Contributing	-
Garage/Warehouse	ca.1922	Historic Contributing	-
Copco No. 2 Complex			
Dam	1925	Historic Contributing	Historic Contributing
Water Conveyance Features	1925	Historic Contributing	Historic Contributing
Headgate	1925 (rebuilt)	Historic Contributing–	Historic Contributing
Tunnel Intake	1925	Historic Contributing	Historic Contributing
Concrete-lined Tunnel	1925	Historic Contributing	Historic Contributing
Wood Stave Pipeline	1925	Historic Contributing	Historic Contributing
Concrete Tunnel	1925	Historic Contributing	Historic Contributing
Steel Penstocks	1925	Historic Contributing	Historic Contributing
Timber Cribbing	1925	Historic Contributing	Historic Contributing
Coffer Dam	1925	Historic Contributing	Historic Contributing
Powerhouse	1925, 1996	Historic Contributing	Historic Contributing
Control Center/Office	ca. 1980	Non-Contributing	-
Maintenance Building	1991	Non-Contributing	-
Oil and Gas Shed		Historic Contributing	-

Facility/Description	Date	National Register Eligibility Recommendation and Reference	
		Kramer 2003b	EIS/R 2012
Cookhouse/Bunkhouse	ca. 1925	Historic Contributing	-
Modern Bunkhouse	ca. 1960	Non-Contributing	-
Garage/Accessory Building	ca. 1960	Non-Contributing	-
Ranch Housing	ca. 1965		
Ranch House 1	ca. 1965	Non-Contributing	-
Ranch House 2	ca. 1965	Non-Contributing	-
Ranch House 3	ca. 1965	Non-Contributing	-
Bungalow Housing	ca. 1925		
Bungalow/Garage 1	ca. 1925	Historic Contributing	-
Bungalow/Garage 2	ca. 1925	Historic Contributing	-
Bungalow/Garage 3	ca. 1925	Historic Contributing	-
Modular Residences	1985		
Modular 1	1985	Non-Contributing	-
Modular 2	1985	Non-Contributing	-
Modular 3	1985	Non-Contributing	-
School House/Comm.Center	1965	Non-Contributing	-
Iron Gate Dam Complex			
Dam	1960-1962	Non-Contributing	Historic Contributing
Spillway	ca. 1980	Non-Contributing	Historic Contributing
Diversion Tunnel	1960-1962	Non-Contributing	Historic Contributing
Water Conveyance System	1960-1962		Historic Contributing
Water Way/Trash Racks	1960-1962	Non-Contributing	Historic Contributing
Pipeline	1960-1962	Non-Contributing	Historic Contributing
Penstock	1960-1962	Non-Contributing	Historic Contributing
Powerhouse	1960-1962	Non-Contributing	Historic Contributing
Communication Building	ca. 1980	Non-Contributing	Historic Contributing
Restroom Building	ca. 1980	Non-Contributing	Historic Contributing
Dam Fisheries Facilities			Historic Contributing
Holding Tanks	1962	Non-Contributing	Historic Contributing
Spawning Building	1962	Non-Contributing	
Fish Ladder	1962	Non-Contributing	
Aerator	1962	Non-Contributing	
Fish Hatchery	1965, ca.1994		

Facility/Description	Date	National Register Eligibility Recommendation and Reference	
		Kramer 2003b	EIS/R 2012
Hatchery Building	1962	Non-Contributing	
Warehouse	1962	Non-Contributing	
Office	1962	Non-Contributing	
Workers Housing 1	1962	Non-Contributing	
Workers Housing 2	1962	Non-Contributing	
Workers Housing 3	1962	Non-Contributing	
Workers Housing 4	1962	Non-Contributing	
Fish Rearing Ponds	1962	Non-Contributing	
Fish Ladder	1962	Non-Contributing	
Visitors Center	1962	Non-Contributing	

6.1.4 Ethnographic Information and TCPs

KRRC's review of ethnographic information for the Project identified TCPs and other culturally sensitive areas along and near the Klamath River based on ethnographic inventory reports prepared by the Klamath Tribes (Deur 2003), Shasta Nation (Daniels 2003, 2006), Karuk Tribe (Salter 2003), and Yurok Tribe (Sloan 2003) for the FERC 2007 Relicensing FEIS.

The Klamath Tribes identified 11 TCPs in the Klamath Basin area, and noted adverse effects to tribal fisheries resulting from impediment of anadromous fish passage due to Klamath River dams (Deur 2003).

The Shasta Nation report (Daniels 2003, 2006) presents a list of village sites recorded in the ethnographic literature, a list of locations that the Shasta Nation consider TCPs, and another inventory of 11 locations, drawn from the first two listings, that are eligible for the National Register.

The Karuk (Salter 2003) and Yurok (Sloan 2003) ethnographic reports draw upon oral interviews, other writings, ethnographical literature, and a review of natural and cultural resources within the Klamath River to discuss each tribe's traditional and historical relationships with the river and its resources to subsistence, material and spiritual culture, and identity.

In response to AIR #29, Section 106 consultation with federally recognized and non-federally recognized tribes occurred beginning in January 2018, after FERC's tribal outreach effort. The KRRC will continue to consult with tribes. KRRC's Section 106 informal tribal consultation efforts will focus on tribal input regarding identification and NRHP evaluation of TCPs, the proposed Klamath Cultural Riverscape (discussed below), and the management , disposition, and treatment of human remains (discussed in Section 8.4.2 below).

Klamath Cultural Riverscape

The Klamath River Inter-Tribal Fish and Water Commission incorporated information from the tribal ethnographic studies, in addition to information provided by the Hoopa Valley Tribe, into an integration report (King 2004) that focused on the Klamath River. The entire length of the river was identified as a type of cultural or ethnographic landscape, termed the Klamath Cultural Riverscape, due to the relationship between the Klamath Tribes, Shasta, Karuk, Hoopa, and Yurok Tribes and the river and its resources (Gates 2003; King 2004). The characteristics that contribute to the riverscape's cultural character include natural and cultural elements such as the river itself; its anadromous and resident fish; its other wildlife and plants; and its cultural sites, uses, and perceptions of value by the tribes (King 2004). Gates (2003) and King (2004) recommended the Klamath Cultural Riverscape as eligible for the National Register based on its association with broad patterns of tribal environmental stewardship, spiritual life, and relationships between humans and the non-human world. The riverscape and/or ethnographic reports and eligibility determination have not been submitted by a Federal agency to the Oregon and California SHPOs for National Register eligibility concurrence (USBR and California Department of Fish and Game (CDFG)[1] 2012: Vol. 1, 3.13-29).

Further research and consultations to define and update the riverscape cultural landscape as a historic property is identified as a Cultural Resources mitigation measure for the Project. The Klamath Cultural Riverscape is an ongoing topic of discussion for the CRWG and informal Section 106 tribal consultation efforts.

6.1.5 Historical Landscape Analysis

As part of the 2017 records search, KRRC conducted a historical landscape analysis to identify locations where post 1850s era settlement and resource developments occurred within the records search area. The materials for this study included the review of the General Land Office (GLO) records, including California plat maps (1856, 1876, 1880, and 1881) and surveyor's notes; Oregon plat maps (1858, 1874, 1881, 1900, and 1917) and surveyor's notes; a variety of published and manuscript resources (Beckham 2006; Boyle 1976; Kramer 2003a, b; PacifiCorp 2004; USDI 1989); and USGS maps available at http://historicalmaps.arcgis.com/usgs. Other map searches included the David Rumsey collection, Northwestern California map collection at Humboldt State University, Library of Congress digital collections, and Online Archive of California. Historical landscape information was digitized into a GIS format.

KRRC is currently completing the review of the J.C. Boyle Collection (MI 165306) housed at the Southern Oregon Historical Society in Medford, Oregon. This archive contains photo albums, newspaper clippings, maps, manuscripts, financial records, and Copco annual reports belonging to Copco Engineer J. C. Boyle, and pertaining predominately to construction of Copco No. 1 dam and reservoir. This archive is a valuable source of information concerning the pre-inundation historical landscape of the Copco No. 1 area and will provide important information regarding cultural and historical resources that may be anticipated during reservoir drawdown. In addition, archival and historical landscape research is currently underway at local

[1] California Department of Fish and Game is now known as the California Department of Fish and Wildlife.

County repositories and historical societies to provide information regarding cultural and historical resources that may be anticipated during reservoir drawdown.

6.1.6 Data Gap Analysis

Subsequent to the completion of the combined record searches, KRRC will examine compiled data and assess it to identify missing information such as gaps in survey coverage, resource recordation, and the status of NRHP eligibility determinations for cultural resources potentially subject to effects during project implementation activities.

6.2 Resource Identification

6.2.1 Pre-Removal Resource Inventory

In response to AIR #28, beginning in July 2017, KRRC initiated cultural resources identification efforts focused on areas within the limits of work that were not subject to previous pedestrian inventory for cultural and historical resources. To date, this new inventory has included three local waste disposal sites currently planned to accommodate concrete rubble and loose earth materials associated with dam removal. The disposal sites include one area for J.C. Boyle Dam (see Figure 5.2-1(C), Sheet 1 in Appendix C), a combined site for Copco No. 1 and Copco No. 2 Dams (see Figure 5.3-1 (C), Sheet 1 in Appendix C), and one area for Iron Gate Dam (see Figure 5.5-1(C), Sheet 2 in Appendix C).

6.2.2 Disposal Site Inventories

J.C. Boyle Disposal Site

The J.C. Boyle Dam disposal site encompasses a 6-acre area located near the current right dam abutment (see Figure 5.2-1(C), Sheet 1 in Appendix C of Definite Plan). This area was included within the cultural resources inventory conducted by PacifiCorp for the Klamath Hydroelectric Project Relicensing study (PacifiCorp 2004). Therefore, KRRC did not undertake a new cultural resources inventory. The PacifiCorp survey did not identify any archaeological sites, isolated finds, or built environment resources within the disposal area.

Copco No. 1 and Copco No. 2 Disposal Site

The Copco No.1 and Copco No. 2 disposal site is located between the two dams, on the northern hillslope above the Klamath River (Figure 5.3-1(C), Sheet 1 in Appendix C of Definite Plan). This area also was included within the cultural resources inventory conducted by PacifiCorp for the Klamath Hydroelectric Project Relicensing study (PacifiCorp 2004). Therefore, KRRC did not undertake a new cultural resources inventory. The PacifiCorp survey did not identify any archaeological sites or isolated finds within the disposal area.

Two extant buildings are located within the Copco No.1 and Copco No. 2 disposal site, consisting of a ca. 1922 residential building and a small garage. These buildings are associated with the Copco No. 1 complex of Klamath Hydroelectric Project. PacifiCorp prepared a Determination of Eligibility for the Klamath Hydroelectric Project (Kramer 2003b) that documents its regional significance and eligibility for listing in the National Register of Historic Places under Criterion A for its association with the industrial and economic development of southern Oregon and northern California.

Copco No. 1 was the first project developed on the river by the California-Oregon Power Company and was placed into service in 1918 and further expanded in 1922 (Kramer 2003b:8). The Copco No. 1 complex includes seven features consisting of the Copco No. 1 dam, water conveyance system (two penstocks), powerhouse, the remains of a guesthouse, two residential buildings and associated garages surviving from the original worker's housing village, and a separate garage/warehouse (Kramer 2003b:8). PacifiCorp evaluated the seven features, constructed between the period of 1912 and 1922, as contributing elements to the NRHP-eligible Klamath Hydroelectric Project (Kramer 2003b).

Iron Gate Disposal Site

The Iron Gate disposal site encompasses an approximately 36-acre area located approximately 750-feet east of Iron Gate Dam, within a small basin that overlooks Iron Gate Reservoir to the northwest (Figure 5.5-1 (C), Sheet 2 in Appendix C of Definite Plan). An area within the western portion of the disposal site, totaling approximately 9 acres, was included within the cultural resources inventory conducted by PacifiCorp for the Klamath Hydroelectric Project Relicensing study (PacifiCorp 2004). The PacifiCorp survey did not identify any archaeological sites, isolated finds, or built environment resources within the disposal area.

To provide 100 percent coverage of the disposal area, in July 2017, KRRC conducted a cultural resources inventory of the remaining acres. KRRC conducted the inventory using a standard systematic pedestrian survey that employed transects spacing of 15 m (65 ft.). The survey convention included a buffer of 46 m (150 ft.) around the footprint of the proposed disposal site. The inventory identified one historic-period archaeological site (LKP-RB-1) and one historic-period isolated find (LKP-EN1-IF).

Other Areas

In addition to the Disposal Site inventories conducted in July 2017, KRRC is currently undertaking a data gap analysis to identify other land-based areas within the limits of work (e.g. haul routes), which includes areas where soils are most likely to be disturbed during construction, that were not previously inventoried for cultural resources, including archaeological, historical, and built environment resources. Such areas will be subject to pedestrian survey to provide 100 percent coverage of direct impact areas associated with the limits of work.

The CRWG may identify additional survey areas located outside the limits of work for pedestrian survey as part of its ongoing efforts to define the Project APE, as well as based on recommendations derived during informal consultation with tribes and consulting parties. The limits of work will continue to be refined during the Section 106 consultation process and as project planning continues.

6.2.3 During and Post-Removal Resource Inventory

Measures to resolve adverse effects to cultural and historical resources developed for the 2012 EIS/R will likely be integrated into the PA as a conclusion to the Section 106 process. In addition cultural resources surveys in the reservoir drawdown zones to identify historic and significant properties, will need to be completed after project approvals are received. In consultation with the CRWG and the approval of FERC, the PA will create a consultation process for considering these surveys. KRRC is in the process of developing a proposed program for implementation during dam removal, which includes cultural resources surveys based on archival research, historical landscape analyses, and tribal consultation. In addition, KRRC will conduct post-demolition surveys of areas outside of the reservoir footprints (i.e., hydropower infrastructure areas, former recreation areas) where revegetation will occur.

6.2.4 General Inventory and Resource Recordation Methods

Archaeological Inventory

Any archaeological inventory to be conducted for the Project will include 100 percent, intensive-level survey of designated areas. The inventory will employ a standard systematic pedestrian survey following the appropriate Oregon and California survey and reporting standards, tailored if appropriate to meet any specific federal land management agency guidelines. Inventory of parcels will employ standard transect spacing of 15 m (65 ft.) or less. The survey convention for elements such as staging areas, borrow areas, substations, and other facilities will include a buffer of 46 m (150 ft.) around the footprint of the proposed activity.

KRRC will conduct surveys in accordance with the Guidelines for Conducting Field Archaeology in Oregon, published by the Oregon State Historic Preservation Office (SHPO 2007), and, in California, by the guidelines provided by the California Department of Historic Preservation. KRRC will complete all inventory efforts on federal lands under the supervision of field supervisors authorized under agency-specific cultural resources permits. All inventory methods will follow those prescribed by United States Forest Service (USFS) and Bureau of Land Management (BLM) protocols, dependent upon the lands being surveyed, and will be conducted by field supervisors and archaeological technicians that fully meet qualifications and standards dependent upon appropriate land management agency permitting requirements

KRRC expects that two categories of cultural resources will be identified: archaeological sites and isolated finds. An archaeological site in Oregon is defined as 10 or more artifacts (including lithic debitage) or a feature likely to have been generated by patterned cultural activity within a surface area reasonable to that activity (a form of density measure). An isolated find in Oregon is defined as one (1) to nine (9) artifacts discovered in a location that appears to reflect a single event, loci, or activity. The presence of any feature advances the find into a site status. KRRC will follow similar guidelines in California, where a strict written policy is not provided. Alternatively, on lands managed by federal agencies, KRRC will follow the policies of those agencies.

Previously recorded sites present within the areas to be inventoried will be relocated, if possible, and re-recorded, as necessary. KRRC will give newly identified sites a temporary field number and plot them onto a USGS field map; UTM coordinates will be recorded using a GPS instrument. KRRC will not permanently flag identified resources or otherwise mark them in the field, unless requested by land management agencies.

All above-ground resources, such as buildings, within or adjacent to (within 100 feet of) the survey areas that are 50 years of age or older, or of indeterminate age, will be noted, and their location and information provided to the Built Environment study team for documentation on an appropriate site record. KRRC will consider visual effects to above-ground resources beyond the pedestrian survey area in a separate study.

Built Environment Inventory

Fieldwork methodology will consist of two phases of identification and evaluation, and will focus on two distinct resource categories – hydroelectric (Phase I) and non-hydroelectric (Phase II) facilities. A reconnaissance level effort will make a preliminary evaluation of all historic-era resources and determine whether they meet the NRHP criteria for evaluation, retain integrity, whether they were constructed over 45 years ago (before 1973), and if they meet any NRHP criteria considerations. KRRC chose the 45-year criterion to take into account that effects that could be present during the full course of project activities.

KRRC will typically conduct fieldwork with teams of two architectural historians, who will drive publicly accessible rights-of-way and record resources in a systematic manner. For those resources that would clearly not have views of the Project due to vegetation, landform, or surrounding development, KRRC will collect only location information, as the resource will be considered outside the APE. For those resources inventoried in the APE, KRRC will collect specific information, at least two or more photographs taken, and each resource noted on a field map with recorded by GPS. For those properties that clearly lack historic integrity, or that is a type of resource that is not indicative of broad patterns of history or related to historical events (Criterion A), not associated with significant person or people (Criterion B), and/or is of a common type, style, or method of construction that does not exhibit high artistic values or represent a significant and distinguishable entity whose components may lack individual distinction (Criterion C), no additional information will be collected and a "not eligible" recommendation will be made. In order to apply the criteria, KRRC will use information collected during fieldwork to revise the historic context for the APE and provide an initial basis from which to evaluate the relative importance of identified resources. KRRC will also conduct additional secondary and archival research on common resource types so that a more comprehensive historic context of these resources within the APE can be developed and used for a comparative analysis and an assessment of significance. This assessment will consider whether the resource retains significance at the local, state, or national levels. Further, the analysis will take into account the relative rarity of a resource type and likewise adjust considerations related to that resource's historical integrity. For those resources that retain integrity, are 45 years old or older, and may be eligible under any of the NRHP criteria for evaluation, the resource will be listed as "unevaluated" and subject to Phase II analysis. This analysis will include detailed recordation and full evaluation.

In addition to field recordation, KRRC will undertake research to better understand the resource's history. This will include SHPO/USFS/BLM files, historic maps (such as GLO, Metsker's, and Sanborn, newspapers, and other applicable resources such as census records, genealogical records, biographical encyclopedias, city directories, and family histories. After taking into account the overall integrity and historical significance of the resource, KRRC will make a final recommendation concerning a resource's NRHP eligibility.

Built Environment HABS/HAER/HALS Recordation

KRRC anticipates that mitigation for impacts on the hydroelectric facility buildings and structures will involve some level of Historic American Building Survey (HABS) and Historic American Engineering Record (HAER), documentation. HABS/HAER recordation has been previously determined to be an important mitigation measure in compliance with NHPA Section 106 provisions.

Chapter 7: Resource Evaluation

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7. RESOURCE EVALUATION

7.1 Archaeological Evaluation

To date, the evaluation of cultural resources identified within the limits of work (and subject to potential direct effects) has occurred based on survey-level data or from subsurface testing work (Phase II investigations) conducted by other parties (not KRRC). The 2004 PacifiCorp report identified three levels of NRHP eligibility for identified sites: eligible, potentially eligible, and not eligible. Eligible sites include those resources that were designated as historic properties on the basis of sufficient existing information about them to draw that conclusion. Potentially eligible sites include those that require more intensive, subsurface investigations to obtain information necessary to determine if they are or are not eligible for the NRHP under Criterion D. Those sites identified as not eligible lack attributes necessary for their inclusion in the NRHP. Neither the California nor Oregon SHPOs has concurred with the NRHP evaluations offered in the previous Klamath River cultural resources reports (Cardno ENTRIX 2012; PacifiCorp 2004). KRRC, working through the CRWG, is facilitating SHPO review of the previous eligibility recommendations to reach NRHP eligibility determinations under the Section 106 process. Once eligibility concurrence is reached, the list of potentially eligible and any yet unevaluated properties will be screened against areas of direct impacts to develop an inventory of affected sites that require evaluation through Phase II testing. Because most individual sites have not yet been identified for evaluation, site-specific methods will be developed later.

The TCPs identified in the tribal ethnographic reports (Section 6.1.4 above) may or may not have archaeological components with information potential and have been evaluated as NHRP-eligible based on other cultural values including associations under Criterion A. Section 106 consultation performed by the FERC, as supported by KRRC, will assist in verifying the NRHP eligibility of TCPs and how TCPs will be integrated into project planning and compliance.

TCRs identified by Tribes as a part of the AB52 consultation process may be disclosed to the SWRBC. If this information is shared with the KRRC, the KRRC will coordinate the evaluation of TCRs for the NRHP with the CRWG and FERC as a part of the Section 106 consultation process.

7.2 Evaluation of Historic Built Environment Resources

The evaluation of historic built environment resources will include an update to the Klamath Hydroelectric Project Request for Determination of Eligibility to include Iron Gate Dam as a historic property and to identify contributing elements to the Klamath Hydroelectric Historic District (KHHD). In addition, an estimated 50 non-hydroelectric historic structures (including buildings, bridges, and other built environment facilities) identified during inventory efforts will require evaluation for eligibility to the NRHP. KRRC will perform built environment evaluation studies to Oregon and California standards. Two historical resources reports for both hydroelectric and non-hydroelectric resources, will be prepared that include information on the resources located in the respective states. The reports will identify the APE, apply the NRHP Criteria for Evaluation, assess project effects, and make recommendations to avoid and minimize effects and mitigate adverse effects. This task will also include a reassessment of those built environment resources that were not 50 years old at time of previous evaluation; and a complete analysis of cultural resources within 100-year flood plain below Iron Gate Dam to Humbug Creek.

Chapter 8: Management Plans and Agreement Documents

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8. MANAGEMENT PLANS AND AGREEMENT DOCUMENTS

KRRC will produce a number of management plans and agreements to support the Project's Section 106, CEQA, and AB 52's compliance efforts. The documents currently planned include a HPMP, Programmatic Agreement, Inadvertent Discovery Plan, Plan of Action for the treatment of human remains, and a Cultural Resources Monitoring Plan. KRRC may add other plans based on recommendations made by the CRWG and Tribes.

8.1 Historic Properties Management Plan and Programmatic Agreement

FERC, with the assistance of KRRC, will prepare and implement a PA for the Project. KRRC will prepare HPMP to assure compliance with the federal and state laws and regulations that govern historic, cultural, and tribal resources. In preparing the PA and HPMP, KRRC will consult, as appropriate, with FERC and the CRWG. KRRC will continue to consult with FERC and the CRWG as appropriate through the Project's implementation until the expiration of the PA.

On the federal level, the relevant statutes include: (1) Section 106 of the NHPA; (2) National Environmental Policy Act (NEPA); and (3) the Native American Graves Protection and Repatriation Act (NAGPRA). Section 106 requires federal agencies to take into account the effects of their undertakings on historic properties, engage consulting parties, and to provide the ACHP with reasonable opportunity to comment. A "historic property" is "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in the NRHP. This term includes artifacts, records, and remains that are related to and located within such properties" (36 CFR § 800.16(l)). The term also includes "properties of traditional religious and cultural importance to an Indian tribe . . . and that meet the National Register criteria" (Ibid). Section 106 also requires consultation with relevant SHPOs, THPOs, Indian Tribes, representatives of local governments, individuals and organizations with a demonstrated interest in the Project, and the public (36 CFR § 800.2(c)).

NEPA requires federal agencies to determine whether an action may "significantly affect the quality of the human environment." Among other things, agencies must consider the "unique characteristics of the geographic area such as proximity to historic or cultural resources (40 CFR § 1508.27(b)(8)." NEPA also encourages agencies to the fullest extent possible, prepare environmental documents concurrently with and integrated with environmental impact analyses and related surveys and studies required by the NHPA (40 CFR § 1502.25(a)).

NAGPRA establishes the ownership of cultural items excavated or discovered on federal or tribal land lies with the lineal descendants and culturally affiliated Indian tribes and Native Hawaiian organizations and, among other things, establishes procedures for the inadvertent discovery or planned excavation of Native American cultural items on federal or tribal lands.

As discussed above, KRRC and PacifiCorp have initiated informal Section 106 consultation consistent with FERC's direction and convened a CRWG that includes FERC, other federal agencies, SHPOs, THPOs, Indian Tribes, as well as other consulting parties that will consider the identification and evaluation of cultural resources as well as the avoidance, minimization, and resolution of adverse effects to historic properties. This informal consultation will establish the groundwork for a PA that KRRC will submit for FERC's approval. The PA and HPMP will be completed prior to FERC's Surrender Order. The HPMP will be appended to the PA, once the agreement is finalized. The PA will be effective for the duration of FERC's jurisdictional authority (i.e. the effective duration of FERC's License Surrender Order) which, if so ordered, is currently estimated to end in 2025.

KRRC will also work with FERC, as well as other federal agencies, SHPOs, Tribes, and consulting parties (which include state-recognized tribes who engage in the State Water Board's AB 52 consultation process) to develop and integrate effect avoidance, minimization, and mitigation measures into the HPMP. KRRC will also implement avoidance, minimization, and mitigation measures developed in the ongoing AB 52 consultation led by the SWRCB. Since these measures are tailored to compliance with California laws and regulations, KRRC may develop comparable measures consistent with Oregon's laws and regulations that govern cultural resources, if applicable. KRRC will work with FERC, other federal agencies, SWRCB, tribes, SHPOs, THPOs, and consulting parties to consider and incorporate these measures into the HPMP and PA as appropriate.

8.2 Programmatic Agreement

As the designated non-federal representative, KRRC will prepare a PA for FERC's consideration that is designed to assist with compliance of Section 106 of the NHPA consistent with 36 CFR § 800.14. The PA will consist of a signed, formal agreement between KRRC, lead and cooperating federal and/or state agencies, the California and Oregon SHPOs, THPOs, Indian Tribes, and consulting parties, and will outline all measures necessary for full compliance with NHPA. These will include but will not be limited to protocols for the identification and evaluation of historic properties, permitting requirements, treatment of historic properties, monitoring requirements, inadvertent discovery protocols, curation, and treatment of human remains. KRRC, in consultation with the federal agencies, SHPOs, THPOs, Indian tribes, and consulting parties will draft a PA suitable for review and consideration by FERC. KRRC will assist with revising the PA following consultation and review by the CRWG and incorporate any necessary revisions to the HPMP (discussed in greater detail in Section 8.2). Finalization of the PA, which includes obtaining necessary signatures for acceptance of the PA, will be the responsibility of FERC. The PA will be effective for the duration of FERC's jurisdiction over the Project.

8.3 Historic Properties Management Plan

KRRC will prepare an HPMP to identify mitigation measures and other protective measures to be implemented before and during drawdown and dam removal activities to protect historic, cultural, and tribal resources during the Project's implementation. KRRC will ask FERC and other applicable federal agencies to approve the HPMP before the commencement of any ground disturbance or reservoir draw down activities. At a minimum, the HPMP will incorporate protocols to address the following: (1) identification and evaluation of historic properties; (2) the avoidance, minimization, and mitigation measures to be implemented;(3) the inadvertent discovery of historic, cultural, and tribal resources; (4) the inadvertent discovery human remains and associated grave artifacts; and (5) the monitoring of cultural resources during KRRC's implementation of the Project. The process to amend the HPMP in the event that additional information is obtained during the Project's implementation will be provided in the PA. Other protocols developed during the Section 106 consultation process will be implemented in the HPMP.

8.3.1 Identification and Evaluation of Historic Properties

The HPMP will address historic properties identified to date within the APE, as well as those historic properties potentially identified during project implementation. The HPMP will include the protocols for the phased identification of (1) resources encountered following dewatering activities; (2) resources on properties (if any) where access is not granted until after permitting, (3) resources (including human remains) found as inadvertent discoveries, and/or (4) resources found during cultural resource monitoring. The HPMP will guide treatment measures to avoid, minimize, and mitigate adverse effects to historic properties through the course of the Project. The HPMP will also identify classes of historic properties, relevant research, and potential data gaps in research for classes of properties present in the APE. The HPMP may include other historic property identification and evaluation considerations developed over the course of the Section 106 consultation process.

8.3.2 Effect Avoidance, Minimization, and Mitigation Measures

KRRC will develop the HPMP, which will include a discussion of measures to avoid, minimize, and/or mitigate adverse effects to historic properties. KRRC will implement feasible mitigation recommendations developed during the SWRCB's AB 52 process. Additional avoidance, minimization, and mitigation measures will be identified through the Section 106 consultation process. These additional measures may include but are not limited to mitigation and monitoring, to address reasonably foreseeable direct, indirect and/or cumulative adverse effects that may result from drawdown and dam removal. Wherever feasible, avoidance and preservation in place will be the preferred treatment for historic properties located within the APE. Avoidance may include design changes and/or use of fencing or barricades to limit access to identified historic properties during dam removal and restoration activities.

In cases where avoidance and minimization are not feasible, resource-specific treatment protocols will be drafted as necessary to resolve adverse effects to historic properties adversely affected by the Project. The process for the development of treatment protocols will be outlined in the HPMP and will be consistent with the Secretary of the Interior's Standards for Archaeological Documentation, Historical Documentation, and Architectural and Engineering Documentation; the ACHP Section 106 Archaeology Guidance; and other guidance from the appropriate SHPOs and/or THPOs, as applicable. Additional standards and guidelines may be identified by FERC and/or the CRWG during the Section 106 process. For effects to archaeological sites that will be mitigated through data recovery, mitigation protocols will include but not be limited to a research design that articulates research questions; data needed to address research questions; methods to be employed to collect data; laboratory methods employed to examine collected materials; and proposed disposition and curation of collected materials and records.

Mitigation protocols for direct effects to historic properties eligible for listing in the NRHP under criteria other than or in addition to criterion D will articulate the context for assessing the properties significance, an assessment of the character-defining features that make the property eligible for listing in the NRHP, and an assessment of how the proposed mitigation measures will resolve the effects to the property. Additional mitigation protocols may be developed during the Section 106 consultation process.

8.4 Inadvertent Discovery Program

KRRC will develop a plan for resolving post-review discoveries. Drawdown of the reservoirs proposed as part of the Project could potentially expose previously recorded and unidentified cultural resources, including archaeological resources and human remains. KRRC will prepare an Inadvertent Discovery Plan that will address the inadvertent discovery of resources protected under federal and state law. KRRC will develop the Inadvertent Discovery Plan during agency and tribal consultations and incorporate feedback from the tribes engaged in such consultations as feasible.

The Inadvertent Discovery Plan will include measures that will be implemented in and downstream of the reservoirs if archaeological materials, human remains, or other cultural resources are discovered during drawdown activities. The Inadvertent Discovery Plan will comply with applicable federal and state laws and regulations regarding cultural resources and human remains. The Inadvertent Discovery Plan will address such situations occurring once reservoir drawdown has commenced and throughout the dam removal and restoration process. The discussion below provides a basis and framework for KRRC's Inadvertent Discovery Plan for the Project and may be adjusted and/or supplemented during the Section 106 consultation process.

8.4.1 Inadvertent Discovery of Cultural Resources

KRRC will develop and implement procedures for its personnel and contractors if historic properties are discovered or unanticipated effects on historic properties occur in conjunction with the drawdown of the reservoirs. KRRC will develop these procedures prior to the initiation of dam removal in accordance with 36 CFR § 800.13(a)(2)(b) (Post-review Discoveries).

As noted above, KRRC will provide instruction to environmental monitors regarding the historic, cultural, and tribal resources that could be discovered during project activities. In addition, all KRRC personnel involved in project field activities will be instructed on site discovery, avoidance, and protection measures that will be triggered in the event of an inadvertent discovery, including information on the federal and state statutes and regulations protecting cultural and tribal resources.

KRRC will develop and implement procedures that address situations where unanticipated cultural resources are encountered on private, non-federal public, or federal lands. The procedures will also include the appropriate agency and tribal contacts and consultations in the event of an inadvertent discovery. Applicable federal, tribal, and state laws may govern the procedures.

If previously unidentified cultural resources are discovered during the implementation of the Project, KRRC will immediately implement the Inadvertent Discovery Plan.

8.4.2 Inadvertent Discovery of Human Remains

KRRC will prepare written protocols that will be incorporated into the Inadvertent Discovery Plan specifically for the discovery of human remains in coordination with the CRWG and with Native American tribes (both the tribes engaged in the Section 106 process and the tribes that engaged in the State Water Board's AB 52 consultation process). The protocol will require signature by FERC as the Federal agency official for purposes of Section 106, and a copy of the protocol will be provided to the consulting tribes.

The protocol for the treatment of human remains will include: (1) planned treatment, care, and handling of human remains, funerary objects, sacred objects, and objects of cultural patrimony; (2) information on the kinds of objects that are considered to be funerary objects, sacred objects, and objects of cultural patrimony; (3) specific information used to determine custody/ownership of the remains; (4) the methods to be used for archaeological recording, analysis, and reporting of human remains, funerary objects, sacred objects, and objects of cultural patrimony; (5) the steps to be followed to contact relevant Native American tribal officials at the time of excavation or inadvertent discovery of human remains, funerary objects, sacred objects, and objects of cultural patrimony; (6) the kind of traditional treatment, if any, to be used for human remains, funerary objects, sacred objects, objects of cultural patrimony; and (7) the planned disposition of human remains, funerary objects, sacred objects, and objects of cultural patrimony.

KRRC will utilize the following as a basis and framework to develop the protocol:

- Human remains and associated grave goods may be discovered during various phases of project's planning and implementation. In all cases, human remains encountered during project activities will be treated in a respectful manner and in accordance with the protocol.
- If human remains and/or associated grave goods are discovered as a result of project activities, project activities near the find will cease to the extent feasible. Project activities will be not be allowed within 200 feet of the discovery until authorization is provided through implementation of the approved treatment protocols unless such a restriction is not feasible (e.g., the infeasibility of

halting reservoir drawdown). One exception to this general principle is the conduct of controlled archaeological investigations, which will be subject to specific requirements outlined in the protocol.

- Human remains and/or associated grave goods will be secured and protected to the extent feasible until appropriate disposition has been determined, in accordance with the protocol and applicable federal, state, and local statutes and regulations. Specific procedures to be followed in the event of a discovery will depend on the ownership status of the lands where the human remains and associated grave goods are discovered.
- The provisions of the NAGPRA will govern inadvertent discoveries of Native American human remains on federal or tribal lands. The federal land management agency, in consultation with FERC, as the lead agency, will be responsible for compliance with the NAGPRA and its implementing regulations for all NAGPRA-related inadvertent discoveries and discovery situations on federal or tribal lands. FERC and any relevant land management agency (e.g., BLM) will consult with the relevant Native American tribe(s) or other ethnic groups related to the human remains identified to determine the treatment and disposition measures consistent with the applicable federal laws, regulations, and policies.
- If human remains are encountered on state or private lands, the appropriate County Coroner will be contacted. All human remains will be treated according to the provisions of the applicable federal, state laws, regulations, or policies, as determined through consultation with the appropriate SHPO, federally- or state-recognized Native American tribe, or other ethnic groups related to the human remains.
- In California, treatment of human burials found on State or private lands are covered under the Public Resources Code, Division 5, Parks and Monuments (Division 5 added by Stats. 1939, Ch. 94.), Chapter 1.75. Native American Historical, Cultural, and Sacred Sites, and the California Native American Graves Protection and Repatriation Act of 2001 (Chapter 5 of Part 2 of Division 7 of the Health and Safety Code).
- In Oregon, treatment of human burials found on State or private lands are covered under Oregon Revised Statute (ORS) 97.745. If human remains are encountered, the state police, Oregon SHPO, the Commission on Indian Services, and the appropriate Native American tribe(s) (which are determined by the Commission on Indian Services) need to be immediately contacted.

8.5 Cultural Resources Monitoring Plan

KRRC will develop a Cultural Resources Monitoring Plan as part of the HPMP for implementation during drawdown and dam removal efforts proposed as part of the Project. The Cultural Resource Monitoring Plan will establish general protocols for monitoring when ground disturbing work is occurring in close proximity to historic properties or where work is occurring in areas where there is a high probability of encountering cultural resources. The Cultural Resources Monitoring Plan may include other areas that will benefit from monitoring, including known archaeological sites and those areas determined to show a high probability for buried cultural deposits. Monitoring will, as appropriate, include field inspection by personnel under the direct supervision of a person meeting the Secretary of the Interior's Professional Qualifications standards and will consult with federally- and state-recognized tribes for tribal monitors, as appropriate. The Cultural Resources Monitoring Plan will address the management and protection of historic properties in the APE to avoid Project-related effects from drawdown, dam removal, and restoration activities. Cultural resources, human remains, or funerary objects discovered during the monitoring of project activities will be treated in accordance with the protocols described in the Inadvertent Discovery Plan.

8.6 Looting and Vandalism Prevention Plan

KRRC will develop a Looting and Vandalism Prevention Plan to reduce the risk of looting or vandalism during the implementation of the Project to the extent that the Project's implementation creates additional risk of looting or vandalism. If looting and vandalism occur to sites in California, KRRC will consult with federal agencies, SHPOs, THPOs, tribes engaged in the Section 106 process and tribes participating in the AB 52 consultation with SWRCB.

The Looting and Vandalism Prevention Plan will include training of KRRC monitors and personnel about looting and vandalism of tribal, cultural, and historic resources. It will also include an established communications protocol and reporting process to law enforcement and other relevant federal, state, and local agencies upon discovery of evidence that looting or vandalism is or has occurred. Public access to the reservoirs will be restricted during drawdown for safety reasons, as well as protecting against the potential looting and vandalism of protected tribal, cultural, or historic resources.

KRRC will also include in the Looting and Vandalism Plan other protective measures, including appropriate restrictions to public access to known or inadvertently discovered historic, tribal, or cultural resources as appropriate and feasible on a case by case basis. Specific measures that will be considered include fencing, posting of signs, strategic plantings, strategic routing of roads, boating access points and trails, or other means that are feasible and necessary to protect unauthorized looting or vandalism of resources protected under federal and state law. Additional measures may be identified during the Section 106 consultation process with FERC and the CRWG.

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Chapter 9: References

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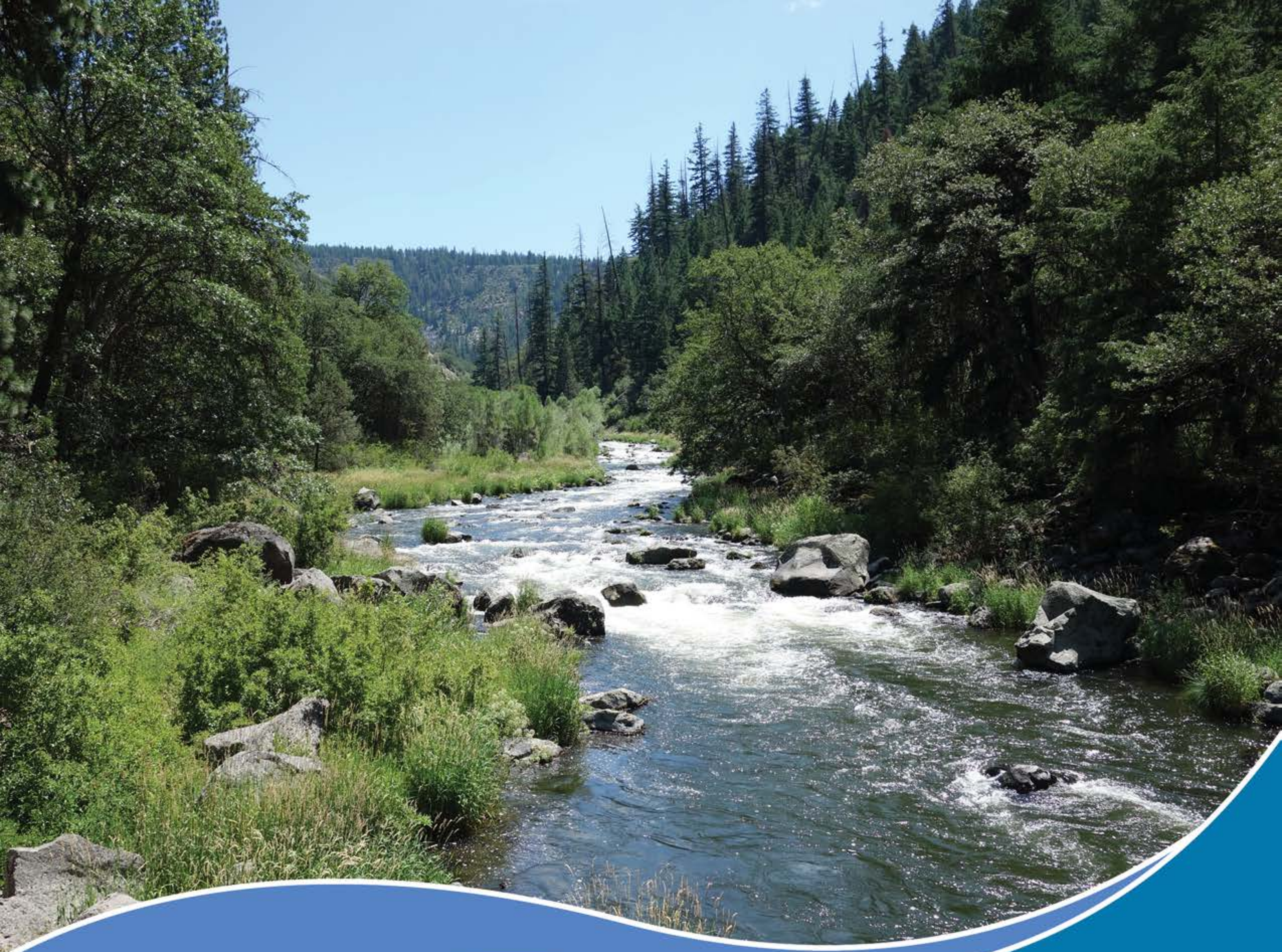

Definite Plan for the Lower Klamath Project

Appendix M - Water Quality Monitoring Plan

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Prepared for:

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Acronyms

COD chemical oxygen demand

DO dissolved oxygen

EIS/R Environmental Impact Statement/Environmental Impact Report

EPA	U.S. Environmental Protection Agency
IMs	Interim Measures
IM-15	Interim Measure 15 - Water Quality Monitoring
KBMP	Klamath Basin Monitoring Program
mg/L	milligrams per liter
NTUs	Nephelometric Turbidity Units
ODEQ	Oregon Department of Environmental Quality
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
SEF	Sediment Evaluation Framework
SLs	screening levels
SLVs	Screening Level Values
SSC	suspended sediment concentrations
SWAMP	Surface Water Ambient Monitoring Program
WQ Plan	Water Quality Monitoring Plan
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USGS	US Geological Services

Chapter 1: Introduction

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1. INTRODUCTION

This Water Quality Monitoring Plan (WQ Plan) describes the proposed water quality monitoring activities prior to, during, and following completion of the Project. In general, the monitoring plan covers the following elements:

- Assessment of Klamath River water quality parameters (e.g. dissolved oxygen, temperature, turbidity, conductivity, suspended sediment, nutrients) collected prior to, during, and following dam removal.
- Sampling and analysis for the presence of blue-green algae related toxins (microcystin) during and following dam removal.
- Toxicity assessment of residual reservoir sediments, and sediments deposited downstream of the project reservoirs in the Klamath River and estuary following dam decommissioning.

This WQ Plan presents a general overview of the water quality monitoring that is presently being conducted in the Klamath River through Interim Measure 15 - Water Quality Monitoring (IM-15), the KRRC's approach to augment this monitoring before, during, and after dam decommissioning, and the KRRC's approach to sampling and analyzing the river and estuary waters and sediments.

KRRC will revise this draft document to be consistent with the water quality monitoring requirements in the final Clean Water Act Section 401 Water Quality Certifications from California and Oregon. Draft 401 Water Quality Certifications from both states are currently under public review and public comments are expected through mid-July 2018. The information collected under this WQ Plan will assist the KRRC in making adaptive management decisions during and following dam decommissioning to lessen impacts to aquatic resources by implementing aspects of the KRRC's Aquatic Resource Measures (Section 7.2 of the Definite Plan).

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Chapter 2: Background

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2. BACKGROUND

2.1 Klamath Interim Measure 15 Water Quality Monitoring

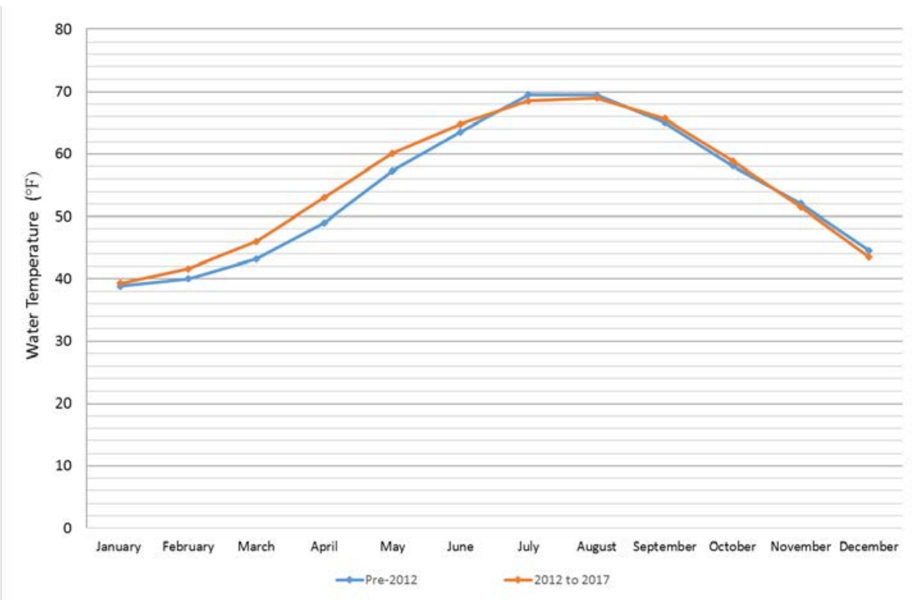
The amended KHSA includes provisions for the interim operation of the Lower Klamath Project (FERC Project 14803) by PacifiCorp prior to decommissioning and included several Interim Measures (IMs) to mitigate conditions created by the dams and to collect baseline information prior to the beginning of dam removal drawdown Activities. The KHSA includes IM-15 that requires PacifiCorp to fund water quality monitoring from Upper Klamath Lake to the Klamath River estuary at the Pacific Ocean. The water quality monitoring under IM-15 entered its tenth year in 2018 and PacifiCorp has an obligation to continue IM-15 monitoring until the dam decommissioning phase of the Project begins. IM-15 contains the following water quality monitoring elements:

- Cyanobacteria and cyanotoxin grab sampling for public health protection at 18 locations from Upper Klamath Lake to the estuary, including nine locations downstream of Iron Gate Dam in the Klamath River.
- Water quality monitoring at 18 sites on the Klamath River from Link River Dam to the estuary. Additional water quality monitoring is conducted at the mouth of the four major Klamath River tributaries (Shasta, Scott, Salmon, and Trinity).
- Hourly sonde data collection at six locations between Iron Gate Dam and the community of Klamath for temperature, dissolved oxygen, pH, and electrical conductivity.
- Seasonal (May-October), monthly, and bimonthly) discrete grab sampling conducted for nutrients, including total nitrogen and phosphorus, nitrate and nitrite, ammonia, particulate and organic phosphorus and dissolved carbon.

The above monitoring is conducted by the U.S. Bureau of Reclamation (USBR), PacifiCorp, and the Yurok and Karuk tribes and is funded by PacifiCorp. The Klamath Basin Monitoring Program (KBMP), a consortium of in-basin regulatory and resource agencies and interested stakeholders, maintains the water quality monitoring data collected under IM-15. KBMP's Klamath River monitoring data and location maps can be found at http://www.kbmp.net. KRRC intends to utilize the existing KBMP data set, augmented by new data collected before, during, and after dam decommissioning, as the WQ Plan data set.

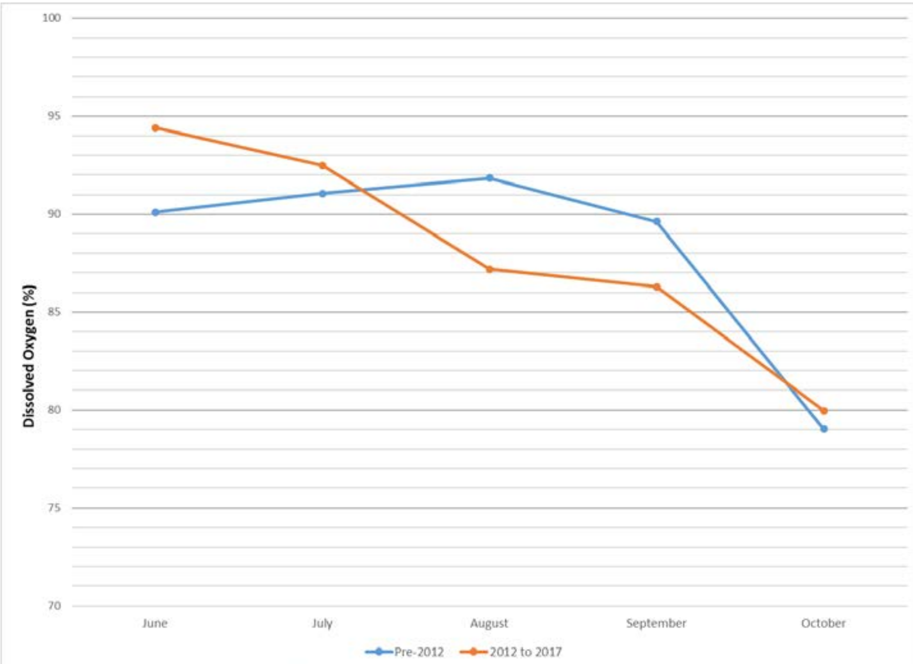
2.1.1 Water Quality Trends

Water quality monitoring in the Klamath Basin has continued since the publication of the Klamath Facilities Removal Environmental Impact Statement/Environmental Impact Report, 2012 (2012 EIS/R). Data compiled from real-time continuous monitoring of parameters such as water temperature, dissolved oxygen (DO), pH, conductivity, and turbidity at a point on the Klamath River just below Iron Gate Dam was analyzed for trends, some of which is presented below. This location provides an overview of water quality in the river as it exits the last dam of the Lower Klamath Project. Water quality in the area generally continues to follow the trends evaluated in the 2012 EIS/R. Figure 2-1 shows the average monthly water temperature in the Klamath River below Iron Gate Dam from 2006 to 2011 and 2012 to 2017, where data was available. In general, water temperature below Iron Gate Dam is warmer in spring months (March through May) than it was in the past, differing by up to 4 percent in April. Figure 2-2 presents the average DO recorded from 2006 to 2017 for the months of June through October, when available. Typically, during the summer and early fall, water temperature in the river is higher and issues with DO occur. During these months, DO was recorded higher in June, July, and October, but lower in August and September compared to previous years. The average monthly pH from 2012 onward was recorded at higher values than those between 2006 and 2011; though similar from May to October, see Figure 2-3. This information suggests that there would be no changes to the conclusion made in the 2012 EIS/R.



Source: Karuk Tribe 2017

Figure 2-1 Monthly Average Water Temperature in the Klamath River below Iron Gate Dam



Source: Karuk Tribe 2017

Figure 2-2 Average Percent DO in the Klamath River below Iron Gate Dam between June and October

Source: Karuk Tribe 2017

Figure 2-3 Monthly pH in the Klamath River below Iron Gate Dam

2.1.2 Contaminants in Sediment

In 2011, an evaluation of the sediments from each reservoir was completed to assess the risk of contamination in biota and humans from the release of reservoir sediments. Results of this evaluation were compared to the 2009 U.S. Army Corps of Engineers (USACE) Sediment Evaluation Framework (SEF) for the Pacific Northwest and U.S. Environmental Protection Agency (EPA) screening levels (SLs). Freshwater contaminant screening levels were updated and finalized in the 2016 SEF and are typically less protective than standards set forth by EPA SLs and Oregon Department of Environmental Quality (ODEQ) Bioaccumulation Screening Level Values (SLVs) for fish consumption. The marine SLs are relatively unmodified from the 2009 SEF. KRRC reviewed the results from the 2011 evaluation under the 2016 SEF SLs and compliance with a level 2B evaluation (see Section 4.7.5 of the Definite Plan for a full discussion). This reevaluation confirmed the conclusions presented in the 2012 EIS/R that the reservoir sediments in each reservoir are suitable for unconfined, aquatic disposal and that contamination risks from reservoir sediment are unlikely and/or are either lower than with the dams still in place and/or lower than background levels.

2.1.3 Algae in the Klamath Hydroelectric Reach

There are two dominant algal communities within the Hydroelectric Reach in the Klamath Basin, phytoplankton and periphyton. Blue-green algae and cyanobacteria are the predominant phytoplankton in Copco 1 and Iron Gate reservoirs and frequently reach nuisance levels in the summer and fall, often producing toxins (i.e. microcystin) at levels that are potentially harmful to humans and animals. Phytoplankton accumulation from the reservoirs occurs in portions of the Klamath River below Iron Gate Dam and can contribute to nuisance levels of blue-green algae, under certain conditions. Cyanobacteria and green algae are the dominate periphyton (i.e., attached algae) in the riverine portions of the Klamath River. The growth and prevalence of nuisance algal blooms of blue-green algae and other species are generally determined by the nutrient concentration, primarily nitrogen and phosphorus, and water temperature within the river. Continued monitoring of nutrients, algae, and algal toxins show the continuation of trends observed and presented in the 2012 EIS/R. A study published in 2015 (Otten et al. 2015) used a variety of genetic approaches to track the source of toxic algae found in the Klamath River below Iron Gate Dam, in addition to 15 other sampling locations throughout the Klamath River. The study concluded that microcystin producing algal populations originate within Copco 1 and Iron Gate reservoirs rather than imported from upstream sources (e.g. Upper Klamath Lake). The relative significance of contributions of the reservoirs and upstream sources is complex and disputed. The KRRC does not state a position on the relationship or relative significance of such sources. To the extent that these reservoirs are a source, the Project will remove the source.

In 2016, the Oregon Heath Authority released the updated Public Health Advisory Guidelines for Harmful Algae Blooms in Freshwater Bodies. This updated the criteria for issuing and lifting a public health advisory. Criteria for issuing a public health advisory is dependent on visible scum (photos and water testing), cell counts (greater than or equal to 100,000 cells per milliliter [cells/mL] for combined species or 40,000 cells/mL for microcystin), and/or toxicity levels (greater than or equal to 10 micrograms per liter for microcystin). Public health advisories can be lifted only after the initial cell count or toxin results are reported below the threshold. The Yurok Tribe also updated their advisory threshold guidelines after the 2012 EIS/R. These updated Level 1 thresholds are equal to those issued by the Oregon Health Advisory for combined species (100,000 cells/mL) but are much lower for microcystin cell count (1,000 cells/mL) and microcystin toxin concentrations (0.8 micrograms per liter). Despite the changes to the guidelines for posting public health advisories for toxic algae blooms, the most recent monitoring data shows that health advisory postings remain common place at Copco 1 and Iron Gate reservoirs and on the Klamath River below Iron Gate Dam.

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Chapter 3: Water Quality Monitoring Plan

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3. WATER QUALITY MONITORING PLAN

3.1 Rationale for Water Quality Monitoring Plan

KRRC anticipates impacts from the Project on aquatic resources in the lower Klamath River through the release of reservoir sediment. The 2012 EIS/R for dam removal anticipated that the reservoir sediments, composed largely of organic silt and clay size particles would exhibit high chemical oxygen demand (COD) and high suspended sediment concentrations (SSC) downstream of Iron Gate Dam. The highly turbid water and low dissolved oxygen caused by sediment release will result in stress and mortality to fish and other aquatic organisms in the mainstem Klamath River during reservoir drawdown. KRRC plans to conduct pre-, concurrent, and post-dam removal water quality monitoring (one year before and three years following dam removal) to assess the impacts of dam removal on the aquatic environment from J.C. Boyle Dam to the estuary. The KRRC will also collect water quality samples at Keno Dam upstream from the Project to assess baseline river conditions.

3.2 Monitoring Locations

Table 3-1 and Figure 3-1 present the locations and characteristics of the project water quality monitoring stations that will operate 12 months of the year at least one year prior to dam removal and up to three years following dam removal. Each monitoring location is also an existing IM-15 monitoring site, thus enabling KRRC to augment previously collected data. KRRC will collect water quality and discharge data at each site, as discussed in the next section.

KRRC was informed by the IM-15 monitoring entities that all locations require strengthening of the sonde holding mechanism to withstand winter conditions (currently, IM-15 data collection activities are ceased from approximately November through April). KRRC is working with the Karuk tribe, Yurok tribe and US Geological Services (USGS) to complete the necessary improvements prior to the beginning of pre-drawdown monitoring activities. KRRC will augment the IM-15 monitoring during the pre-drawdown monitoring period by upgrading and operating the stations during the winter months. Once drawdown is initiated, KRRC will operate the monitoring stations year-round and IM-15 monitoring will cease.

KRRC removed the Walker Bridge site along the Klamath River at River Mile 156.3 from the list due to access approval issues. If access issues are resolved, KRRC may add the site back into the list of monitoring sites.

The Klamath River site above Shovel Creek is located approximately 3 river miles downstream from the California/Oregon stateline and KRRC is considering it as a possible location for a stateline monitoring station. The site is currently monitored under IM-15. The final location of the stateline monitoring location may change including moving this monitoring to the JC Boyle Powerplant location at RM 219.7. The stateline monitoring location, specifics and duration of operation will be defined in consultation with will ODEQ and California SWRCB.

Table 3-1 Monitoring Locations

Location	River Mile	Current Monitoring Entity	Existing Sonde	USGS Gage Station
Klamath River below Keno Dam	233.4	USBR and PacifiCorp	n	y
Klamath River below J.C. Boyle Powerplant	219.7	PacifiCorp	n	y
Klamath River above Shovel Creek (near Stateline)*	206.42	PacifiCorp	n	n
Klamath River below Iron Gate Dam	189.7	PacifiCorp	y	y
Klamath River below Seiad	128.5	Karuk Tribe	y	y
Klamath River at Orleans (USGS)	59.1	Karuk Tribe	y	y
Klamath River near Klamath	6.0	Yurok Tribe	y	y

3.3 Water Quality Monitoring Parameters and Frequency

Table 3-2 lists the water quality parameters KRRC will monitor at each of the monitoring locations. KRRC will collect time-series water quality and stream discharge data, in accordance with the Water Quality Certifications, to assess water quality impacts of the Project. Discrete water quality samples will also be collected to support the suspended sediment load quantification, characterize constituent concentrations that cannot be measured using sondes, and to validate the sonde time-series data.

Table 3-2 Water Quality Monitoring Parameters

Constituent	Frequency	Type of Data
Temperature	Hourly, 12 months per year	Time-Series
Dissolved Oxygen	Hourly, 12 months per year	Time-Series
pH	Hourly, 12 months per year	Time-Series
Conductivity	Hourly, 12 months per year	Time-Series
Turbidity	Hourly, 12 months per year	Time-Series
SSC	Up to 24 samples pre-drawdown; weekly during drawdown, monthly following drawdown for 36 months or until TSS equals background at Keno	Discrete (Auto-Sampler)

Constituent	Frequency	Type of Data
SSC	4 storm events pre-drawdown; every two weeks during and after drawdown or until TSS equals background at Keno	Depth-width integrated sample
Chemical Oxygen Demand	Monthly, daily during drawdown	Discrete
Total Nitrogen	Monthly	Discrete
Total Phosphorous	Monthly	Discrete
Microcystin Cell Count	Monthly	Discrete

KRRC will collect sonde turbidity data as Nephelometric Turbidity Units (NTUs). However, impacts to aquatic resources from reservoir sediments have been quantified in milligrams per liter (mg/L) of SSC. The KRRC collected reservoir sediment samples in 2017 and plans to have the USGS conduct a series of laboratory tests to develop a SSC versus turbidity relationship for the reservoir sediments. This relationship will assist in making adaptive management decisions during and following dam removal and in understanding the impacts to aquatic resources. KRRC will develop a laboratory protocol for the SSC/turbidity relationship analysis that identifies the accuracy and reliability of this relationship along with any uncertainties and specific field verification testing during dam decommissioning.

KRRC will characterize chemical Oxygen Demand and nutrient concentrations to assess the impacts of reservoir sediment decomposition, and other biological activities, on the dissolved oxygen concentrations in the river.

KRRC will quantify cell counts of microcystin producing blue-green algae to determine attainment of existing heath related water quality standards.

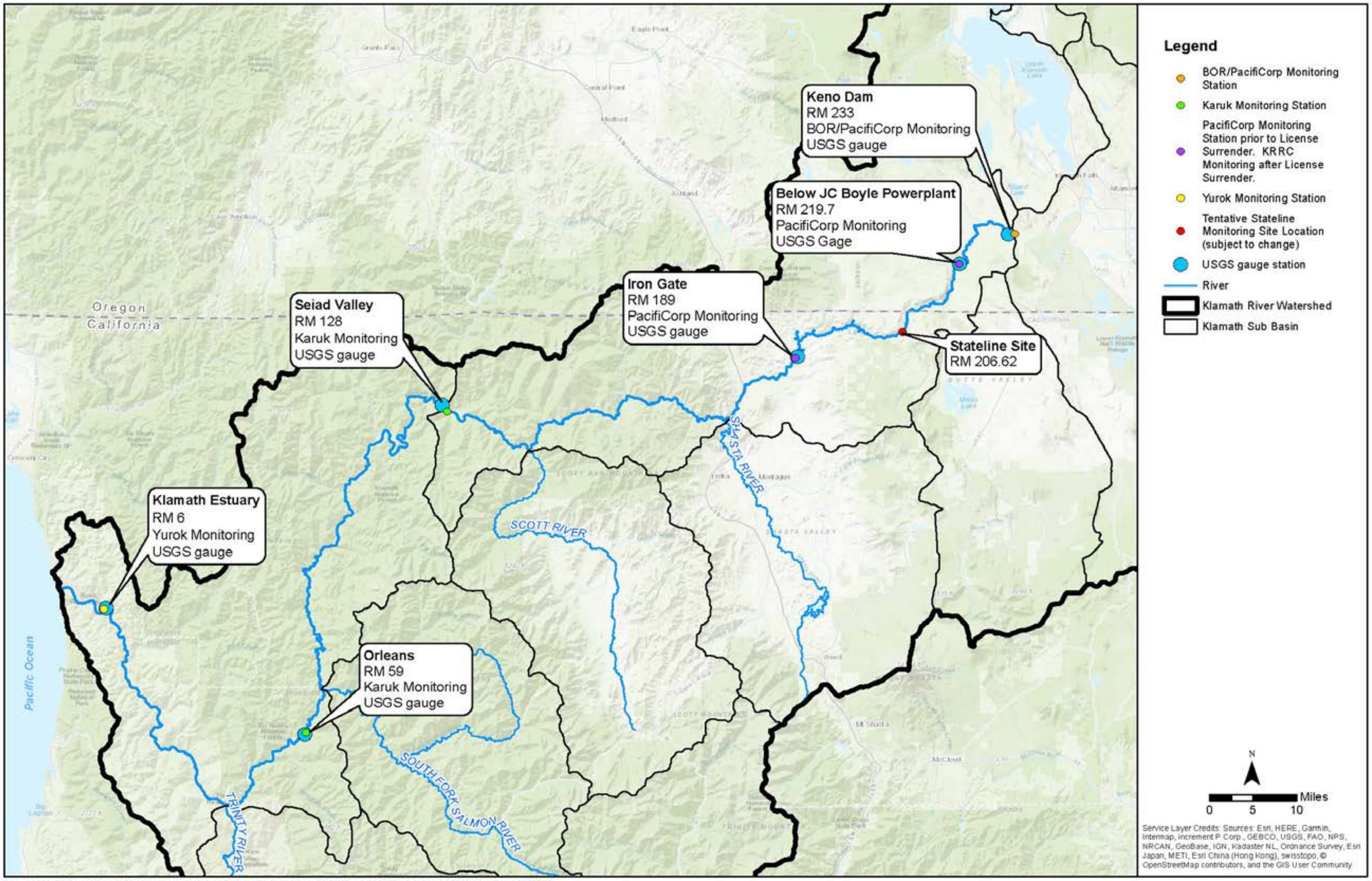

Figure 3-1 Water Quality Monitoring Locations

3.4 Riverbed Sediment Sampling and Analysis

During the Secretarial Determination process, USBR collected 75 five sediment cores in 2009 from the three reservoirs that will be removed as part of the Project and analyzed sediments for 501 anthropogenic and naturally occurring chemicals and compounds. USBR assessed whether significant risk existed for humans or aquatic biota via five contaminate exposure pathways. The data analysis was done in collaboration with the states of Oregon and California, as well as the EPA. The USBR concluded that no chemicals or compounds were detected in reservoir sediments at concentrations exceeding human health screening levels, and no other preclusions to releasing the reservoir sediments during dam decommissioning to the freshwater or marine environment were identified for human or aquatic biota exposure (USBR 2012d).

The above finding aside, the draft California Section 401 Water Quality Certification requires characterization of sediment quality in reservoir and riverbed sediments upstream and downstream of the project reservoirs, and in the Klamath estuary. KRRC will develop a sediment characterization plan in consultation with Oregon and California regulatory agencies to satisfy the requirements of the Section 401 Water Quality Certifications for both states with consistent sampling and testing protocols and procedures.

All sampling, analysis, and evaluation of sediments for the presence of toxic compounds will follow the procedures and protocols defined in the USACE Sediment Evaluation Framework for the Pacific Northwest, July 2016 (RSET 2016).

3.5 Plan Implementation and Schedule

The KRRC will implement this Plan in accordance with the sampling schedules and frequencies defined herein and for up to three years following dam removal. Monitoring activities will continue until the State Water agencies are satisfied that attainment of Basin Plan water quality standards occurs, or after the specified time period (3 years) expires for post-construction monitoring stated within the California and Oregon 401 Water Quality Certifications, whichever occurs first.

KRRC will implement the WQ Plan in accordance with the State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP). KRRC will develop a project-specific Quality Assurance Project Plan (QAPP) to describe the monitoring protocols and will include detailed mapping and figures depicting site locations, characteristics and equipment configurations. The QAPP will define:

- Monitoring entities (i.e. Yurok and Karuk tribes, USGS, USBR) and their specific roles and responsibilities
- Monitoring program design details and data collection protocols
- Data management activities and data storage
- Data quality objectives and quality assurance/quality control (QA/QC)
- Regulatory, stakeholder, and public reporting of the collected data.

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Chapter 4: References

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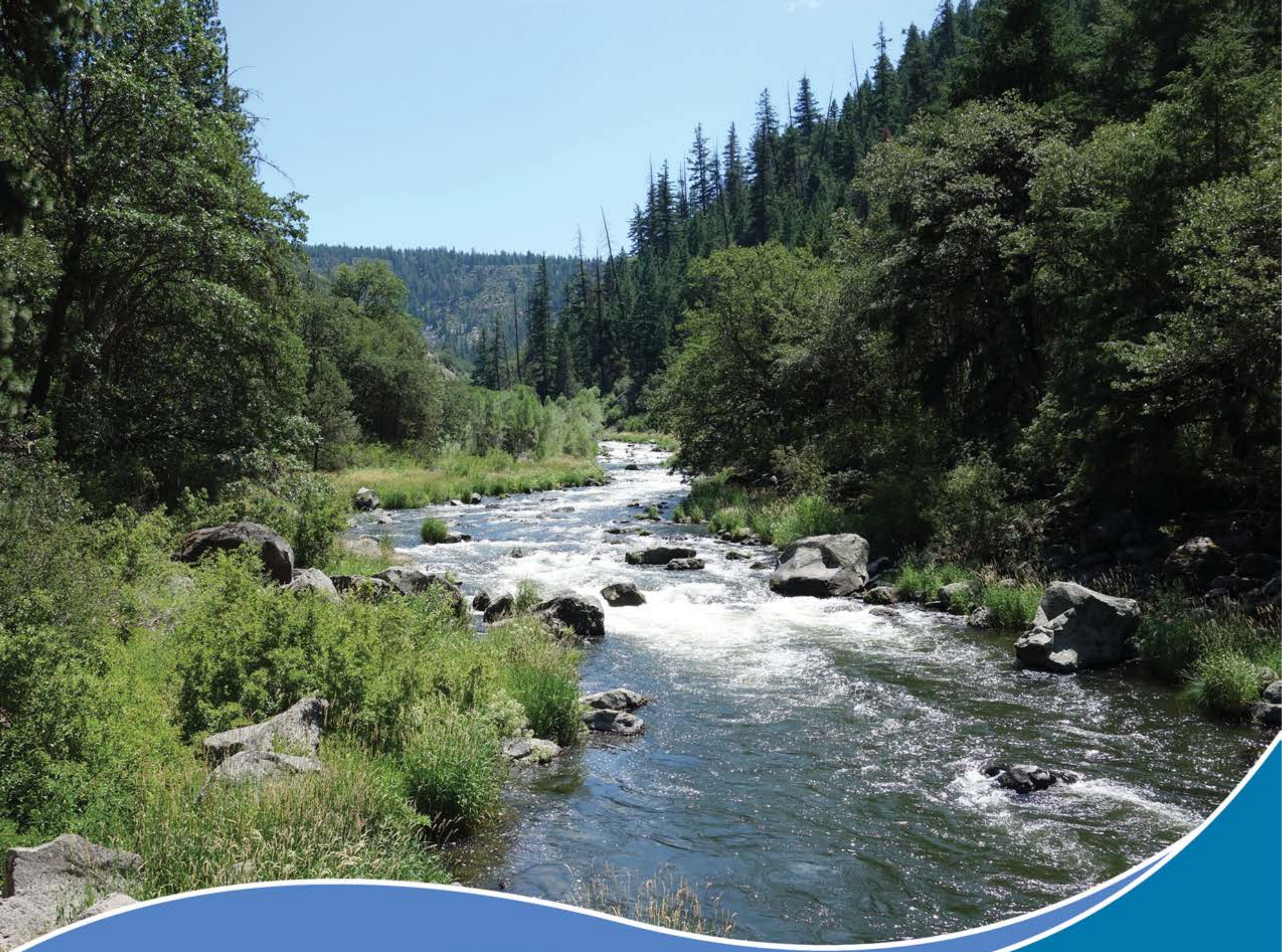

Definite Plan for the Lower Klamath Project

Appendix N – Groundwater Well Management Plan

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Prepared for:

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List of Figures

Acronyms and Abbreviations

CDFW California Department of Fish and Wildlife
DWR California Department of Water Resources
OWRD Oregon Water Resources Department
USBR United States Bureau of Reclamation

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Chapter 1: Introduction and Purpose

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1. INTRODUCTION

The Project may impact groundwater levels in the immediate vicinity of the reservoirs. The United States Bureau of Reclamation (USBR) performed a desktop review of wells located within a 2.5-mile radius of the three main reservoirs (Iron Gate, Copco, and J.C. Boyle) of the Project and reported these well locations in the 2012 Final Environmental Impact Statement/Environmental Impact Report for dam decommissioning (USBR and CDFW 2012). The USBR concluded that additional monitoring work would be required before, during, and following dam decommissioning to better understand reservoir removal effects on the surrounding groundwater wells.

This Groundwater Well Management Plan identifies groundwater wells that the Project may adversely impact. If the Project adversely impacts groundwater wells, KRRC will take steps (e.g., well deepening) to return the production rate of any affected domestic or irrigation groundwater supply well to conditions prior to dam decommissioning. There are five steps in this plan:

1. Database Search and Agency Coordination
2. Outreach to land owners and residents
3. Installation of groundwater monitoring wells
4. Groundwater monitoring
5. Post-Dam removal outreach/notification of findings
6. Proposed actions to improve production rate

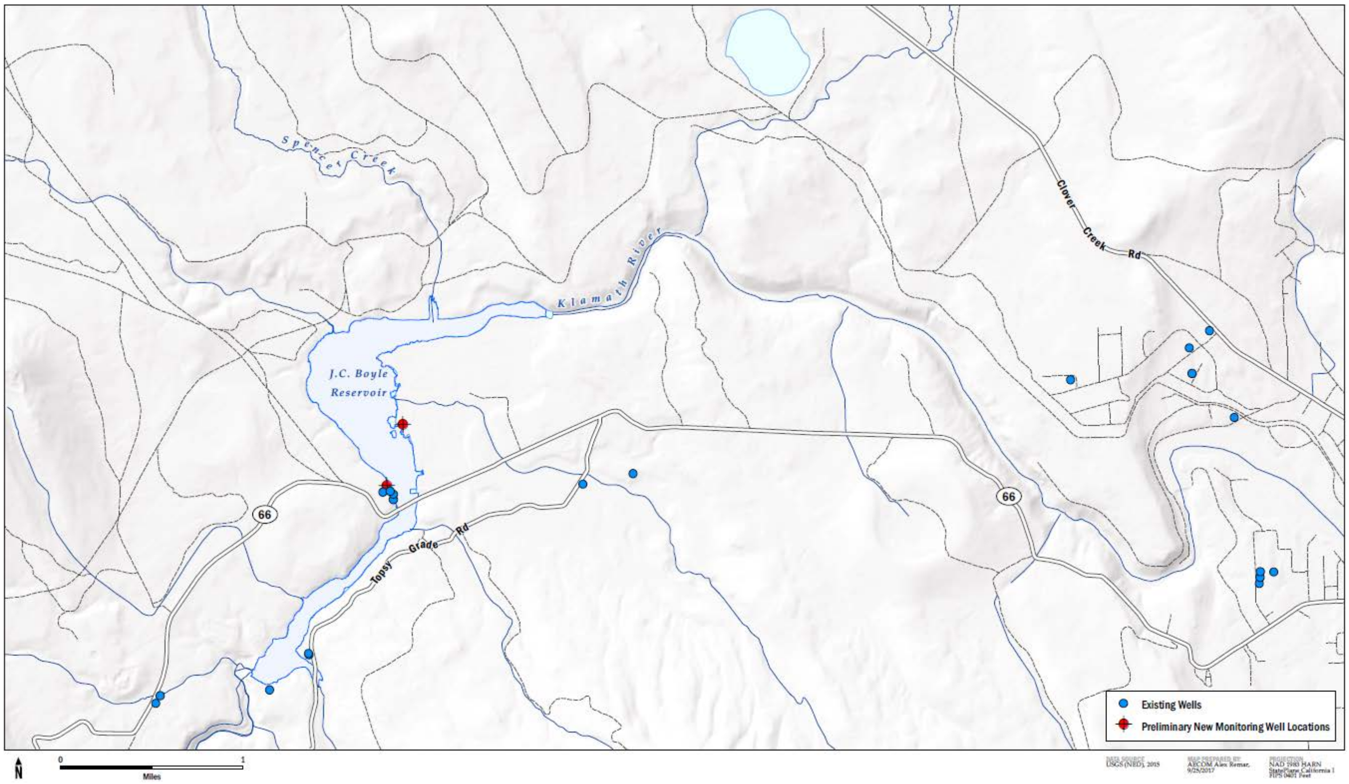

Figure 1 Identified Groundwater Wells within 2.5 Miles of J.C. Boyle Reservoir

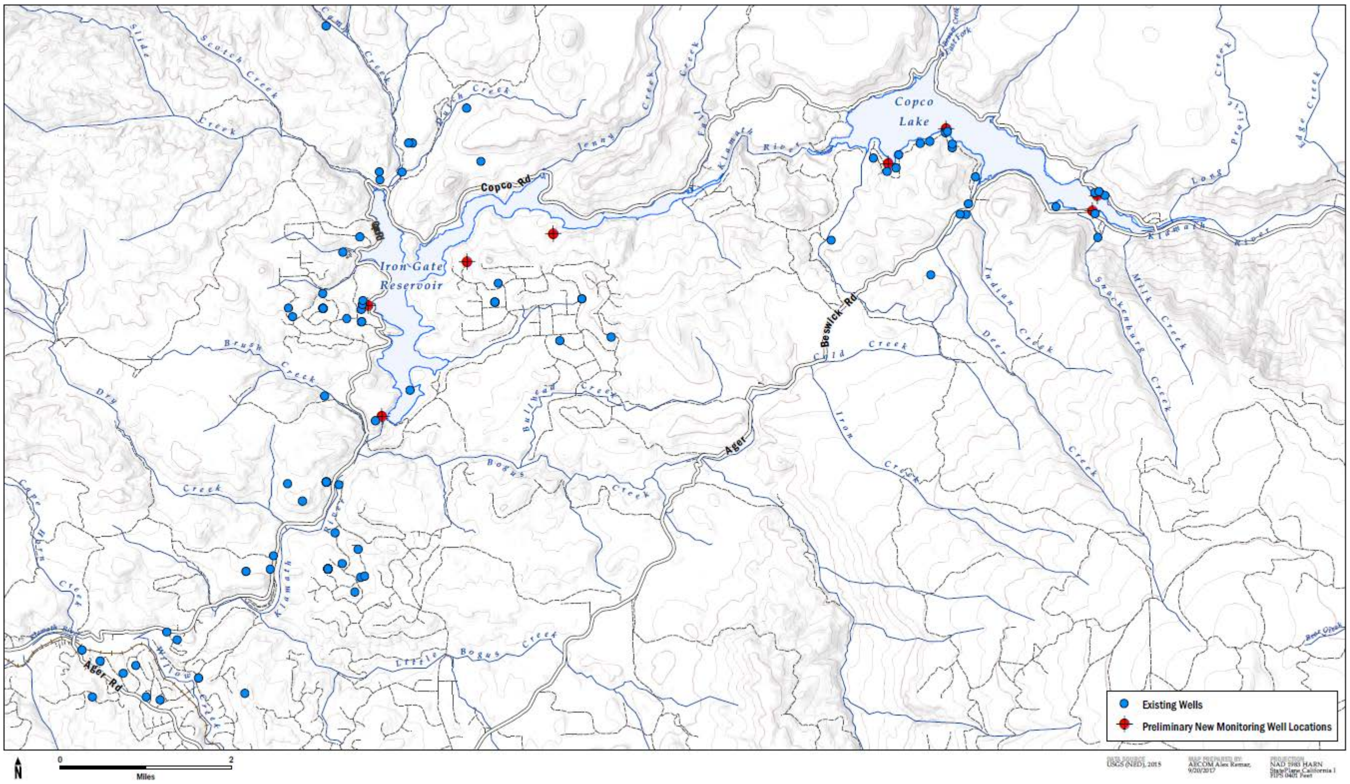

Figure 2 Identified Groundwater Wells within 2.5 Miles of Copco Lake and Iron Gate Reservoir

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Chapter 2: Management Plan

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2. MANAGEMENT PLAN

The following sections summarize the five steps in this plan:

1. Database Search and Agency Coordination
2. Outreach to land owners and residents
3. Installation of groundwater monitoring wells
4. Groundwater monitoring
5. Post-Dam removal outreach/notification of findings
6. Proposed actions to improve production rate

2.1 Database Search and Agency Coordination

The KRRC reviewed USBR's database that identifies 124 existing wells located within a 2.5-mile radius of the project reservoirs. The KRRC attempted to verify the location of these wells and identified any new wells within this radius installed since 2012. The KRRC contacted Siskiyou County, the California Department of Water Resources (DWR), and Oregon Water Resources Department (OWRD) about the accessibility of their groundwater well data bases.

Siskiyou County did not provide any specific information on well locations or ownership due to insufficient staff resources. County staff stated that there are no shared water systems at the California reservoirs[1], so KRRC assumed that all reservoir residents utilize groundwater for domestic use. (Rick Dean, personal communication, July 27, 2017). Siskiyou County recommended that the KRRC contact DWR to verify previously recorded well locations and to identify any potential new well records.

The KRRC contacted DWR and was told that DWR's policy does not allow the sharing of well ownership information (Benjamin Brezing, personal communication, August 8, 2017). .

The KRRC contacted OWRD and was directed to use their public database to download well logs for those surrounding J.C. Boyle (Mary Grainey, personal communication, August 23, 2017). Of the 17 well logs that KRRC identified and downloaded using the OWRD database search, only one provided a specific location..

Given the gaps in information discernable from these data bases,, the KRRC has proposed a broad land owner outreach program as described below.

[1] KRRC has since learned from residents that there is a shared spring water supply near Copco Lake that supplies a portion of the residences there.

2.2 Outreach to Land Owners and Residents

KRRC retained the locations reported by USBR in 2012 for further analysis. To fully understand and update this information, the KRRC will undertake an outreach effort in 2018-2019 to all residents and landowners within 2.5 miles of the project reservoirs to inquire about their groundwater wells.

The KRRC will develop and send an information and questionnaire mailer to property owners, residents, and businesses within 2.5 miles of each project reservoir in 2018. The mailer will include a request to monitor the well for water level prior to, during, and following dam decommissioning. The KRRC will also use its planned public meetings and meetings targeted at reservoir land owners to "spread-the-word" about the proposal to identify wells for monitoring within 2.5 miles of the reservoirs. The KRRC will identify as many well owners as possible that are willing to participate in the monitoring program. Initial information requested by the questionnaire will include:

- Description of the well monitoring program
- Request to participate in the well monitoring program
- Specific information requests:
  - Property address and well location
  - Current depth to groundwater
  - Physical parameters of the well (casing size, well depth, screen interval, pump size)
  - Historical groundwater well problems (quantity and quality)

2.3 Installation of Groundwater Monitoring Wells

The KRRC will identify a sufficient number of residential wells within the proximity of each reservoir to monitor the effects of reservoir drawdown on the groundwater aquifer (sentinel wells). Wells near the reservoirs (less than ¼ mile) are preferred, as the groundwater recharge effect from the reservoir decreases with distance from the reservoir. If an insufficient number of well owners agree to participate in the groundwater monitoring activity, the KRRC will install a minimum of 10 sentinel monitoring wells around the three reservoirs. KRRC will install the monitoring wells between residents and the reservoirs on PacifiCorp land. KRRC proposes to install up to four monitoring wells each at Iron Gate Reservoir and Copco Lake and two wells at J.C. Boyle Reservoir. Figures 1 and 2 show proposed monitoring well locations.

2.4 Groundwater Monitoring

KRRC will monitor sentinel wells belonging to participating landowners including any monitoring wells installed by the KRRC pre- and post-dam decommissioning to identify seasonal fluctuations in groundwater levels and any groundwater level changes that may be attributable to reservoir removal. KRRC will also monitor sentinel wells for general water quality parameters including pH, conductivity, and major anions and cations. To establish baseline conditions, the KRRC plans to monitor sentinel wells monthly for a minimum of one year prior to dam decommissioning. Following dam decommissioning, KRRC will conduct groundwater monitoring monthly for up to one year or until such time that post-project groundwater levels and general water quality parameters have been determined (no discernable water level declines or changes in quality over a four-month period) or they mirror baseline conditions.

During the drawdown period, KRRC will install data loggers in the sentinel wells to continuously record groundwater levels and pH and conductivity. If KRRC identifies changes attributable to reservoir removal to water levels or quality that might indicate potential supply problems, the KRRC proposes to take the actions described in Section 2.6 to restore temporary and/or long-term water supplies.

2.5 Post-Dam Removal Outreach/ Notification of Findings

The KRRC will compile and summarize in writing the groundwater data collected prior to, during, and following dam decommissioning. KRRC will use these data to identify any trends or changes in groundwater water levels and quality that may be attributable to reservoir removal. The KRRC will prepare a report of findings and identify any areas where groundwater wells are determined to be vulnerable to groundwater levels or water quality declines resulting from reservoir removal. The KRRC will make the report available to all well owners in the study area. Well owners will have the opportunity to request an evaluation of their well to determine if there are changes in groundwater water levels and quality attributable to reservoir removal.

2.6 Proposed Actions

If the data collected during or following dam decommissioning indicates a loss of supply or adverse water quality to any potable or irrigation well, and that these circumstances are attributable to reservoir removal, then the KRRC will provide temporary water supplies until long-term measures such as motor replacement, well deepening, or full well replacement are identified and implemented as needed to return the production rate of any affected domestic or irrigation groundwater supply well to conditions prior to dam decommissioning .

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Chapter 3: References

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3. REFERENCES

USBR and CDFW 2012. U.S. Bureau of Reclamation and California Department of Fish and Wildlife. *Klamath Facilities Removal – Final Environmental Impact Statement/Environmental Impact Report*. December.

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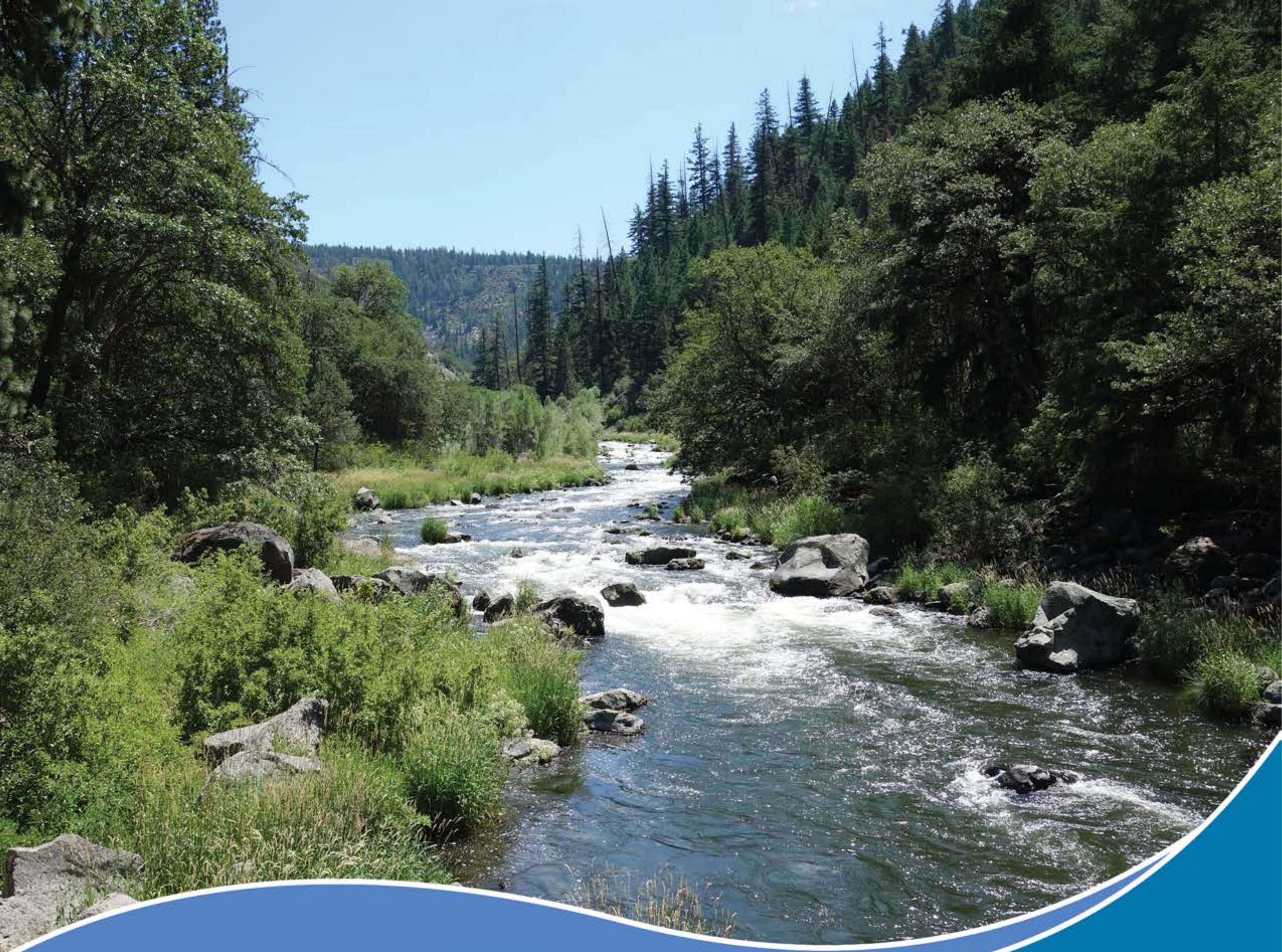

Definite Plan for Decommissioning

Appendix O1 – Fire Management Plan

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Acronyms

BLM	U.S. Bureau of Land Management
Cal Fire SU	Cal Fire Siskiyou Unit
CCR	California Code of Regulations
CFR	Code of Federal Regulations
FDL	Fire Danger Level
FMP	Fire Management Plan
FPD	Fire Protection District
KLD	Klamath-Lake District
KRRC	Klamath River Renewal Corporation
LIFC	Lakeview Interagency Fire Center
ODF	Oregon Department of Forestry
OAR	Oregon Administrative Rules
ORS	Oregon Revised Statutes
PALs	Predicted (or Designated) Activity Levels
PDM	Power-Driven Machinery
PRC	California Public Resources Code
SCOFMP	South Central Oregon Fire Management Partnership
USFS	U.S. Forest Service

Chapter 1: Need for Fire Management

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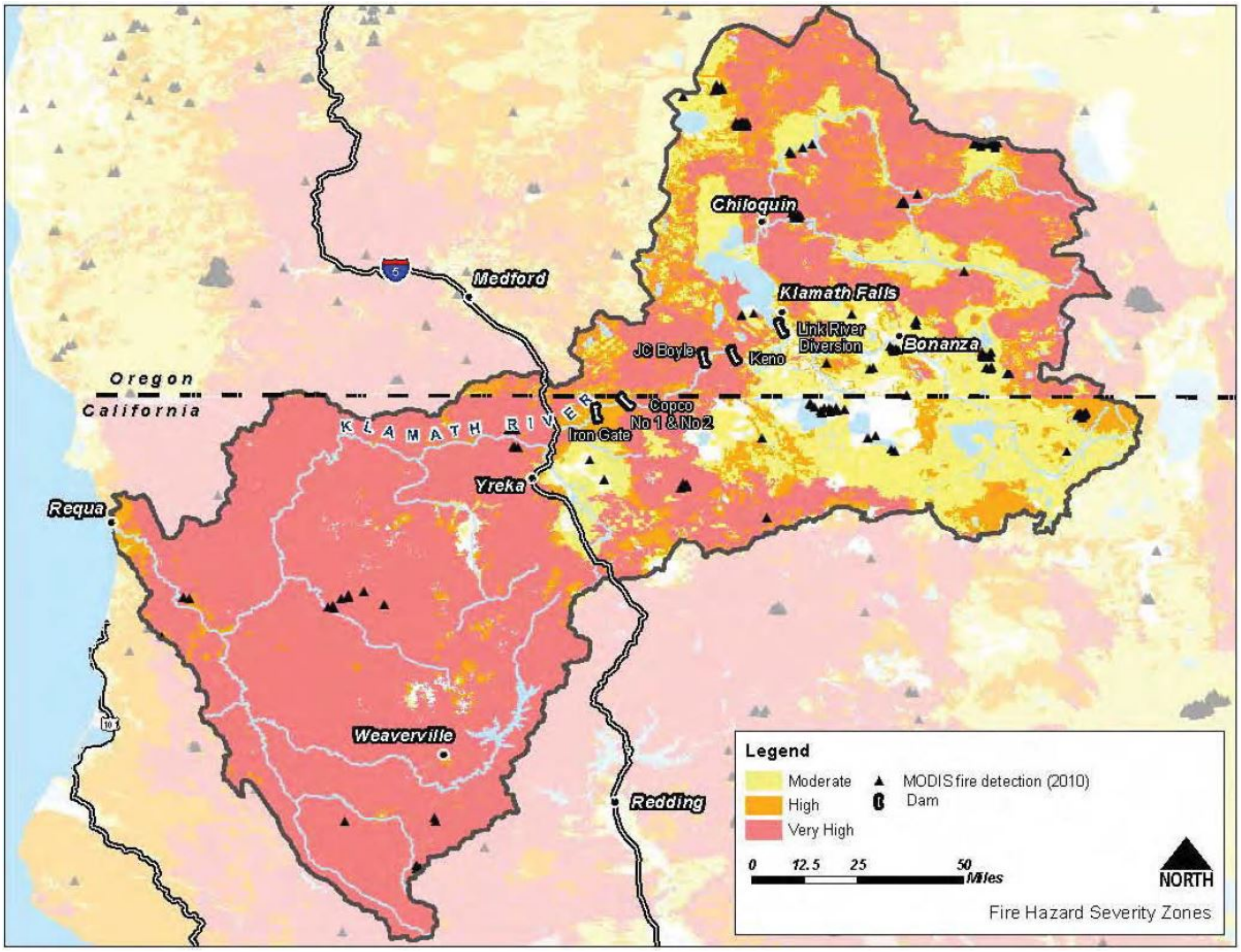
1. NEED FOR FIRE MANAGEMENT

KRRC developed this Fire Management Plan (FMP) to address fire prevention and response methods including fire precaution, pre-suppression, and suppression measures to support implementation of the Definite Plan for the Lower Klamath Project (Definite Plan) proposed by the Klamath River Renewal Corporation (KRRC) for physical removal of four dam developments (Iron Gate, Copco No. 1, Copco No. 2, and J.C. Boyle), hereinafter the Project. The FMP requires that areas of construction and deconstruction work involving activities that could result in open sparks or flame be cleared of dried vegetation or wetted-down to prevent wildfires. The FMP also requires fire suppression equipment be on-site at all times and emergency contact numbers be posted, in case of a fire. With the removal of the reservoirs as a source of water for fighting wildfires, the Fire Management Plan also provides measures for potential alternative sources of water for firefighting.

The areas surrounding the four Klamath River dams are at risk of wildfires particularly during the dry season, and the risk of triggering a fire associated with construction and demolition activities necessitates the development and implementation of a fire management plan such as this FMP to prevent and respond to fires. California Department of Forestry and Fire Protection (Cal Fire) categorizes the fire threat in the region as high to very high (Cal Fire, 2007). Fire hazard mapping using the MODerate-resolution Imaging Spectroradiometers by the US Forest Service Remote Sensing Application Center (USFS 2010) shows the distribution of fire threats in the Klamath basin (Figure 1-1), and Klamath County has identified Wildland Urban Interfaces (WUI), where fire damage hazards are high (Wildland Fire Technologies, 2016). There is a ranking system associated with WUIs and J.C. Boyle Dam, which is partially located in the Keno WUI Community, has a WUI rating of High, the highest value in Klamath County.

Construction and dam removal activities potentially increase the risk of fire if not properly managed. Activities of concern include accidental spills of flammable material, spark generation in vegetated open space, use of equipment and machinery that generates heat such as welding, grinding, and use of generators. Agencies dealing with fire prevention and suppression in the region have developed regulations and management methods to combat the increased risk of fire associated with construction activities. KRRC developed the FMP in accordance with the standards of, and in consultation with the local, state, and federal fire suppression agencies. The following sections describe the relevant agencies, their jurisdictions and regulatory requirements, and the FMP components to ensure the safe execution of the Project.



Source: USBR 2012

Figure 1-1 Map of fire hazard in the Klamath River basin generated using the MODerate-resolution Imaging Spectroradiometers by the USFS.

Chapter 2: Fire Suppression Agencies

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2. FIRE SUPPRESSION AGENCIES

The FMP requires coordination with multiple city, county, state, and federal fire suppression agencies including USDA Forest Service (USFS), Bureau of Land Management (BLM), the Oregon Department of Forestry (ODF) Klamath-Lake District (KLD), Cal Fire - Siskiyou Unit (Cal Fire SU), local districts of Klamath and Jackson Counties in Oregon and Siskiyou County in California, and local city and volunteer fire stations (Table 2-1). Fire safety and suppression resources are available from the various agencies in the event of a fire.

Table 2-1 Fire protection agencies in the project vicinity

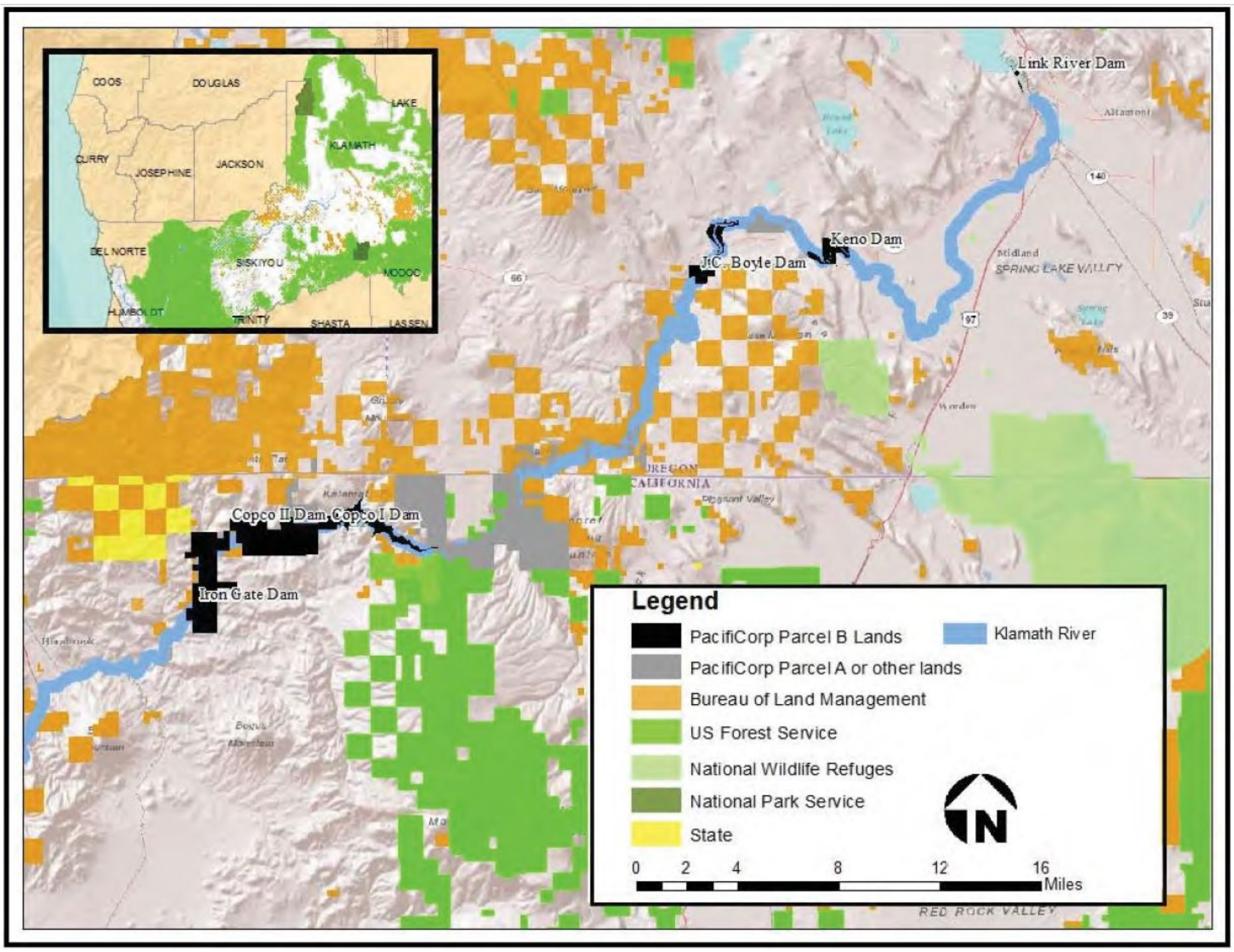
Agency	Type	Jurisdiction
USDA Forest Service	Federal	National Forests, federally managed land
Bureau of Land Management	Federal	BLM lands, federally managed land
Cal Fire	State of California	State Resource Lands, California
Oregon Department of Forestry	State of Oregon	State Resource Lands, Oregon, BLM land in Klamath River Canyon
Klamath County Fire District	Local, County of Klamath	Unincorporated County Lands and the City of Klamath Falls
Colestin Rural Fire District	Local, County of Jackson	County Fire District in Jackson County, Oregon
Siskiyou County Fire Protection Districts: Copco Lake, Hornbrook, Montague, South Yreka, Tulelake, Etna, Ft. Jones, Weed	Local, County	Unincorporated County Lands throughout Siskiyou County, California
Mount Shasta Fire Department	Local, City of Mount Shasta	Mt. Shasta Municipal Boundaries
Yreka Fire Department	Local, City of Yreka	City of Yreka Municipal Boundaries

Source: USBR and CDFW 2012

The USFS and BLM are the two federal agencies responsible for fire support and suppression in the Project vicinity. Both agencies provide wildfire protection primarily on land under their direct ownership and management but will provide support and assistance to other agencies when requested. Federal land near the Project limit of work is primarily limited to several BLM parcels along the Klamath River downstream of J.C. Boyle Dam and along Iron Gate and Copco reservoirs (Figure 2-1). BLM land near the Project limit of work in Oregon, including the Klamath River Canyon, is managed for fire by ODF KLD.

The Oregon and California State forestry and fire prevention agencies (ODF and Cal Fire) are the primary fire protection providers in the unincorporated areas in the Project limit of work. ODF and Cal Fire enforce their respective state laws and regulations and coordinate fire support with the local agencies. Cal Fire operates and works with local city, county, and volunteer fire departments. Fire management in Siskiyou County is operated as the Cal Fire SU. The Iron Gate and Copco developments are located within the Siskiyou County Unit Shasta Valley Battalion 2 area, and the Klamath River flows through Battalion 3. Cal Fire stations in the project vicinity include the City of Yreka and Hornbrook, which is located 10 miles west of Iron Gate Dam. The J.C. Boyle development in Oregon is under the jurisdiction of ODF KLD. The ODF KLD is a member of the South Central Oregon Fire Management Partnership (SCOFMP), which is a cooperative group of agencies including USFS, BLM, US Fish and Wildlife, and Crater Lake National Park. The SCOFMP shares resources to manage fire in the region, which primarily comprises Klamath and Lake Counties. Dispatch responsibilities for the SCOFMP are with the Lakeview Interagency Fire Center (LIFC).

The city-operated fire stations in the region include the Yreka and Mount Shasta Fire Departments in California. Many county fire stations are present throughout the project vicinity, and are associated with Klamath and Jackson counties in Oregon and Siskiyou County in California (Table 2-1).



Source: USBR and CDFW 2012

Figure 2-1 Land ownership in the project vicinity. Figure from EIS/R (2012).

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Chapter 3: Regulations and Requirements

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3. REGULATIONS AND REQUIREMENTS

KRRC developed this FMP to meet the regulations and requirements set forth by the fire suppression agencies in the Project vicinity (Figure 2-1). Most of the dam deconstruction and reservoir management will take place on private land. ODF and Cal Fire handle state regulations for fire management with regard to various construction related activities. BLM and USFS manage their respective lands, and those regulations only need to be met for construction taking place on federal land. There are several BLM parcels along the Klamath River adjacent to and in the Project limits of work. In Oregon, ODF KLD manages the BLM lands east of the Cascades crest and west of Hwy 97 and regulates them for fire according to ODF rules. This area includes the Klamath Canyon project area. In California, a few BLM parcels are located near the Copco project footprint. In these locations, BLM generally defers to restrictions corresponding to the Predicted (or Designated) Activity Levels (PALs) set by the USFS Klamath National Forest and relies on Cal Fire for direct protection responsibilities (Brodhead, L., personal communication 2017.08.29). For logging operations on BLM land in California, contractual fire prevention and suppression measures vary between projects but must typically conform to general Cal Fire and USFS regulations and the input from a BLM Authorized Agent assigned to the contract (Brodhead, L., personal communication 2017.08.29). The USFS owns land that is near Copco reservoir but outside of the project footprint. Therefore, the FMP does not address specific USFS fire prevention and suppression requirements outlined in the Code of Federal Regulations (CFR).

3.1 Oregon Department of Forestry – Klamath Lake Unit

Oregon law prescribes regulations and minimum requirements for fire prevention and suppression that are applicable in each ODF Fire Protection District during fire season. In Oregon, fire season is declared by each ODF district and is typically between early June and mid- to late-October. Table 3-1 lists the laws and requirements for all ODF districts.

ODF districts west of the Cascades crest have industrial operations requirements and restrictions that correspond to four adjective classes Industrial Fire Precautionary Levels (IFPL). A different system is in place for ODF districts east of the Cascades crest, such as the ODF KLD. Construction operations must follow the regulations in Table 3-1 for all levels of fire danger during fire season. Additional restrictions are enforced when fire hazard is classified as “extreme.” ODF does not have general restrictions or requirements when work is performed outside of the fire season.

If required by Oregon law ORS 477.625, KRRC’s contractor will obtain a permit for Power-Driven Machinery (PDM) from the ODF state forester for construction activities that involve heavy machinery. Fire prevention requirements under the PDM permit are dependent on the Fire Danger Level (FDL) and requirements for fire prevention and suppression preparedness relate to the type of machinery and fire hazard. The PDM permit requirements are more restrictive during "Extreme" adjective class FDL and include the suspension of the operation of tracked machinery between the hours of 1 pm and 8 pm ((ORS 477.625(1a), OAR 629-043-0026(5)). The Project will use tracked equipment and, if a PDM permit is required, such use will be subject to these restrictions during extreme fire danger. ODF typically informs PDM permit holders of changes in fire hazard and operation requirements. PDM permits expire at each new calendar year and KRRC's contractor will renew a PDM as necessary.

The ODF forester can grant waivers from the fire prevention and suppression requirements, including the PDM permit, in some instances. Waivers may be granted for favorable weather conditions, topographic setting, and/or alternate methods and equipment proposed by the operator that provide equal or better fire prevention and suppression.

Table 3-1 2017 ODF fire season minimum requirements

Category	Reference	Requirement
No Smoking	ORS 477.510	No smoking while working or traveling in an operation area
Hand Tools	ORS 477.655, OAR 629-043-0025	Supply hand tools for each operation site - 1 tool per person with a mix of pulaskis, axes, shovels, hazel hoes. Store all hand tools for fire in a sturdy tool box clearly identified as containing firefighting tools. Supply at least one box for each operation area. Crews of 4 or less are not required to have a fire tools box as long as each person has a shovel, suitable for fire-fighting and available for immediate use while working on the operation.
Fire Extinguishers	ORS 477.655, OAR 629-43-0025	Each internal combustion engine used in an operation, except power saws, shall be equipped with a chemical fire extinguisher rated as not less than 2A:10BC (5 pound).
Power Saws	ORS 477.640, OAR 629-043-0036	Power saws must meet Spark Arrester Guide specifications - a stock exhaust system and screen with < .023 inch holes. The following shall be immediately available for prevention and suppression of fire: • One gallon of water or pressurized container of fire suppressant of at least eight ounce capacity • One round pointed shovel at least 8 inches wide with a handle at least 26 inches long • The power saw must be moved at least 20' from the place of fueling before it is started.
Fire Tools, Extinguishers for Trucks	ORS 477.655, OAR 629-043-0025	Equip each truck driven in forest areas for industrial purposes with: • One round pointed shovel at least 8 inches wide, with a handle at least 26 inches long • One axe or Pulaski with 26 inch handle or longer • One fire extinguisher rated not less than 2A:10BC (5 pound).

Category	Reference	Requirement
Spark Arresters and Mufflers	ORS 477.645, OAR 629-043-0015	All non-turbo charged engines must meet Spark Arrester Guide specifications except: • Fully turbo charged engines. • Engines in motor vehicles operating on improved roads equipped with an adequate muffler and exhaust system. • Engines in light trucks (26,000 GVW or less) that are equipped with an adequate muffler and an exhaust system. • Engines in heavy trucks (greater than 26,000 GVW) that are equipped with an adequate muffler and exhaust system. • If a truck engine is not fully turbo-charged, then the exhaust must extend above the cab and discharge upward or to the rear, or to the end of the truck frame. • Water pumping equipment used exclusively for fighting fire. • Engines of 50 cubic inch displacement or less, except ATV's and motorcycles, shall be equipped with an adequate muffler and an exhaust system. • Engines in ATV's and motorcycles must be equipped with an adequate muffler and exhaust system or an approved screen, which completely encloses exhaust system. • Power saws. (See power saw requirements)
Pump, Hose, and Water Supply	ORS 477.650, 477.625, OAR 629-043-0026, 629-43-0020	Supply a pump, hose and water supply for equipment used on an operation. • Pump must be maintained ready to operate and capable to provide a discharge of not less than 20 gallons per minute at 115 psi at pump level. Note: Volume pumps will not produce the necessary pressure to effectively attack a fire start. Pressure pumps are recommended. • Water supply shall be a minimum of 300 gallons if a self-propelled engine. Water supply shall be a minimum of 500 gallons if not self-propelled (pond, stream, tank, sump, etc.) • One water supply is adequate as long as the operator can deliver water to the fire within 10 minutes • Provide enough hose (500 feet minimum) not less than 3/4" inside diameter to reach areas where power driven machinery has worked. Note: Should a fire occur, the operator must be able to position the water supply in a location where enough hose is available to reach the area worked by power driven machinery. This includes mobile equipment as well as motorized carriages and their moving lines. Moving lines are defined as main lines and haul back lines. This can be achieved in many ways, including the practice of having a water tank and hose attached to a piece of equipment, like a skidgen or skidder, that can get the water to the fire. • Water supply, pump, and at least 250' of hose with nozzle must be maintained as a connected, operating unit ready for immediate use.

Category	Reference	Requirement
Fire Watch Service	ORS 477.665, OAR 629-043-0030	Each operation area is to have a fire watch. Fire watch shall be on duty during any breaks (up to 3 hours) and for three hours after all power-driven machinery used by the operator has been shut down for the day. The ODF KLD has specific fire watch duration prescriptions based on Fire Danger Level adjective class. • Low = 1 hr fire watch • Moderate = 2 hrs • High to Extreme = 3 hrs Fire watch shall: • Be physically capable and experienced to operate firefighting equipment. • Have facilities for transportation and communications to summon assistance. • Observe all portions of the operation on which activity occurred during the day. Upon discovery of a fire, Fire watch personnel must: First report the fire, summon any necessary firefighting assistance, describe intended fire suppression activities and agree on a checking system; then, after determining a safety zone and an escape route that will not be cut off if the fire increases or changes direction, immediately proceed to control and extinguish the fire, consistent with firefighting training and safety.
Operation Area Fire Prevention	ORS 477.625, OAR 629-043-0026	• Keep all power driven machinery free on excess flammable material which may create a risk of fire. • Avoid line-rub on rock or woody material, which may result in sparks or sufficient heat to cause ignition of a fire. • Disconnect main batteries from powered components (other than what may be necessary to retain computer memory) through a shut-off switch or other means or leave equipment on ground cleared of flammable material.

Source: ODF 2010, 2017

3.2 Cal Fire – Siskiyou Unit

California law prescribes regulations and minimum requirements for fire prevention and suppression that are applicable during fire season in all lands within the Cal Fire jurisdiction. The California Public Resources Code (PRC) requires preventative fire measures (Table 3-2) that are imposed during the time where a Burn Permit is required under PRC-4423. For Zone B, which includes northern California counties, this period usually begins May 1 and persists until proclamation of the termination of fire season by the fire director. Cal Fire does not require a permit for the use of equipment and heavy machinery on a construction site. State forest and fire laws may be enforced by USFS, BLM, NPS, and certain county fire departments in addition to Cal Fire personnel. The California Code of Regulations (CCR) has specific and generally applicable regulations that pertain to fire prevention and suppression, e.g., requirements for smoking during fire season, but no associated permits are required. The CCR, PRC, and FRC regulations pertaining to construction sites and logging operations in California and the associated best management practices are described in detail in the Cal Fire Industrial Operations Fire Prevention Field Guide (1999).

Table 3-2 California Public Resources Code Fire precautionary measures*

Category	Reference	Requirement
Fire Causing Equipment	PRC-4427	No person shall use or operate any motor, engine, boiler, stationary equipment, welding equipment, cutting torches, tarpots, or grinding devices from which a spark, fire, or flame may originate, which is located on or near any forest-covered land, brush-covered land, or grass-covered land, without doing both of the following: a. First clearing away all flammable material, including snags, from the area around such operation for a distance of 10 feet. b. Maintain one serviceable round point shovel with an overall length of not less than 46 inches and one backpack pump water-type fire extinguisher fully equipped and ready for use at the immediate area during the operation. This section does not apply to portable powersaws and other portable tools powered by a gasoline-fueled internal combustion engine.
Use of Internal Combustion Engines	PRC-4428	No person shall use or operate any vehicle, machine, tool or equipment powered by an internal combustion engine operated on hydrocarbon fuels, in any industrial operation located on or near any forest, brush, or grass-covered land between April 1 and December 1 of any year, or at any other time when ground litter and vegetation will sustain combustion permitting the spread of fire, without providing and maintaining, for firefighting purposes only, suitable and serviceable tools. a. A sealed box of tools shall be located, within the operating area, at a point accessible in the event of fire. This fire toolbox shall contain: one backpack pump-type fire extinguisher filled with water, two axes, two McLeod fire tools, and a sufficient number of shovels so that each employee at the operation can be equipped to fight fire. b. One or more serviceable chainsaws of three and one-half or more horsepower with a cutting bar 20 inches in length or longer shall be immediately available within the operating area, or, in the alternative, a full set of timber-felling tools shall be located in the fire toolbox, including one crosscut falling saw six feet in length, one double-bit ax with a 36-inch handle, one sledge hammer or maul with a head weight of six, or more, pounds and handle length of 32 inches, or more, and not less than two falling wedges. c. Each rail speeder and passenger vehicle shall be equipped with one shovel and one ax, and any other vehicle used on the operation shall be equipped with one shovel. Each tractor used in such operation shall be equipped with one shovel.

Category	Reference	Requirement
Fire Fighting Tools	PRC-4429	In an area of any industrial or other operations on or near any forest-covered land or brush-covered land, there shall be provided and maintained at all times, in a specific location, for firefighting purposes only, a sufficient supply of serviceable tools to equip 50% of the able-bodied personnel for fighting fires. • Tools shall be included shovels, axes, saws, backpack pumps, and scraping tools. • One serviceable headlight adaptable for attachment to at least one-half of the tractor-bulldozers used on the operation. • A sufficient number of canteens and flashlights to equip a third of the able-bodied personnel.
Water Pumps	PRC-4430	The use or operation of any steam-operated engine or machine equipment, located on or near forest-covered land or brush-covered land, requires • One adequate force pump or water under pressure equivalent to a pump, and not less than 200 feet of hose not less than one inch in diameter for each steam-operated engine or equipment. • The pump or water pressure shall be capable of applying a minimum of 40 pounds pressure at the nozzle on 200 feet of hose, such nozzle to be 0.25 inch or larger in diameter. • If two steam-operated engines or steam equipment are customarily operated within 100 feet of each other, only one engine or piece of equipment need be equipped with pump and hose.
Gas Powered Saws	PRC-4431	No person shall use or operate or cause to be operated any portable saw, auger, drill, tamper, or other portable tool powered by a gasoline-fueled internal combustion engine on or near any forest-covered land, brush-covered land, or grass-covered land, within 25 feet of any flammable material, without providing and maintaining at the immediate locations of use or operation of the saw or tool, for firefighting purposes one serviceable round point shovel, with an overall length of not less than 46 inches, or one serviceable fire extinguisher. The type and size of fire extinguisher necessary to provide at least minimum assurance of controlling fire caused by use of portable power tools under various climatic and fuel conditions shall be specified in regulations issued by the Director of Forestry and Fire Protection. The required fire tools shall at no time be farther from the point of operation of the power saw or tool than 25 feet with unrestricted access for the operator from the point of operation.

Category	Reference	Requirement
Spark Arresters	PRC-4442	a. No person shall use, operate, or allow to be used or operated, any internal combustion engine which uses hydrocarbon fuels on any forest-covered land, brush-covered land, or grass-covered land unless the engine is equipped with a spark arrester maintained in effective working order or the engine is constructed, equipped, and maintained for the prevention of fire. b. Spark arresters affixed to the exhaust system of engines or vehicles shall not be placed or mounted in such a manner as to allow flames or heat from the exhaust system to ignite any flammable material. c. A spark arrester is a device constructed of nonflammable materials specifically for the purpose of removing and retaining carbon and other flammable particles over 0.0232 of an inch in size from the exhaust flow of an internal combustion engine that uses hydrocarbon fuels or which is qualified and rated by the United States Forest Service. d. Engines used to provide motor power for trucks, truck tractors, buses, and passenger vehicles, except motorcycles, are not subject to this section if the exhaust system is equipped with a muffler. e. Turbocharged engines are not subject to this section if all exhaust gases pass through the rotating turbine wheel, there is no exhaust bypass to the atmosphere, and the turbocharger is in effective mechanical condition.
Exclusion of Outdated, Handheld Internal Combustion Equipment	PRC-4443	No person shall use, operate, or cause to be operated on any forest-covered land, brush-covered land, or grass-covered land any handheld portable, multi-position, internal-combustion engine manufactured after June 30, 1978, which is operated on hydrocarbon fuels, unless it is constructed and equipped and maintained for the prevention of fire.

** Measures are applicable during any times of the year when burning permits are required unless otherwise stated.*

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Chapter 4: Contacts

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4. CONTACTS

KRRC's contractor will be in frequent contact with the pertinent fire suppression agencies during construction to discuss fire hazards, prevention, suppression, and contingency plans. KRRC's contractor and a designated Safety Officer will identify the nearest local fire stations to the current operation areas and ensure the emergency contact information for each agency is posted at the project site and available to fire watch personnel and on-site workers.

In Oregon, the primary contact agency is ODF KLD. KRRC's contractor will contact the ODF KLD Unit Forester and Stewardship Forester during development of detailed, site-specific fire management plans to identify fire management resources in the Project vicinity. ODF KLD will be the first agency contacted in the event of a fire on the Oregon portion of the Project.

In California, the primary contact agency is Cal Fire SU. KRRC's contractor will contact the Cal Fire SU Prevention Specialist during development of detailed, site-specific fire management plans to identify resources in the Project vicinity. Cal Fire SU will be the first agency contacted in the event of a fire on the California portion of the Project.

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Chapter 5: Fire Management Plan

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5. FIRE MANAGEMENT PLAN

5.1 Responsibilities

KRRC's contractor will designate an individual as "Safety Officer" to be available and on-call 24 hours a day, 7 days a week in the event of a fire at the project site. The Safety Officer will be the primary on-site communication linkage to ODF and Cal Fire foresters and will be responsible for managing all on-site fire prevention and suppression documentation, including the contact information for local emergency services, such as local fire departments and hospitals. The Safety Officer will be responsible for instructing other workers in the required fire prevention and suppression measures, including the use of fire suppression equipment and the protocols in the event of a fire, and for communicating current fire hazards and any changes in prevention and suppression methods on a daily basis. KRRC's contractor will clearly post a table of emergency contact agencies, their jurisdictions, and phone numbers at each project site. The Safety Officer will ensure that all fire suppression equipment is well-maintained and located in proper position within the construction site.

In the event of a fire, the Safety Officer will immediately contact LIFC dispatch and ODF KLD in Oregon or Cal Fire SU in California and subsequently any other pertinent fire suppression agencies and the Federal Energy Regulatory Commission local office as appropriate. The Safety Officer will then initiate fire suppression protocols and command fire control activities on the site until relieved by fire suppression professionals. The goal is to immediately and aggressively extinguish any fire that occurs during the Project without sacrificing the safety of workers. If the Safety Officer judges equipment on-site incapable of suppressing the fire, the Safety Officer will initiate an evacuation of the project site.

KRRC's contractor and Safety Officer will work with ODF KLD and Cal Fire SU foresters to develop broad scale contingency plans for fire containment within their respective jurisdictions in the Project areas. KRRC's contractor will meet regularly with ODF KLD and Cal Fire SU foresters to discuss Project progress and updates as they pertain to fire prevention and suppression. The Safety Officer will continuously evaluate the location, condition, and importance of existing fuel breaks and will alert the relevant fire suppression agencies if fuel breaks need to be modified. KRRC's contractor and Safety Officer will identify the location of water resources for fire suppression, and KRRC's contractor will inform the ODF KLD and Cal Fire SU foresters of any modifications to existing water resources due to dam removal activities, e.g., the drawdown of the reservoirs.

5.2 Fire Prevention and Suppression Measures and Equipment

This FMP includes fire prevention and response methods that are consistent with the policies and standards of the various local, county, state, and federal jurisdictions. KRRC's contractor will take precautionary, pre-suppression, and suppression measures to ensure public safety in the Project vicinity and comply with the fire season regulations and requirements set forth by ODF (Table 3-1) and Cal Fire (Table 3-2). KRRC's contractor will work closely with the ODF KLD Unit Forester and Stewardship Forester and the Cal Fire SU Forester to develop effective communication links, evolving plans for fire prevention and suppression, and suppression actions in the event of a fire. ODF KLD will likely assign a Stewardship Forester to the Project for the duration of the Project.

If required by ORS 477.625, KRRC's contractor will obtain an ODF PDM permit. Operation hours of tracked machinery are limited by the PDM permit during extreme fire danger, and KRRC's contractor will suspend operation of these machines between the hours of 1 pm to 8 pm when required. KRRC's contractor will take additional measures to keep machinery and the work area clear of excess flammable material. If acquired, KRRC's contractor will renew the PDM permit annually, if needed, until Project completion. California does not have restrictions on the hours of operation of equipment and machinery.

A fire watch will take place on work breaks and following the completion of each work day to monitor the Project limit of work for fire. The Safety Officer will train the fire watchman in the appropriate responses in the event of a fire. ODF KLD prescribes fire watch duration based on FDL. Low fire danger requires a 1-hour fire watch, medium requires 2 hours, and high and extreme require 3 hours. ODF alerts all PDM permit holders of upcoming changes in FDL.

A primary feature of this FMP is preparedness for fire prevention and response in compliance with Oregon and California state regulations (Table 3-1 and Table 3-2, respectively). All construction vehicles and crews will be outfitted with the appropriate type and number of fire suppression tools, including but not limited to shovels, axes, and fire extinguishers. All vehicles and machinery will be equipped with functional spark arresters and/or mufflers, where applicable, and KRRC's contractor will routinely clean spark arrester ports. Gas powered saws, if operated at the Project, will maintain the fire suppression equipment prescribed by Oregon and California. Water pumping systems conforming to the Oregon and California requirements for water volume, hose dimensions, and pumping rates will be located on-site to suppress fires. The Safety Officer will develop best management practices for smoking in accordance with ORS and CCR regulations.

KRRC's contractor and Safety Officer will conduct work using best management practices in addition to compliance with all federal, state, and local laws. KRRC's contractor will establish communication lines to the various fire suppression agencies, particularly ODF KLD and Cal Fire SU. KRRC's contractor will maintain all equipment to the working standards of the manufacturer and keep them clean of flammable material and debris. This includes ensuring that the batteries and hydraulic and fuel lines are in good condition. Equipment will be stored overnight in locations cleared of flammable material. KRRC's contractor will clear work areas of dried vegetation to reduce risk of fire.

5.3 Additional Areas of Concern

Local and regional weather patterns and antecedent moisture conditions can significantly impact fire hazards and fire behavior. Lightning is a leading cause of wildfire in Siskiyou County, and most of the larger fires are categorized as wind-driven fires (Siskiyou County, 2016). Current and antecedent temperature and precipitation conditions directly influence the amount and condition of fuels. KRRC's contractor will consult with ODF KLD and Cal Fire SU foresters about anticipated weather conditions that may increase fire hazards and frequently update operations and fire response plans to changing environmental conditions. It is possible for favorable weather conditions to result in ODF KLD foresters granting waivers of certain fire prevention and suppression requirements.

KRRC's contractor will consult local and state fire management plans where available and communicate with local and state fire suppression agencies to identify existing resources and infrastructure in the Project areas that are at risk in the event of a fire.

Table 5-1 Fire services in the project vicinity

County	Fire Protection Services
Siskiyou County, CA	Fire protection is provided by 9 incorporated cities fire protection districts: Yreka, Fort Jones, Etna, Weed, Mt. Shasta, Dorris, Dunsmuir, Montague, and Tulelake. Other nearby fire protection districts and stations in Siskiyou County include Copco Lake Fire Protection District, Hornbrook Fire Protection District, Butte Valley Fire Protection District, Mayten Fire Protection District, and Grenada Fire Protection District. (Siskiyou County, 2016)
City of Yreka, CA	Fire services are provided by the Yreka Fire Volunteer Department (City of Yreka 2010d; City of Yreka 2010e).
Klamath County, OR	Klamath County is served by 17 fire districts including Klamath County Numbers 1 through 5, Keno, Chiloquin, Central Cascades, Crescent, Oregon Outback, Chemult, Bonanza, Bly, Malin, and Merrill (Klamath County, 2016).
Jackson County, OR	Fire protection services provided by Jackson County include Ashland and Medford Fire and Rescue Stations and Jackson County Fire District Stations. Nearby services are provided by Colestin Rural Fire Protection District and Greensprings Rural Fire District.

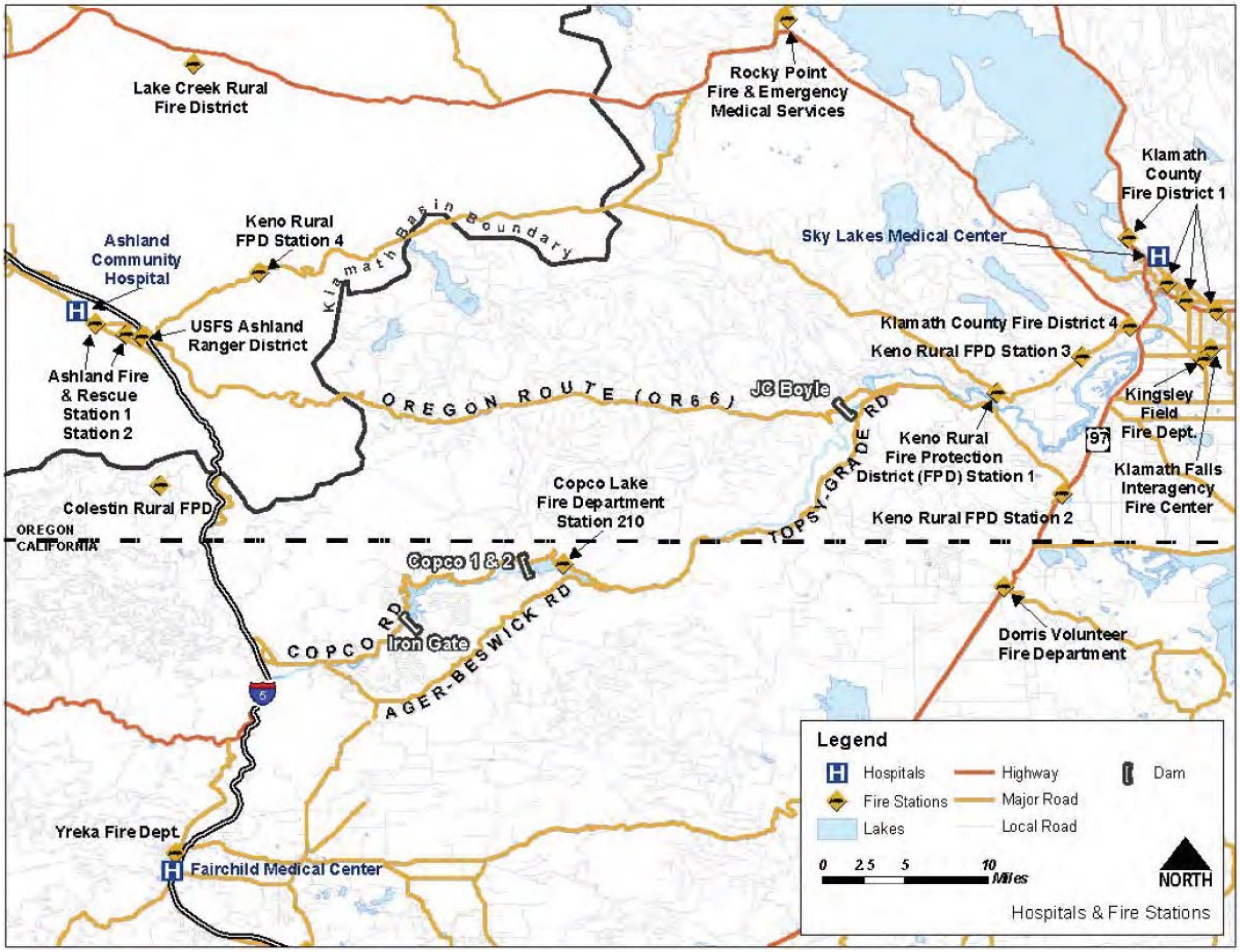
5.4 Fire Suppression Resources

KRRC's contractor will work with local and state fire agencies to locate necessary fire suppression infrastructure and emergency resources. Several of the fire suppression agencies have fire management and suppression plans that identify resources at risk and resources for fire suppression within their respective jurisdictions and outline protocols that would be initiated in the event of a fire. SCOFMP has developed a plan and set of operation protocols for fire support in the area (South Central Oregon Fire Management Partnership, 2015). Klamath County has a Community Wildfire Protection Plan document and companion database to support wildfire prevention and suppression planning efforts in the county (Wildland Fire Technologies, 2016). Cal Fire SU has a Unit Strategic Fire Plan that describes fire prevention goals and resources and guides fire management and fire suppression tactics (Siskiyou County, 2016).

KRRC's contractor and Safety Officer will provide the location of nearby fire stations, hospitals, access roads, evacuation routes, and water sources (Figure 5-1) to all employees. Due to the rural nature and the low concentration of roads in the area, most roads are used as evacuation routes in the event of fire or other emergencies. The Safety Officer will ensure that water tanks intended for fire suppression are full during operation hours and the fire watch period at the end of each work day. KRRC's contractor will identify the location of and access to the closest water sources in the event fire suppression tanks need to be refilled during fire suppression. The Safety Officer will communicate with local fire suppression agencies to identify water sources (e.g., fire hydrants, reservoirs, rivers) and access points proximal to the operation areas, and supplement scarce water resources with water storage tanks as needed.

In the California Project vicinity, Cal Fire SU provides fire suppression resources and coordinates with additional local fires suppression entities (Table 5-1). It has a Cal Fire- and USFS-staffed Emergency Command Center located at the Siskiyou Unit Headquarters in Yreka that handles dispatching services for Cal Fire, USFS, 30 local government departments, and 5 ambulance companies (Siskiyou County, 2016). The Cal Fire SU is divided into 4 battalions, and the Project limit of work is in Battalion 2 (Shasta Valley), which has Cal Fire stations in Yreka and Hornbook. For the Copco and Iron Gate dams, the closest fire stations in the area are the Copco Lake Fire Department Station 210, which services the area surrounding the Copco 1 reservoir, and the Yreka Fire Department. Jackson County, Oregon, has several nearby fire districts, including Ashland and Jackson County Fire Districts and Colestin Rural Fire District that can provide additional fire suppression resources.

In the Oregon Project vicinity, ODF KDL is primarily responsible for organizing fire prevention and suppression; and stations and districts that service Oregon are in Table 5-1. ODF KLD operates within the SCOFMP and shares resources and responsibilities with the other agencies therein. LIFC handles dispatch responsibilities for SCOFMP. Klamath County has 17 fire districts and 30 fire stations. Jackson County has several nearby fire districts also capable of providing fire suppression resources, including Greensprings Rural Fire District, Jackson County Fire Districts, and Ashland fire stations. For J.C. Boyle Dam, the closest station is the Keno Rural Fire Protection District (FPD) Station 1.



Source: USBR 2012

Figure 5-1 Map of hospitals, fire stations, and major fire routes near the Klamath Dams

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Chapter 6: Water Supply Assessment Post-Dam Removal

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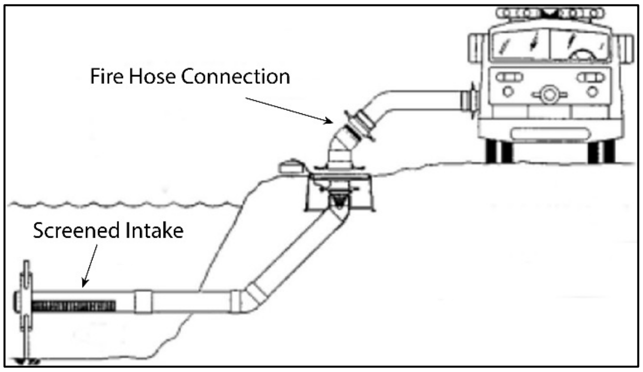
6. WATER SUPPLY ASSESSMENT POST-DAM REMOVAL

The reservoirs provide a source of water for helicopter fire suppression crews fighting fires in the Project vicinity, and this resource will be reduced following removal of the dams and drawdown of the reservoirs. Following removal, helicopter crews will be able to extract water from the Klamath River (both the current channel and the channel reaches to be exposed in the current reservoirs following drawdown), Ewauna Lake, and Upper Klamath Lake (USBR and CDFW 2012). However, most helicopter water tanks require 3 feet of water depth to be filled, so helicopters will be able to use only certain portions of the Klamath River. Response and travel times between water tank fills for helicopter crews are expected to increase following reservoir drawdown (USBR and CDFW 2012). Fire suppression efforts near J.C. Boyle will not experience significant increases in travel time given that Ewauna and Upper Klamath Lakes are located approximately 13 miles away. With typical fire-fighting helicopter speeds between 90 and 140 mph (Jarrell, J., personal communication 2017.09.25), increases in round-trip travel time will be a maximum of 15 minutes after removal of J.C. Boyle. Analysis of aerial photos shows the presence of deep pools with suitable conditions for helicopter filling in the currently free-flowing reaches of the Klamath River around three reservoirs, particularly in the reaches between Copco and J.C. Boyle reservoirs and downstream of Iron Gate Dam. Maximum travel time increases to utilize the Klamath River for refilling are also expected to be on the order of 15 minutes, and potentially even less if pools are present in the former reservoirs post-removal.

To compensate for the loss of reservoir water supply, KRRC will develop additional water supplies and access points for fire suppression following the removal of the dams. Flows in the Klamath River and tributaries will not change post-removal, so firefighting crews can still use the river as a water supply. The potential of pool features for helicopter water filling will be evaluated in the field and used to generate a map of resources that can be used by air-based firefighting crews. To assist ground-based firefighting efforts, this FMP proposes the development of sites for installation of permanent dry hydrants from which water trucks and fire engines could draw directly from the Klamath River and larger tributaries. Dry hydrants are passive, unpressurized systems with a screened intake placed in the channel above the channel bed in a location of satisfactory depth (during dry conditions), flow rate, and channel stability and an above-ground fire hose connection to which truck-mounted pumps can be connected (Figure 6-1). Dry hydrants are commonly used as water supply for fighting fires in rural areas. Typical dry hydrants and fire truck pumps can supply over 1,500 gallons per minute, which is sufficient for rapid filling of typical water tankers and firefighting apparatus.

Potential sites for the dry hydrants were selected that leverage existing, permanent infrastructure (e.g., fire stations, bridges, roads, boat launches), offer proximity and ease of access to current or anticipated post-removal Klamath River or tributary channels, and are within PacifiCorp or state-owned property boundaries. Bridges and crossings are desirable given the increased certainty of access to water post-removal and the ability to utilize the structure for mounting the dry hydrant rather than excavating earthen material for pump installation.



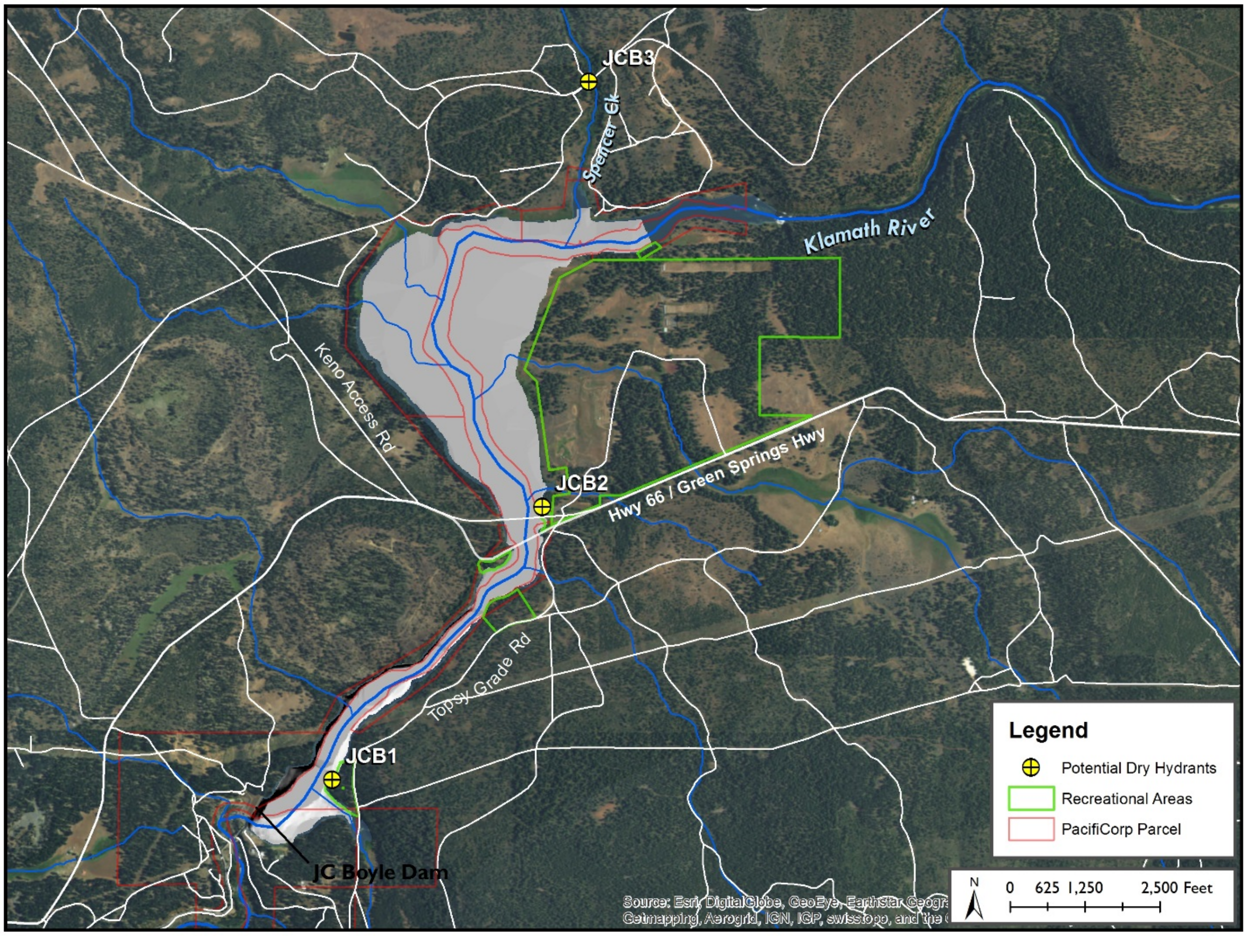
Adapted from ettfire.com

Figure 6-1 Diagram of dry hydrant system

At J.C. Boyle, three potential dry hydrant locations were identified (Figure 6-2). JCB1 is sited at Topsy Campground along Topsy Grade Road, where the valley is wider and more accessible. JCB2 is located on Highway 66 and could utilize the bridge for dry hydrant placement. JCB3 is located at a bridge over Spencer Creek, which maintains sufficient flow rate in the summers for dry hydrant pumping.

At Copco and the reach of the Klamath River upstream of Copco Lake, eight potential dry hydrant sites were identified (Figure 6-3). Access to the mainstem Klamath River upstream of Copco No. 1 after removal will be limited if the channel reoccupies the historical alignment as predicted. The historical Klamath River had a sinuous planform, and the mainstem will likely be either far from existing roads or difficult to access because of steep, high relief bluffs particularly near the Copco No. 1 Dam site.

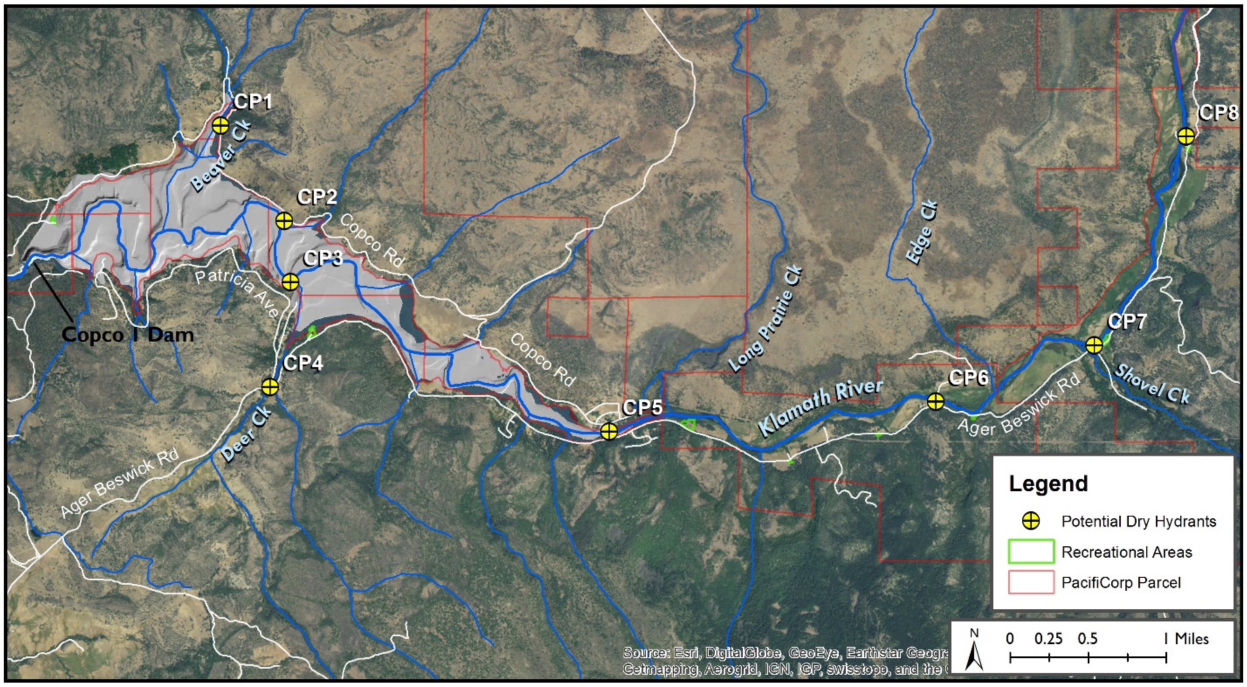
CP1 is located along Copco Road adjacent to where Beaver Creek is expected to run post-removal, but, if flow is sufficient, could be moved to where Copco Road crosses Beaver Creek upstream of the confluence with East Beaver Creek. CP2 is along the historical Klamath River and Copco Road downstream of Raymond Gulch at a location where the valley topography is locally expected to be less steep. CP3 is located near the historical confluence of the Klamath River and Deer Creek off Patricia Avenue, where historic topography is locally less steep and a Copco Lake Fire Station is nearby. CP4 is sited where Ager Beswick Road crosses Deer Creek. CP5 is at the Copco Road bridge over the Klamath River at the eastern margin of the reservoir and is situated adjacent to the Copco Lake Fire Department Station A. CP6 is located on a bridge over the Klamath River upstream of the current influence of the dam that is accessible off Ager Beswick Road. CP7 is located on a small bridge over the Klamath River off Ager Beswick Road and immediately upstream of the Shovel Creek confluence. CP8 is located at a fishing access area off Ager Beswick Road where a rapid holds grade to maintain a deeper pool for water extraction.



Historical topographic surface beneath the reservoir and historic Klamath River centerline are shown for reference.

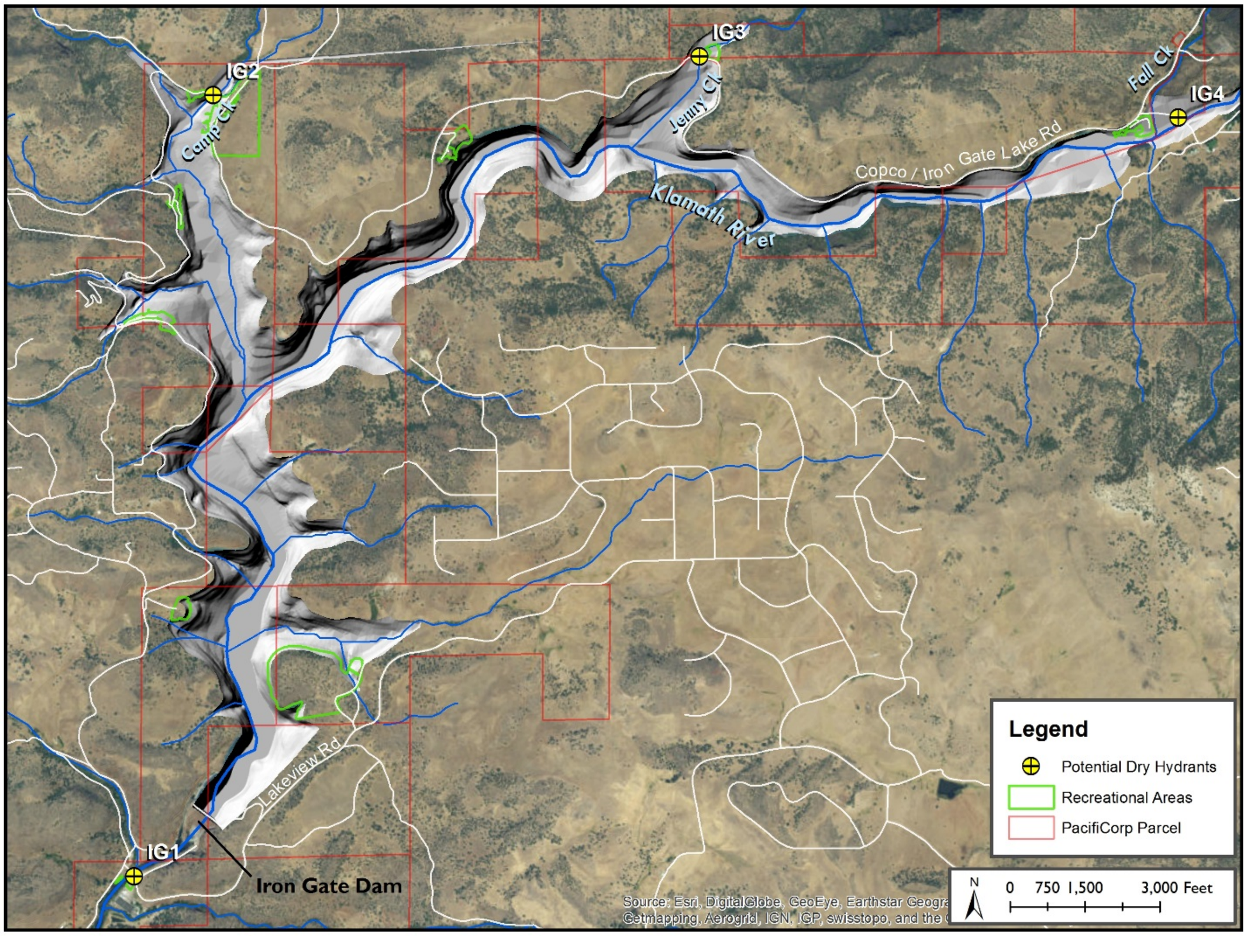
Figure 6-2 Locations of potential dry hydrants for J.C. Boyle Reservoir

At Iron Gate, four potential dry hydrant locations were identified (Figure 6-4). IG1 is sited at the Lakeview Rd bridge crossing over the Klamath River, downstream of Iron Gate dam and adjacent to the Iron Gate hatchery. IG2 is located in the vicinity of the Camp Creek campground where Copco Road crosses Camp Creek. IG3 is located at the bridge where Copco Road crosses Jenny Creek. IG4 is sited at the Daggett Road bridge crosses the Klamath River, which is adjacent to the Fall Creek confluence and Copco Road.



Historical topographic surface beneath the reservoir and historic Klamath River centerline are shown for reference.

Figure 6-3 Locations of potential dry hydrants for Copco Lake



Historical topographic surface beneath the reservoir and historic Klamath River centerline are shown for reference.

Figure 6-4 Locations of potential dry hydrants for Iron Gate Reservoir

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Chapter 7: References

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7. REFERENCES

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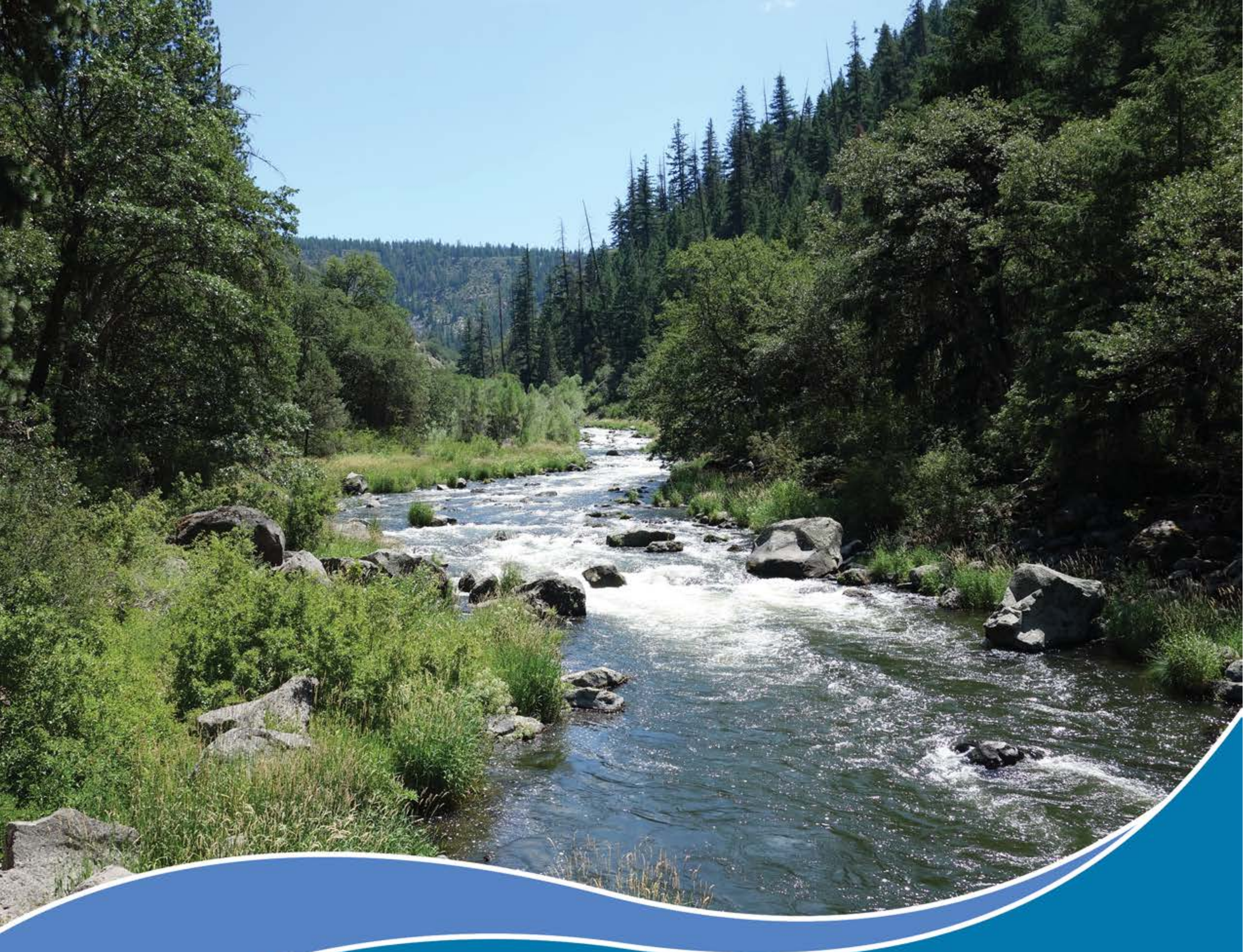

Definite Plan for Decommissioning

Appendix O2 – Traffic Management Plan

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Prepared for:

Klamath River Renewal Corporation

Prepared by:

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Table of Contents

List of Tables

Acronyms

Caltrans	California Department of Transportation
CHP	California Highway Patrol
KRRC	Klamath River Renewal Corporation
ODOT	Oregon Department of Transportation
OR	Oregon Route
TMP	Traffic Management Plan

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Chapter 1: Need for Traffic Management Plan

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1. NEED FOR TRAFFIC MANAGEMENT PLAN

KRRC prepared this Traffic Management Plan (TMP) for the implementation of the Definite Plan for the Lower Klamath Project (Definite Plan) proposed by the Klamath River Renewal Corporation (KRRC) for physical removal of the four dam developments (Iron Gate, Copco No. 1. Copco No. 2, and J.C. Boyle) (the Project). The TMP is a specialized program tailored to minimize impacts by applying a variety of techniques such as *Public Information, Motorist Information, Incident Management and Construction Strategies.* The major objectives of the TMP are to maintain efficient and safe movement of vehicles through the construction zone covered by activities in the Definite Plan and to provide public awareness of potential impacts to traffic on both haul routes and access roads to the four dam developments.

Construction activities can create additional traffic delays and safety concerns on the affected highways and roadways. Planning work activities and balancing traffic demand with highway capacity is more critical during construction or maintenance. To prevent unreasonable traffic delays resulting from planned work during implementation of the Definite Plan, KRRC developed this TMP, and KRRC's contractor will implement it, to maintain acceptable levels of service, traffic circulation and safety on the state and county highway and roadway system.

This TMP outlines the structure and key requirements that will be incorporated by the KRRC's contractor into a final traffic management plan. The final traffic management plan will be informed by KRRC's contractor's specific means and methods for construction, which could refine the approach to access and traffic management. The final traffic management plan will meet applicable regulatory permit requirements, as well as applicable state and local ordinances, as appropriate. In developing the final traffic management plan, the Contractor will coordinate with the following agencies:

- Oregon Department of Transportation (ODOT)
- California Department of Transportation (Caltrans)
- Klamath and Siskiyou Counties
- Oregon State Police
- California Highway Patrol (CHP)

1.1 Access Summary

Throughout the construction and demolition contemplated in the Definite Plan, various roads in the vicinity of the four developments will experience some changes to traffic conditions, with the potential to impact other road users. The KRRC anticipates changes to traffic conditions could result from the following activities:

- Delivery of construction equipment
- Short haul of deconstructed dam materials (concrete and soil) for near-site disposal
- Long haul of deconstructed dam, hydropower and other materials for off-site disposal
- Delivery of rehabilitation materials
- Road, bridge and culvert improvements
- Worker access
- Fish hauling, as applicable

The proposed haul routes for each development are summarized in Table 1.1-1, and generally shown in Definite Plan Figure 1.2-2(C). Definite Plan Section 5 (Dam Removal Approach) and Section 7.4 (Road Improvements) provide additional details concerning access and associated road improvements.

Table 1.1-1 Primary Access Route Summary

Development	Interstate Access	Regional Access	Local Access
J.C. Boyle	Interstate 5 (in Oregon) and US97	Oregon Route (OR) 66	Topsy Grade Road, Keno Worden Road
Copco No.1 and Copco No. 2	Interstate 5 (in California)	Copco Road	Ager-Beswick Road, Patricia Ave.
Iron Gate	Interstate 5 (in California)	Copco Road	Lakeview Road, Daggett Road

1.2 Management Strategies

This section describes strategies KRRC proposes to minimize construction-related traffic delays and maintain safe movement of vehicles during implementation of the Definite Plan. These strategies are of a general nature and are intended to reduce the overall level of congestion. KRRC's contractor will include more detailed techniques for management of potential traffic impacts in the final traffic management plan. The proposed management strategies are grouped into the following four broad categories: (1) public information; (2) motorist information; (3) incident management; and (4) construction strategies. The numbered list below summarizes each category of management strategy and associated details.

1. **Public Information:** KRRC's contractor will adopt various methods to ensure the public have easy access to information regarding any current or upcoming interruptions to the local or state road network. Proposed methods, at a minimum, will include the use of telephone hotlines, a Traveler Information System via the Project website, local community outreach (meetings, newsletters, etc.), press release(s), and local news media, as appropriate.
2. **Motorist Information:** KRRC's contractor will develop a motorist information system to provide advance notice to motorists of potential traffic delays throughout the project sites and associated access routes. Proposed methods will include portable changeable message signs, stationary mounted signs, and highway advisory radio.

3. **Incident Management:** KRRC's contractor will devise an incident management procedure to outline traffic procedures to be adopted in the case of an incident on a road or highway. The procedure will be developed in collaboration with local and state agencies (listed above), and in accordance with local and state requirements.
4. **Construction Strategies:** KRRC's contractor will incorporate the following construction strategies into the final traffic management plan:

   a) **Roadway Closures**: During construction, some longer-term (more than a day) road closures will occur, though only on minor dam access roads where no public interruption would occur. Some short duration road closures will occur on more frequented roads, to enable bridge, culvert and road upgrades or replacements. KRRC's contractor will consider road users when these closures are scheduled and appropriate public and motorist information regarding detours will be issued in due course.
   b) **Traffic Handling and Stage Construction**: During construction, KRRC's contractor will provide signage and traffic control where Project generated traffic will impact road users. KRRC's contractor will determine the extent of signage and traffic control through consideration of the changes to road conditions caused by the activities and the amount of public traffic using the roads. KRRC's contractor will develop more detailed signage and traffic control plans as part of the final traffic management plan.
   c) **Construction Access to Work Zones**: KRRC's contractor will locate informational signs along the roads directly adjacent or leading to construction work zones, to direct construction traffic and notify other motorists of their presence. Where possible, KRRC's contractor will plan trip schedules to minimize impacts, i.e. avoiding peak traffic times. KRRC's contractor will control ingress and egress of construction trucks when exiting and entering the work areas to and from the respective highways.
   d) **Haulage**: Various waste materials will originate from the deconstruction of the four developments. The majority of waste volume, the embankment dam fill and concrete, will be disposed of onsite, requiring minimal haulage. KRRC's contractor will haul some materials such as reinforcing steel, mechanical and electrical equipment and other building waste to local recycling facilities or dump sites. KRRC's contractor will schedule haul trips to minimize interruption on the road network, such as by avoiding peak hour times. In addition, KRRC's contractor will use signage to give other motorists notice of truck haulage activities.
   e) **Emergency Detour Plan**: KRRC's contractor will identify emergency service routes within the project area, as appropriate, during detailed design, in coordination with state and local jurisdictions. These emergency detour routes will likely serve hospitals, fire/police stations, emergency shelters, command centers, and other facilities that provide essential services in times of emergencies. The KRRC does not anticipate material impacts on emergency serviced routes, though the potential for minor impacts due to increased traffic will nevertheless be considered.
   f) **Traffic Safety Effects**: The KRRC has identified potential traffic safety hazards from truck hauling, including, the use of blind or sharp corners and turnouts, slow vehicles conflicting with roadway speed limits, and visibility reduction due to dust. KRRC's contractor will manage these by adopting appropriate best practice signage, traffic management systems and dust control

measures. KRRC's contractor will perform a risk assessment of all intersections and roadways as part of the final traffic management plan.

g) **Pedestrians and Bicycles**: KRRC's contractor will identify areas where pedestrians and cyclists could potentially share roads with construction vehicles. KRRC's contractor will install appropriate signage to notify both construction vehicle drivers and non-motorized users of each other's potential presence on the roads. If an unacceptable level of risk to non-motorized users is deemed to persist, KRRC's contractor will arrange appropriate detours to allow continued movement for such users.

Chapter 2: References

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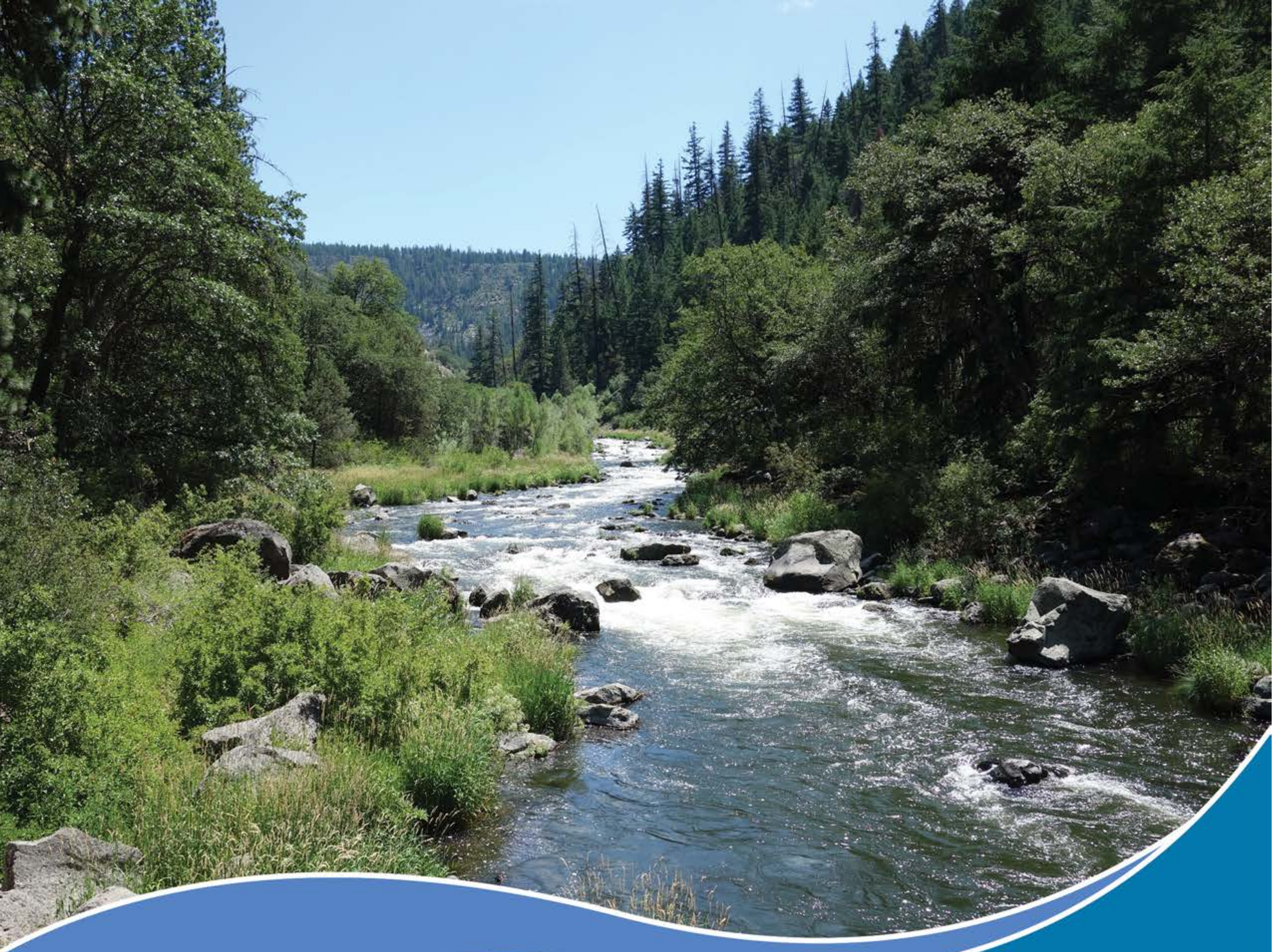

Definite Plan for the Lower Klamath Project

Appendix O3 –Hazardous Materials Management Plan

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Klamath River Renewal Corporation

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List of Tables

Acronyms

ACM Asbestos Containing Material
EPA Environmental Protection Agency
ESA Environmental Site Assessment
HMMP Hazardous Materials Management Plan
KRRC Klamath River Renewal Corporation
LBP lead based paint
PCBs polychlorinated biphenyls

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Chapter 1: Hazardous Materials Management Plan

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1. HAZARDOUS MATERIALS MANAGEMENT PLAN

This Hazardous Materials Management Plan (HMMP) was developed to address the management of hazardous materials during implementation of the Definite Plan proposed by the Klamath River Renewal Corporation (KRRC) for physical removal of four developments (Iron Gate, Copco No. 1, Copco No. 2, and J.C. Boyle), hereinafter, the Project. PacifiCorp, EDR, or local agencies provided all data KRRC used to develop this HMMP. KRRC will update the HMMP, as appropriate, following the planned Phase I-Environmental Site Assessment (ESA) visits and interviews and the Phase II Site Investigation, if needed after the Phase I ESA.

The following structures have been reported at each of the four developments.

- J.C. Boyle Dam and Powerhouse: This facility consists of a reservoir, combination embankment and concrete dam, gated spillway, diversion culvert, water conveyance system, and powerhouse, completed in 1958. Current structures at the site include an office building (known as the Red Barn), a maintenance shop, a fire protection building, a communications building, two (2) occupied residences near the dam, and a large warehouse near the powerhouse.
- Copco No. 1 Dam and Powerhouse: This facility consists of a reservoir, concrete dam, gated spillway, diversion tunnel, intake structure, and powerhouse constructed between 1911 and 1922. Current structures at the site include an occupied residence with small garage, a vacant house, and a maintenance building.
- Copco No. 2 Dam and Powerhouse: This facility consists of a reservoir, concrete diversion dam, embankment section, gated spillway, water conveyance system, and powerhouse completed in 1925. Current structures at the site include a control center building, a maintenance building, and an oil and gas storage building.
- Iron Gate Dam and Powerhouse: This facility consists of a reservoir, embankment dam, ungated side-channel spillway, diversion tunnel, intake structures, and powerhouse completed in 1962. Current structures at the site include a communications building, restroom building, and two (2) occupied residences.

Asbestos Containing Material (ACM), lead based paint (LBP), and polychlorinated biphenyls (PCBs) may be present in building materials based on the years construction activity occurred at each of the four developments. Prior to removal, KRRC or KRRC's contractor will sample and test for ACM, LBP, and PCBs at all structures that are to be removed. KRRC's contractor will handle and dispose of any abated material with asbestos, lead, and or PCBs which exceed hazardous waste criteria levels as hazardous waste at approved hazardous waste facilities in accordance with applicable federal and state regulations. KRRC's contractor will dispose of remaining materials as non-hazardous construction debris.

KRRC's contractor will manage all hazardous materials removed from the developments (i.e., paints, oils, and welding gases) by returning to the vendor, recycling, or managing and disposing of such materials as hazardous waste at an approved hazardous waste facility in accordance with applicable federal and state regulations. If not data exists, KRRC's contractor will test transformer oils for PCBs. Prior to disposal, KRRC's contractor will decontaminate any tanks which contained hazardous materials.

KRRC's contractor will handle universal hazardous waste (i.e., lighting ballasts, mercury switches, and batteries) in accordance with applicable federal and state universal waste regulations.

Table 1 shows the types of hazardous materials that may be present at each development.

Table 1 Anticipated Types of Hazardous Waste

Type of Waste	J.C. Boyle	Copco No. 1	Copco No. 2	Iron Gate
Asbestos	X	X	X	X
Batteries	X	X	X	X
Bearing and hydraulic control system oils	X	X	X	X
Treated wood	X	X	X	X
Coatings containing heavy metals	X	X	X	X
Contaminated soils	?	?	?	?
PCBs	?	?	?	?
Oil and fuel tanks	X	X	X	X
Hazardous materials storage	X		X	
Septic system	X		X	X
Gas cylinders	X			
Mercury containing fixtures		?	?	
Creosote treated wood			X	

KRRC's contractor will include any additional hazardous materials identified during the Phase I site visits and Phase II investigations, if any, in an updated hazardous materials management plan.

1.1 J.C. Boyle

According to the Detailed Plan (USBR 2012), potential hazardous materials at the J.C. Boyle Dam and Powerhouse include asbestos, batteries, bearing and hydraulic control system oils, treated wood, and coatings containing heavy metals in the powerhouse and on the exterior surfaces of the steel penstock pipes, surge tank, bulkhead gate, generator gantry crane, and other painted equipment, which will require specialized abatement and disposal. Contaminated soils may exist at the locations of painted exterior equipment and would require remediation. Asbestos may be found in ceiling and floor tiles, roofing materials, and electrical wiring insulation. Although all transformers have tested negative for PCBs, some residual PCBs may exist in closed systems such as transformer bushings. Equipment containing over 37,500 gallons of various types of oils and fuels has been identified at the site. The Red Barn administration complex includes a hazardous materials building for the storage of materials regulated by the Environmental Protection Agency (EPA), and a fueling facility containing above-ground gasoline (1,000 gallon) and diesel (500 gallon) tanks which meet state and federal requirements. Underground septic systems in use within the Red Barn complex of office and maintenance buildings and two residences will be removed. KRRC's contractor will follow applicable federal, state, and local regulations, including those for spill prevention and containment, in the transportation and disposal of all waste materials. Table 2 lists the reported material and quantities for J.C Boyle from the Hazardous Materials Inventories provided by PacifiCorp.

Table 2 Hazardous Materials Inventory – J.C. Boyle

Hazardous Class	Common Name	Quantities (Average daily)	Storage Container
Flammable and Combustible Liquids	Gasoline	500 gallons	AST
Flammable and Combustible Liquids	Diesel Fuel No. 2	300 gallons	AST
Flammable Gases	Acetylene	200 cubic feet	Cylinder
Nonflammable Gases	Argon, Liquid	200 cubic feet	Cylinder
Flammable and Combustible Liquids	Gear Oil	20 gallons	Plastic Drum
Flammable and Combustible Liquids	Hydraulic oil	30 gallons	Plastic Drum
Corrosives (Liquids and Solids)	Lead Acid Batteries	10,840 pounds	Glass bottle or Jug
Flammable and Combustible Liquids	Used Oil	20 gallons	Steel Drum
Flammable and Combustible Liquids	Paint	15 gallons	Cans
Nonflammable Gases	Nitrogen	1,200 cubic feet	Cylinder
Flammable Gas	Propane	300 gallon	AST

1.2 Copco No. 1

According to the Detailed Plan, potential hazardous materials at Copco No. 1 Dam and Powerhouse include asbestos, batteries, bearing and hydraulic control system oils, treated wood, and coatings containing heavy metals in the powerhouse and on the exterior surfaces of the steel penstock and air vent pipes, as well as on other painted equipment, which will require specialized abatement and disposal. Contaminated soils may exist at the locations of painted exterior equipment and would require remediation. Asbestos may be found in electrical wiring insulation and possibly in other building materials. Mercury may exist in older light switches. Although all transformers have tested negative for PCBs, some residual PCBs may exist in closed systems such as transformer bushings. Equipment containing nearly 12,000 gallons of various types of oils has been identified at the Copco No. 1 site. KRRC's contractor will follow applicable federal, state, and local regulations, including those for spill prevention and containment for the transportation and disposal of all waste materials. Table 3 lists the reported material and quantities for Copco No. 1 from the Hazardous Materials Inventories provided by PacifiCorp.

Table 3 Hazardous Materials Inventory – Copco No. 1

Hazardous Class	Common Name	Quantities	Storage Container
Flammable Gas	Liquefied Petroleum Gas	171 gallons	AST - Cylinder
Flammable and Combustible Liquids	Governor Oil (hydraulic oil)	1,500 gallons	Tank inside building
Flammable and Combustible Liquids	Transformer Oil	11,000 gallons	Tank inside building
Corrosives (Liquids and Solids)	Lead Acid Batteries	66 gallons	Glass bottle or Jug
Nonflammable Gases	Nitrogen	150 cubic feet	Cylinder
Flammable Gases	Liquefied Petroleum Gas	499 gallons	Cylinder

1.3 Copco No. 2

According to the Detailed Plan, potential hazardous materials at Copco No. 2 Dam and Powerhouse include creosote-treated wood-stave (redwood) penstock and treated wood, asbestos, batteries, bearing and hydraulic control system oils, and coatings containing heavy metals in the powerhouse and on the exterior surfaces of the steel penstock and air vent pipes, which will require specialized abatement and disposal. Contaminated soils may exist at the locations of painted exterior equipment and would require remediation. Asbestos may be found in electrical wiring insulation and possibly in other building materials. Mercury may exist in older light switches. Although all transformers have tested negative for PCBs, some residual PCBs may exist in closed systems such as transformer bushings. Equipment containing over 18,000 gallons of various types of oils and fuels has been identified at the site. The administration and control center includes a building for the storage of EPA-regulated materials, and a fueling facility containing above-ground gasoline (1,000 gallon) and diesel (500 gallon) tanks which meet state and federal requirements. Underground septic systems in use for seven residences near the powerhouse will be removed. KRRC's contractor will follow applicable federal, state, and local regulations, including those for spill prevention and containment for transportation and disposal of all waste materials. Table 4 lists the reported material and quantities for Copco No. 2 from the Hazardous Materials Inventories provided by PacifiCorp.

Table 4 Hazardous Materials Inventory – Copco No. 2

Hazardous Class	Common Name	Quantities	Storage Container
Flammable and Combustible Liquids	Diesel Fuel No. 2	375 gallons	AST
Flammable Gas	Liquefied Petroleum Gas	250 gallons	AST - Cylinder
Flammable and Combustible Liquids	Transformer Oil	12,778 gallons	AST
Flammable and Combustible Liquids	Gasoline	500	AST
Nonflammable Gases	Oxygen	500 cubic feet	Cylinder
Flammable and Combustible Liquids	Governor and Bearing Oil (hydraulic oil)	3,600 gallons	Steel drum, Plastic/Non-metallic drum
Flammable Gases	Acetylene	300 cubic feet	Cylinder
Nonflammable Gases	Nitrogen	750 cubic feet	Cylinder
Nonflammable Gases	Argon, Liquid	700 cubic feet	Cylinder
Flammable and Combustible Liquids	Oil base paint	50 gallons	Cans
Corrosives (Liquids and Solids)	Lead Acid Batteries	64 gallons	Glass bottle or Jug

1.4 Iron Gate

According to the Detailed Plan, potential hazardous materials at Iron Gate Dam and Powerhouse include asbestos, batteries, bearing and hydraulic control system oils, treated wood, and coatings containing heavy metals in the powerhouse and on the exterior surfaces of the steel penstock and air vent pipes, and other painted equipment, which will require specialized abatement and disposal. Contaminated soils may exist at the locations of painted exterior equipment and would require remediation. Asbestos may be found in electrical wiring insulation and possibly in other building materials. Although all transformers have tested negative for PCBs, some residual PCBs may exist in closed systems such as transformer bushings. Equipment containing nearly 5,000 gallons of various types of oils has been identified at the site. Underground septic systems in use for the restroom and two residences near the dam will be removed. KRRC's contractor will follow applicable federal, state, and local regulations, including those for spill prevention and containment, for transportation and disposal of all waste materials. Table 5 lists the reported material and quantities for Iron Gate from the Hazardous Materials Inventories provided by PacifiCorp.

Table 5 Hazardous Materials Inventory – Iron Gate

Hazardous Class	Common Name	Quantities	Storage Container
Nonflammable Gases	Nitrogen	1,850 cubic feet	Cylinder
Flammable and Combustible Liquids	Governor and Bearing Oil (hydraulic oil)	1,400 gallons	Tank Inside Building
Flammable and Combustible Liquids	Transformer Oil	3,500 gallons	Other
Corrosives (Liquids and Solids)	Lead Acid Batteries	102 gallons	Other

Chapter 2: References

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2. REFERENCES

USBR 2012. U.S. Bureau of Reclamation. *Detailed Plan for Dam Removal – Klamath River Dams – Klamath Hydroelectric Project – FERC License No. 2082 – Oregon-California*. July 2012.

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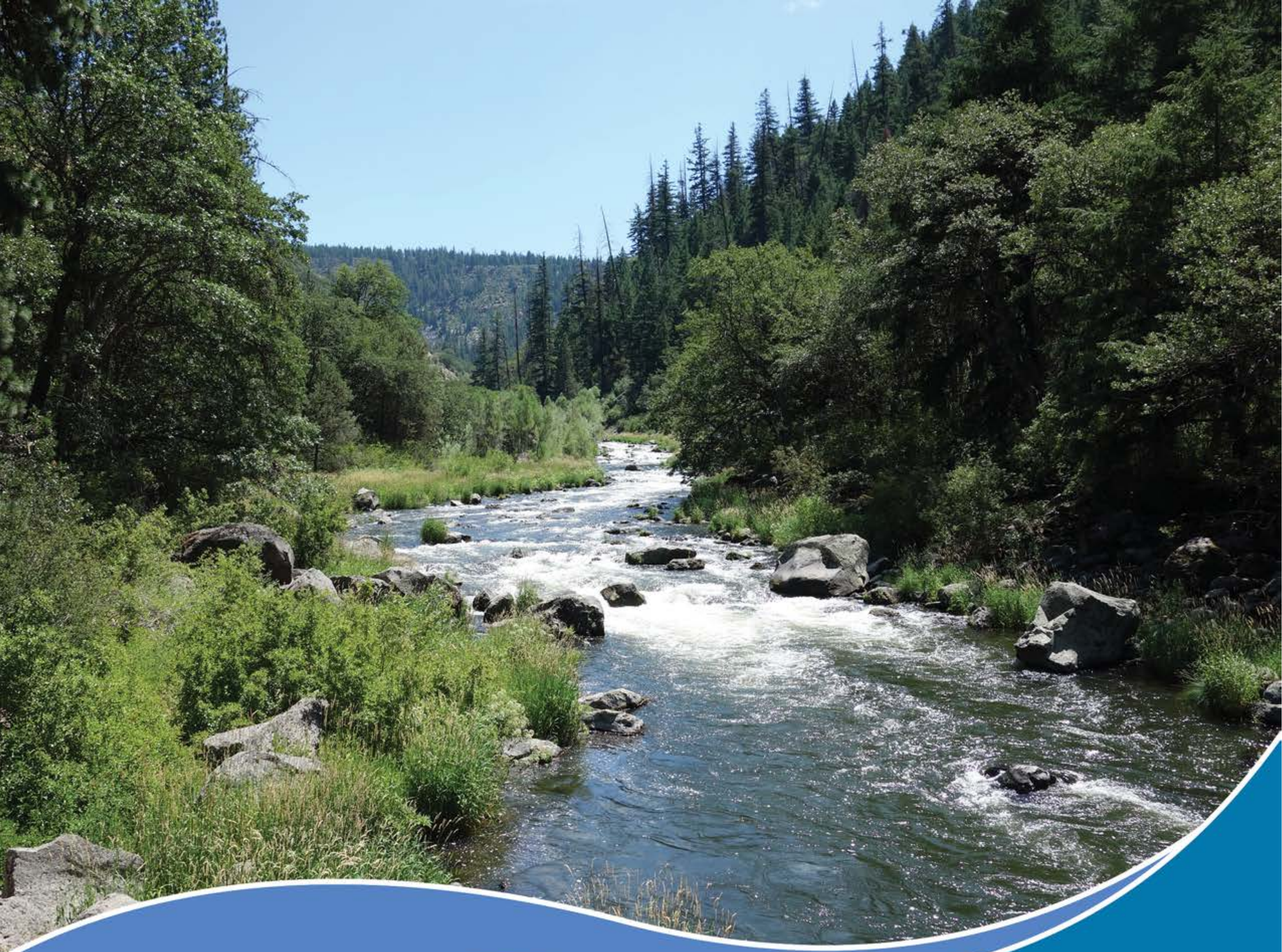
www.klamathrenewal.org



Definite Plan for the Lower Klamath Project

Appendix O4 – Emergency Response Plan

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Acronyms

CLOMR	conditional letter of map revision
DSOD	California Division of Safety of Dams
EOP	Emergency Operations Plan
ERP	Emergency Response Plan
FERC	Federal Energy Regulatory Commission
KRRC	Klamath River Renewal Corporation
LOMR	letter of map revision
MSDS	Material Safety Data Sheet
SPCC	Spill Prevention Control and Countermeasures

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Chapter 1: Emergency Response Plan

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1. EMERGENCY RESPONSE PLAN

This Emergency Response Plan (ERP) was developed to support implementation of the Definite Plan for the Lower Klamath Project (Definite Plan) proposed by the Klamath River Renewal Corporation (KRRC) for physical removal of the four developments (Iron Gate, Copco No. 1, Copco No. 2, and J.C. Boyle), hereinafter the Project. The Detailed Plan (USBR 2012) had proposed mitigation measure H-1 to develop and implement an Emergency Response Plan to provide adequate notification to agencies and the public of the potential changes in timing and magnitude of flooding below Iron Gate; the KRRC is instead proposing this ERP as part of the Definite Plan.

KRRC's contractor will develop written procedures to help prevent incidents, to assure preparedness in the event incidents occur, and to provide a systematic and orderly response to emergencies. KRRC's contractor will closely coordinate this ERP with the Contractor's Health and Safety Plan, Spill Prevention and Response Plan, Fire Management Plan, and PacifiCorp's Emergency Action Plan for each development.

This ERP applies to all personnel working on the project site. Prior to commencing construction activities, the Contractor's Health and Safety lead will review emergency response procedures with all personnel assigned to the project site, as appropriate.

Applicable emergency scenarios include, but are not limited to, the following:

- Medical, including injury or illness
- Fire
- Traffic incident
- Hazardous material spill
- Downstream hydraulic change planning
- Dam or tunnel failure
- Catastrophic emergency (e.g. earthquake, high wind event, etc.)
- Security threat

The sections below discuss each type of emergency scenario and its associated response plan.

1.1 General Requirements

This ERP includes the following list of general emergency requirements.

1. KRRC's contractor will post emergency service cards in all offices within the project limit of work and in all construction vehicles. KRRC's contractor will post maps to clinics and hospitals by all land-line phones. Emergency service cards will list emergency phone numbers for the local fire department,

ambulance services, life flight medical helicopters, local police department, local medical clinic, nearest hospital, and KRRC contractor's construction manager, onsite supervisor, and Safety Officer.

2. This ERP, as well as the steps to take in an emergency, will be posted and readily accessible at each of the developments within the project limit of work.
3. An adequate number of site personnel (minimum of one per dam site) will have current certification cards in First Aid and CPR.
4. Each development on the project site will be equipped with a First Aid cabinet, trauma kit, AED, and stretcher basket.
5. In the event of an emergency, all personnel will clear the radio for "Emergency Use Only" by calling "May-Day, May-Day, please clear the radio for emergency use."
6. Should an offsite emergency response team be required, the Contractor's on-site supervisor or the KRRC construction manager will designate an on-site employee to meet and escort the response team to the injury or emergency location.
7. Medical personnel/facilities on the project site: This will be specifically determined before the start of construction.
8. Emergency response plan procedures and documentation are subject to annual KRRC audits and shall be reviewed and/or updated annually.

1.2 Medical Emergency

In the event of an onsite medical emergency, KRRC contractor's onsite supervisor and the KRRC construction manager shall be notified immediately with details concerning the location, name of injured person(s) and a brief description of the situation. First aid action will be initiated immediately, as necessary, through the use of trained onsite first aid providers. The injured shall not be left unless absolutely necessary to quickly notify the jobsite office and then return. Injured person(s) shall not be moved unless they are in immediate danger of further injury. KRRC's contractor will develop written procedures for medical emergencies that include standard reporting forms to document the emergency.

The following hospitals are located within the project vicinity:

1. Sky Lakes Medical Center
   2865 Daggett Ave, Klamath Falls, OR 97601
   (541) 882-6311
2. Fairchild Medical Center
   444 Bruce St, Yreka, CA 96097
   (530) 842-4121
3. Asante Ashland Community Hospital
   280 Maple St, Ashland, OR 97520
   (541) 201-4000

1.3 Fire Management

Refer to the Fire Management Plan in Appendix O1 - Fire Management Plan for procedures and contacts related to managing fire emergencies.

1.4 Traffic Incident or Emergency

In the event of a traffic incident or emergency onsite, or along construction access routes currently in use by KRRC's contractor, the onsite supervisor and the KRRC construction manager shall be notified immediately with details concerning the location, name of injured person(s), if any, and a brief description of the situation. An incident management procedure will be devised to outline traffic procedures to be adopted in the event of an incident on a road or highway. If medical attention is required, protocols outlined above in 1.2 for "Medical Emergencies" shall be followed. KRRC's contractor onsite supervisor will notify the local authorities of a traffic incident or emergency, as appropriate.

1.5 Hazardous Material Spill Management

The Contractor shall develop a separate Spill Prevention and Response Plan, which shall comply with all governmental approvals and applicable local, state and federal laws and regulations. In the event of an onsite hazardous material spill, KRRC contractor's onsite supervisor and the KRRC construction manager shall be notified immediately with details concerning the location, type of material and a brief description of the situation. The Spill Prevention and Response Plan shall include detailed procedures and documentation forms to prevent and respond to spills. Topics or requirements to be provided in the final plan include, but are not limited to, the following:

1. Identification and location of staging and material stockpiles in areas that will prevent spills from entering the river channel
2. All hazardous materials shall be stored in a clearly identified and protected area, and all hazardous materials brought onsite will have a Material Safety Data Sheet (MSDS), which will be provided to the Contractor's Health and Safety lead.
3. Vehicles or equipment operated adjacent to a lake, river, stream or other water body shall be checked and maintained daily to prevent leaks of materials. If a leak is discovered, the leak will be stopped and the equipment will be removed from the project site for repair.
4. Required equipment/vehicle maintenance, refueling and lubrication will be performed at a pre-determined, protected location. If this is not possible, the activity will be completed at least 100 feet from any water body.
5. All aboveground storage tanks containing fuel or oil stored onsite in excess of 1,320 gallons will require a site-specific Spill Prevention Control and Countermeasures (SPCC) Plan.
6. All workers will receive training on the Project Spill Response and Reporting Procedures

In the event of a hazardous materials spill, the MSDS will be referenced to identify safe handling and cleanup procedures. Attempts to handle a hazardous materials spill will only be undertaken if doing so presents no exposure or risk of danger or contamination to personnel. Cleanup of all hazardous material spills will commence as soon as is safely possible following any spill. If a spill requires a hazardous waste cleanup operation and specially trained crew, the Contractor's Health and Safety lead will ensure properly trained personnel conduct the cleanup and remediation. This is not anticipated for cleanup of spills of common construction materials.

1.6 Downstream Hydraulic Change Planning

Prior to dam removal, the KRRC or KRRC's contractor will inform the National Weather Service River Forecast Center of any planned major hydraulic change (removal of one or more of the dams) to the Klamath River that could potentially affect the timing and magnitude of flooding below Iron Gate. The River Forecast Center is the federal agency that provides official public warning of floods. As needed, the River Forecast Center would update their hydrologic model of the Klamath River to incorporate these hydraulic changes so that changes to the timing and magnitude of flood peaks would be included in their forecasts. As currently occurs, flood forecasts and flood warnings would be publicly posted by the River Forecast Center for use by federal, state, county, tribal, and local agencies, as well as the public, so timely decisions regarding evacuation or emergency response could be made.

Contact Information for the California Nevada River Forecast Center:

US Dept. of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
California Nevada River Forecast Center
3310 El Camino Avenue, Room 227
Sacramento, CA 95821-6373
916-979-3056
Webmaster Email: cnrfc.webmaster@noaa.gov

During the detailed design phase, the KRRC or KRRC's contractor will submit a conditional letter of map revision (CLOMR) report to FEMA of a planned major hydraulic change to the Klamath River that could affect the 100-year flood plain. Subsequently, the KRRC or KRRC's contractor will submit a letter of map revision (LOMR) to FEMA, to provide recent hydrologic/hydraulic modeling and updates to the land elevation mapping. This information will be provided to FEMA so they can update their 100-year flood plain maps downstream of Iron Gate Dam (as needed), so flood risks (real-time and long-term) can be evaluated and responded to by agencies, the private sector, and the public.

1.7 Dam or Tunnel Failure

In the event of a tunnel failure during construction activities or drawdown, the immediate area shall be evacuated and the KRRC contractor's onsite supervisor and the KRRC construction manager shall be notified immediately. In the event tunnel failure results in partial or full blockage of flow, KRRC or KRRC's contractor will notify the Federal Energy Regulatory Commission (FERC) and other regulatory agencies, as required,, and the KRRC or KRRC's contractor will develop a plan to mitigate any associated impacts. The plan will be developed within five (5) calendar days of the tunnel failure, and will be sent to the FERC for review and approval and to other regulatory agencies, as required.

In the event of a dam failure, or an imminent dam failure, during construction activities or drawdown, the immediate area shall be evacuated and KRRC contractor's onsite supervisor and the KRRC construction manager shall be notified immediately. KRRC's contractor onsite supervisor shall contact 911, local law enforcement, local fire departments, the Klamath and Siskiyou County emergency services, the FERC local Office of Dam Safety, and the California Division of Safety of Dams (DSOD) immediately.

County Emergency Services, FERC's local Office of Dam Safety and DSOD contact information is provided below:

1. Siskiyou County Office of Emergency Services
   806 South Main Street
   Yreka, CA 96097
   530-841-2155
2. Klamath County Emergency Management
   2543 Shasta Way
   Klamath Falls, OR 97601
   541-851-3741
3. FERC Local Office of Dam Safety
   805 SW Broadway
   Fox Tower - Suite 550
   Portland, OR 97205
   503-552-2715
4. DSOD: Specific contact and phone numbers for working and non-working hours shall be coordinated with DSOD prior to finalization of the Emergency Action Plan by the contractor. The current project contact at DSOD is Nekane Hollister at 916-227-4627.

Klamath County, Oregon, has an Emergency Operations Plan that outlines procedures to ensure protection of life and property during a dam failure. The government and private agencies involved as well as their roles and responsibilities in response to a dam failure are defined therein. Flood inundation maps are available in the office of the Klamath County Emergency Manager. KRRC's contractor will review this document during preparation of the final ERP.

During preparation of the written procedures to implement this ERP, KRRC's contractor shall review PacifiCorp's Emergency Action Plans for each development. These plans will contain useful information on emergency contacts and protocol.

1.8 Catastrophic emergency (e.g., earthquake, extreme weather event, etc.)

In the event of a catastrophic emergency, KRRC contractor's onsite supervisor and the KRRC construction manager shall be notified immediately with details concerning the location, name of any injured person(s) and a brief description of the situation at any damaged structure or facility. It is imperative that each employee is accounted for. The designated supervisor will perform a physical headcount of all on-site personnel as soon as possible.

When evacuation is determined necessary, the following procedures shall be followed:

1. Employees will leave any buildings and the site area or as advised and report to the designated emergency staging area. The emergency staging area for the various project sites will be clearly identified in KRRC contractor's written emergency response procedures. When evacuating, employees should walk, remain quiet, and follow all other emergency instructions.
2. When evacuating work areas, employees should close doors behind them, but not lock doors unless otherwise instructed.
3. Employees working with electrically operated machines or equipment should switch the equipment off or unplug it prior to leaving the work area.
4. After evacuation is completed, the KRRC expects the police and other emergency personnel will prevent entrance to the effected site area.
5. When the catastrophic emergency is over, KRRC contractor's project manager or KRRC construction manager, in conjunction with the Safety Officer, will advise employees when it is safe to return to the site.

1.9 Security Threat

Security threats to any facility within the project site will be immediately communicated to KRRC contractor's onsite supervisor and the KRRC construction manager. Based on the information or type of threat received, a response will be initiated by KRRC contractor's onsite supervisor that may include any of the following:

1. Cessation of all work activity and mustering of site personnel
2. Notification of local law enforcement agencies
3. Notification of the Federal Bureau of Investigation

Chapter 2: References

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2. REFERENCES

USBR 2012b. U.S. Bureau of Reclamation. *Detailed Plan for Dam Removal – Klamath River Dams – Klamath Hydroelectric Project – FERC License No. 2082 – Oregon-California*. July 2012.

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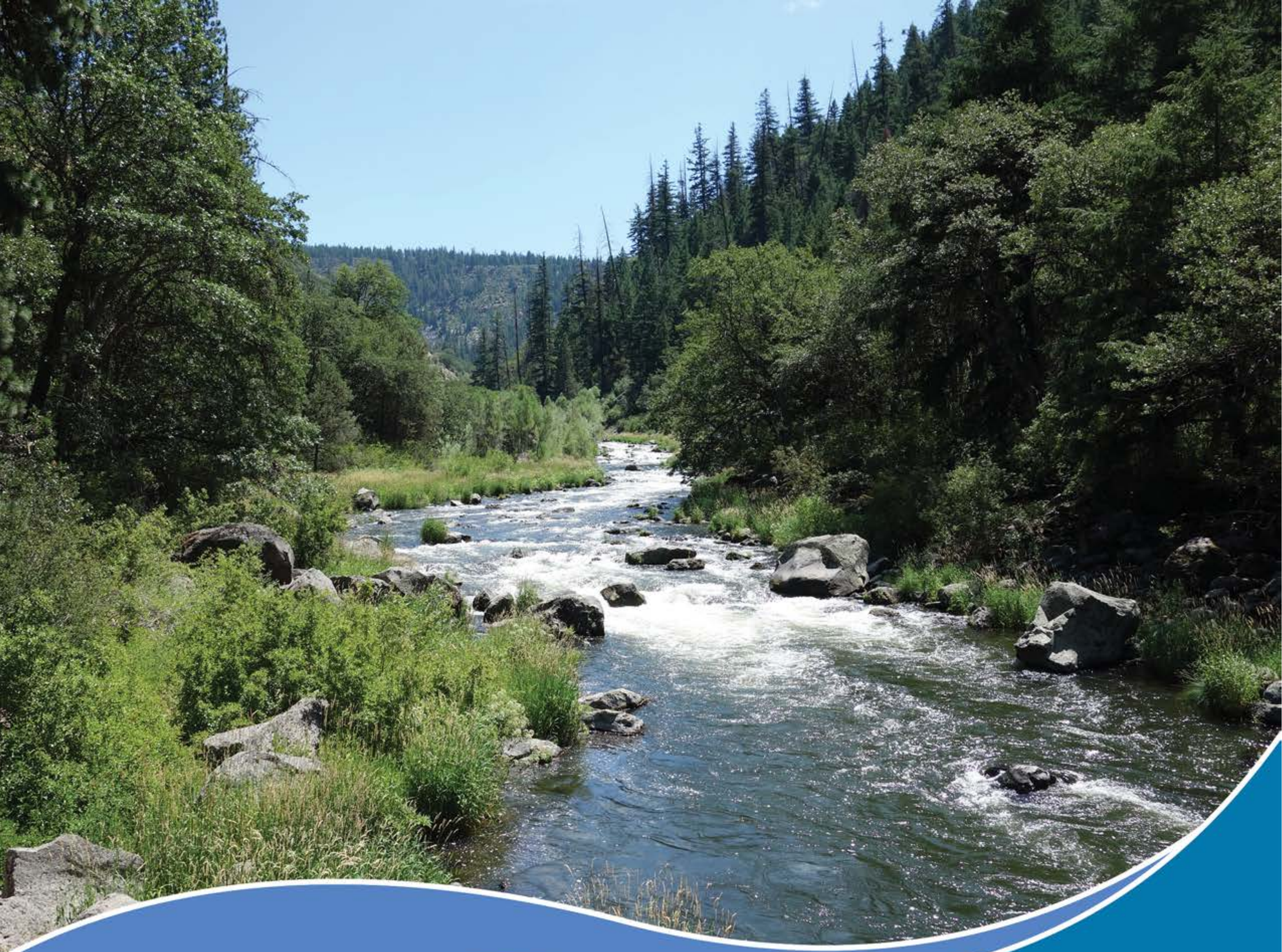

Definite Plan for the Lower Klamath Project

Appendix O5 –Noise and Vibration Control Plan

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Prepared for:

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Table of Contents

Acronyms

KRRC	Klamath River Renewal Corporation
NVCP	Noise and Vibration Control Plan

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Chapter 1: Noise and Vibration Control Plan

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1. NOISE AND VIBRATION CONTROL PLAN

The purpose of this Noise and Vibration Control Plan (NVCP) is to address and reduce increases in day and night time noise levels resulting from construction activities during implementation of the Definite Plan for the Lower Klamath Project (Definite Plan) proposed by the Klamath River Renewal Corporation (KRRC) for physical removal of the four dam developments (Iron Gate, Copco No. 1, Copco No. 2, and J.C. Boyle), hereinafter the Project. KRRC's contractor will develop a final NVCP to document the KRRC's noise and vibration objectives based on regulatory and industry guidelines as relevant to specific activities to be completed under the Definite Plan. The final NVCP will address KRRC's contractor staff roles and responsibilities for noise and vibration control, define noise intensive activities and timing, identify sensitive receptors, evaluate construction noise levels, and outline a monitoring program for noise and vibration.

KRRC's contractor will incorporate the following measures into the final NVCP to reduce effects to sensitive receptors associated with noise and vibration. Measures include, but are not limited to, the following:

- KRRC's contractor shall maintain equipment in compliance with federal, state and local noise standards (e.g., exhaust mufflers, acoustically attenuating shields, shrouds, or enclosures)
- KRRC's contractor shall schedule truck loading, unloading, and hauling operations to reduce daytime and nighttime noise impacts to the extent feasible
- Construction activities will be conducted or phased so that noise generated during construction will not exceed thresholds or durations identified by the appropriate regulatory authorities
- KRRC's contractor shall employ appropriate blasting techniques to minimize noise and vibration to the extent feasible
- Equipment and trucks used for the Project shall employ the best available noise control techniques to the extent feasible
- Stationary sources shall be located as far from adjacent noise-sensitive receptors as reasonably possible and shall be enclosed if feasible
- Where feasible, temporary portable sound barriers will be deployed where construction noise would cause noise levels at sensitive receptor locations to exceed an applicable criteria threshold
- KRRC or KRRC's contractor shall notify nearby residents of hours and duration of construction activities
- At least two weeks prior to the anticipated start of construction at a particular location, KRRC or KRRC's contractor will notify all property owners within 1,000 feet of that location that construction activities are about to commence
- KRRC's contractor shall have a complaint hotline for local residents, and shall promptly address noise and vibration complaints

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PDF p.262, report p. 7-8

First paragraph: "beds that will be salvaged and translocated is predicated on the available habitat in the Klamath River downstream from the Trinity River confluence (RM 43.4), and between J.C. Boyle Dam (RM 230.6) and Copco Reservoir (RM 209.0), and the abundance of mussels between Iron Gate Dam…"

Deleted: between Seiad Valley (RM 131.9) and Somes Bar (RM 66.4),

1. FRESHWATER MUSSELS

The objective of the freshwater mussels measure is to address reservoir drawdown and project effects on freshwater mussels located in the Klamath River in the Hydroelectric Reach and downstream from Iron Gate Dam (RM 193.1). The 2012 EIS/R AR-7 focused conducting a freshwater mussel relocation pilot study followed by the salvage and relocation of freshwater mussels prior to reservoir drawdown. Salvaged mussels were to be held in a temporary location for later placement following reservoir drawdown, and placed in locations that will not be affected by the reservoir drawdown. Based on a review of the information discussed in greater detail below, KRRC and the ATWG concluded that a moderate scale freshwater mussel relocation effort is warranted. The proposed measure includes a freshwater mussel reconnaissance in 2019 followed by a limited freshwater mussel salvage prior to reservoir drawdown. Specifically, KRRC will salvage freshwater mussels from the 8-mile long Iron Gate Dam (RM 193.1) to Cottonwood Creek (RM 185.1) reach and translocate these mussels to one or more appropriate locations in the Klamath River, downstream from the Trinity River confluence (RM 43.4), and between J.C. Boyle Dam (RM 230.6) and Copco Reservoir (RM 209.0). The translocation sites will be determined following the 2019 reconnaissance and discussion with the ATWG.

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1.1 Proposed Measure

Based on a review of the 2012 EIS/R AR-7 presented in Section 9.2 below, input from the ATWG, and current freshwater mussels literature, the KRRC concluded that revisions to AR-7 are necessary to offset the anticipated short-term effects of the Project on freshwater mussels. The proposed measure includes a reconnaissance, salvage, and relocation of freshwater mussels from the 8-mile reach between Iron Gate Dam and the Cottonwood Creek confluence with the Klamath River. The monitoring and adaptive management plan has two specific actions.

- **Action 1:** KRRC will complete a reconnaissance in 2019 to assess the distribution and density of freshwater mussels in the 8-mile long bedload deposition reach from Iron Gate Dam (RM 193.1) downstream to the Cottonwood Creek confluence (RM 185.1). The reconnaissance effort will determine if the mussel beds identified in the 2007-2010 surveys are still present, and estimate abundance of a subset of the mussel beds in the reach.

- **Action 2**: Based on the reconnaissance and discussions with ATWG, KRRC will salvage and relocate a portion of the freshwater mussels located between Iron Gate Dam and Cottonwood Creek prior to drawdown to reduce project effects to the mussel community. Up to 20,000 mussels are planned for translocation to appropriate habitats in the Klamath River, downstream from the Trinity River confluence (RM 43.4), and between J.C. Boyle Dam (RM 230.6) and Copco Reservoir (RM 209.0). Translocation sites will be located in areas that are anticipated by KRRC to experience minimal changes in channel bed elevation due to sediment deposition associated with the Project.

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The proposed measure is intended to reduce project effects on freshwater mussels located downstream from Iron Gate Dam. The following sections provide additional detail on the proposed measure actions.

1.1.1 Action 1: Freshwater Mussel Reconnaissance

The KRRC will prepare a reconnaissance plan to assess freshwater mussels in the Iron Gate Dam to Cottonwood Creek reach in 2018. Habitat conditions will also be evaluated downstream from the Trinity River confluence, and between J.C. Boyle Dam and Copco Reservoir to determine the habitat capacity for translocated mussels. An existing freshwater mussel data set (base data for Davis et al. 2013), compiled by the Karuk Tribe, USFWS, and other collaborators from 2007 to 2010 for the Klamath River downstream from Iron Gate Dam, will be reviewed and used to plan the reconnaissance. The reconnaissance will confirm mussel beds identified in the 2007-2010 surveys and estimate abundance at a subset of the mussel beds locations. Habitat metrics in the potential translocation reach will be evaluated to maximize translocation success. The freshwater mussel reconnaissance and translocation reach habitat assessment are anticipated to take 5 days.

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1.1.2 Action 2: Freshwater Mussel Salvage and Relocation

The KRRC will coordinate and implement a freshwater mussel salvage plan with freshwater mussel specialists. Based on the reconnaissance, a portion of the freshwater mussels located between Iron Gate Dam and Cottonwood Creek will be salvaged and relocated to reduce project effects to the freshwater mussel community. The freshwater mussel salvage and translocation effort is anticipated to require 10 days. The percentage of the existing mussel beds that will be salvaged and translocated is predicated on the available habitat in the Klamath River downstream from the Trinity River confluence, and between J.C. Boyle Dam and Copco Reservoir, and the abundance of mussels between Iron Gate Dam and Cottonwood Creek. Approximately 15,000 to 20,000 mussels are planned for translocation. During the course of these actions, it is not anticipated that the entire population of mussels residing below Iron Gate Dam will be recovered.

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1.2 Summary of the Affected Species, Anticipated Project Benefits and Effects, Recent Literature, 2012 EIS/R AR-7, and Proposed Measure

The following sections review the components of the 2012 EIS/R AR-7, anticipated project effects and long-term benefits on freshwater mussels, and current freshwater mussel literature.

1.2.1 Affected Species

Species intended to be addressed in the 2012 EIS/R AR-7 include:

- Oregon floater *(Anodonta oregonensis)*
- California floater *(A. californiensis)*
- Western ridged mussel *(Gonidea angulata)*
- Western pearlshell mussel *(Margaritifera falcata)*

1.2.2 Anticipated Project Effects on Measure Species

Short-term effects of the Project (prolonged exposure to high suspended sediment levels and bedload movement) are predicted to be deleterious to freshwater mussels in the Hydroelectric Reach and in the lower Klamath River downstream from Iron Gate Dam (Reclamation and CDFG 2012). Substantial freshwater mussel population reductions are expected due to sediment effects and possibly low dissolved oxygen levels. The change in hydrological properties following project implementation may also disrupt the current distribution of freshwater mussels downstream from Iron Gate Dam (Davis et al. 2013). Table 9-1 includes the likely and worst-case effects on freshwater mussel species in the Klamath River.

Table 9-1 2012 EIS/R anticipated effects summary for freshwater mussels

Species	Life Stage	Likely Effects	Worst Effects
California Floater Oregon Floater Western Ridged Western Pearlshell	All	Substantial reduction in populations	Substantial reduction in populations

Source: USBR and CDFG 2012

The following sections include descriptions of anticipated effects to freshwater mussels based on information 2012 EIS/R (Reclamation and CDFG 2012; Vol. 1, pp. 3.3-173 to 3.3-175) as well as additional information from additional freshwater mussel studies, some of which were completed after the publication of the 2012 EIS/EIR.

Freshwater Mussels

Available studies have evaluated Klamath River Basin freshwater mussel age structure, growth rates, and size distribution (*G. angulata*; Tennant 2010); population distribution and habitat use (Krall 2010; Davis et al. 2013; May and Pryor 2015); and habitat associations (Westover 2010; Davis et al. 2013). Klamath River mussels are long lived (from 10 to more than 100 years, depending on species) and may not reach sexual maturity until 4 years of age or more. *Anodonta* species are found primarily downstream from Iron Gate Dam, and likely benefit from the stable hydrology and fine sediment deposits attributed to hydroregulation below the dam (Davis et al. 2013). *G. angulata* is the most abundant freshwater mussel in the Klamath River and the species is widely distributed between Iron Gate Dam and the Trinity River (Westover 2010;

Davis et al. 2013). *M. falcata* is the least abundant freshwater mussel found in the Klamath River and seems to be mostly found downstream from the confluence of the Salmon River (Westover 2010; Davis et al. 2013).

Freshwater mussel tolerance of high suspended sediment, low dissolved oxygen, and bedload deposition are not well understood. Vannote and Minshall (1982) evaluated freshwater mussels in an aggrading river system in Idaho and concluded that *G. angulata* appear to be better adapted for aggrading rivers based on siphon positions, shell morphology, and foot placement in the underlying substrate. *M. falcata* seemed to be less adapted for aggrading rivers due to a less developed siphon for filtering water. *M. falcata* also rarely burrow into substrate more than 25-40 percent of the valve length which may increase the mussel's susceptibility to scour (Vannote and Minshall 1982). *G. angulata* migrate vertically in the channel bed and are capable of maintaining position near the channel bed surface (Vannote and Minshall 1982). *M. falcata* are not known to migrate and are therefore more susceptible to sediment burial. *Anodonta* species are likewise susceptible to sediment scour and burial due to their thinner shells. Mussels that are dislodged from their normal vertical position and fall onto their sides may not regain the normal position and may perish (Vannote and Minshall 1982).

Mussels play important roles in aquatic ecosystems. Mussels influence water quality, nutrient cycling, and habitat and are also known as "ecosystem engineers" that actively modify their environment (Xerces Society 2009; Lopes-Lima et al. 2016; Lummer et al. 2016). They filter fine sediment and organic particles, create byproducts that are food items for macroinvertebrates, and comprise the greatest proportion of animal biomass in some waterbodies (Xerces Society 2009). In the Klamath River Basin, freshwater mussels filter and sequester toxins including toxigenic algae microsystins (Kann et al. 2010) and mercury (Bettaso and Goodman 2010). Filtration of waterborne toxins may result in bioaccumulation in freshwater mussels leading to human consumption risks (Bettaso and Goodman 2010; Kann et al. 2010).

The Project is anticipated to result in high suspended sediment levels and bedload deposition in the 8 miles of the Klamath River between Iron Gate Dam and Cottonwood Creek. Extremely poor water quality due to high suspended sediment concentrations is expected in the first 2 miles of the Klamath River downstream from Iron Gate Dam (Reclamation and CDFG 2012). Fine sediment effects on freshwater mussels include gill clogging, possible growth reduction, and impairment to mussel larval stages (Lummer et al. 2016). Due to both the anticipated deleterious high suspended sediment concentrations and low dissolved oxygen levels, freshwater mussels downstream from Iron Gate Dam may experience substantial mortality with the most significant impacts anticipated to mussels located immediately downstream from Iron Gate Dam.

Over the long-term, freshwater mussels are expected to benefit from the Project through the conversion of Hydroelectric Reach reservoirs to gravel bed rivers which will restore freshwater mussel habitat, reduce water quality and water temperature impairments related to the reservoirs, and restore access for anadromous and resident host fish species that will distribute freshwater mussel larvae throughout the Klamath River upstream from Iron Gate Dam. However, due to the long time freshwater mussels take to reach sexual maturity, the recolonization and/or growth of existing freshwater mussel populations upstream of Iron Gate Dam may be slow and may not be readily noticeable for some time.

1.2.3 2012 EIS/R AR-7

The 2012 EIS/R AR-1 (Vol. I, pp. 3.3-248 to 3.3-249) directed the salvage of freshwater mussels from the Hydroelectric Reach and downstream from Iron Gate Dam. Salvaged mussels were to be relocated to suitable instream habitat unaffected by high suspended sediment concentrations, or could be placed in temporary facilities and returned to the Klamath River following the Project. A salvage and relocation pilot study was also suggested to assess salvage feasibility and relocated mussel survival. Based on the pilot study results, a detailed salvage and relocation plan was to be developed.

1.2.4 KRRC's and the ATWG's Review of AR-7 for Feasibility and Appropriateness

The KRRC assessed the feasibility and appropriateness of AR-7 through multiple planning meetings held with the ATWG between May and August 2017. During these meetings, current information on Klamath River fisheries was presented and information on other dam removal projects conducted in the western United States was reviewed to understand how the aquatic ecosystem might respond, as discussed above. The ATWG's concerns regarding the 2012 AR-7 included:

- Unfamiliarity with successful freshwater mussel relocation efforts.
- Disease transmission concerns.

The following sections provide additional information regarding AR-7 feasibility and appropriateness, based on fisheries literature and ATWG input.

Unfamiliarity with Successful Freshwater Mussel Relocation Efforts

The ATWG was unfamiliar with successful freshwater mussel translocation efforts. Anecdotal information discussed during the ATWG planning meeting (Yreka, CA, May 23, 2017) alluded to low translocation success for the Elwha Dam Removal Project and highway construction projects. Additional information was acquired by the KRRC on the Elwha Dam Removal Project freshwater mussel (*M. falcata*) translocation. For that project, freshwater mussels were translocated to two sites and remained in one site prior to the dam removal project (P. Crain, U.S. Park Service, personal communication, 2017). The relocated freshwater mussels had high survival following the translocation and prior to the dam removals. Subsequent events that impacted the translocated mussels resulted in high mussel mortality. The events included raccoon predation due to shallow habitat at the first translocation site, and excessive sediment deposition at a side channel translocation site. The third monitored site was an artificial outfall channel from the water treatment facility that went dry due to inadvertent project operations. Mussels that remained in the Elwha River downstream from Elwha Dam are suspected to have experienced high mortality due to excessive sediment deposition following dam removal, followed by channel scour during the post-dam sediment sorting process.

Freshwater mussel translocation project monitoring results are not well represented in the fisheries literature. Unpublished freshwater mussel translocation monitoring manuscripts were reviewed to better understand the range of potential translocation success. Fernandez (2013) described the translocation success of 265 individual *M. falcata* in coastal southwest Washington. Between 55 percent and 95 percent of the transplanted *M. falcata* were accounted for in the translocation sites between one and three years following the translocation.

A review of translocation projects found mean mortality of relocated mussels was 49 percent based on an average recovery rate of 43 percent (Cope and Waller 1995). Cope and Waller (1995) found that survival of relocated mussels was generally poor and the factors influencing the survival of relocated mussels were poorly understood. For mussel relocation to be successful, more consideration must be given to habitat characterization at both the source and translocation sites. Olden et al. (2010) and Germano et al. (2015) offer considerations for successful freshwater organism and wildlife translocation efforts, respectively Luzier and Miller (2009) offer suggestions and considerations for freshwater mussel translocations.

Disease Transmission Concerns

The role of freshwater mussels in freshwater disease transmission is not well understood. Freshwater mussels are known to provide habitat for polychaete worms, one of the hosts in the life *C. shasta*. Polychaetes have been infrequently collected from freshwater mussel shells in the Hydroelectric Reach of the Klamath River (PacifiCorp 2004). Mussels may serve as a vector for other fish pathogens like *Flavobacterium columnare* and *Ichthyophthirius multifiliis* that are endemic to the Klamath River Basin (K. Kwak, CDFW, personal communication 2017).

Freshwater mussels inhabit the Klamath River upstream from Iron Gate Dam (Byron and Tupen 2017) and in tributaries upstream (Byron and Tupen 2017) and downstream from Iron Gate Dam (Davis et al. 2013; Howard et al. 2015; May and Pryor 2015), disease transmission may be less of a concern.

1.3 Summary

The Project is anticipated to have significant short-term effects, but long-term benefits for freshwater mussels. The 2012 EIS/R AR-7 included a freshwater mussel salvage and relocation pilot study followed by an informed salvage and relocation plan prior to the Project. The proposed measure includes completing a reconnaissance of existing freshwater mussels from Iron Gate Dam to Cottonwood Creek and potential translocation habitat on the Klamath River downstream from the Trinity River confluence, and between J.C. Boyle Dam and Copco Reservoir. KRRC will salvage and relocate freshwater mussels prior to the reservoir drawdown. It is not anticipated that the entire population of mussels residing below Iron Gate Dam will be recovered.

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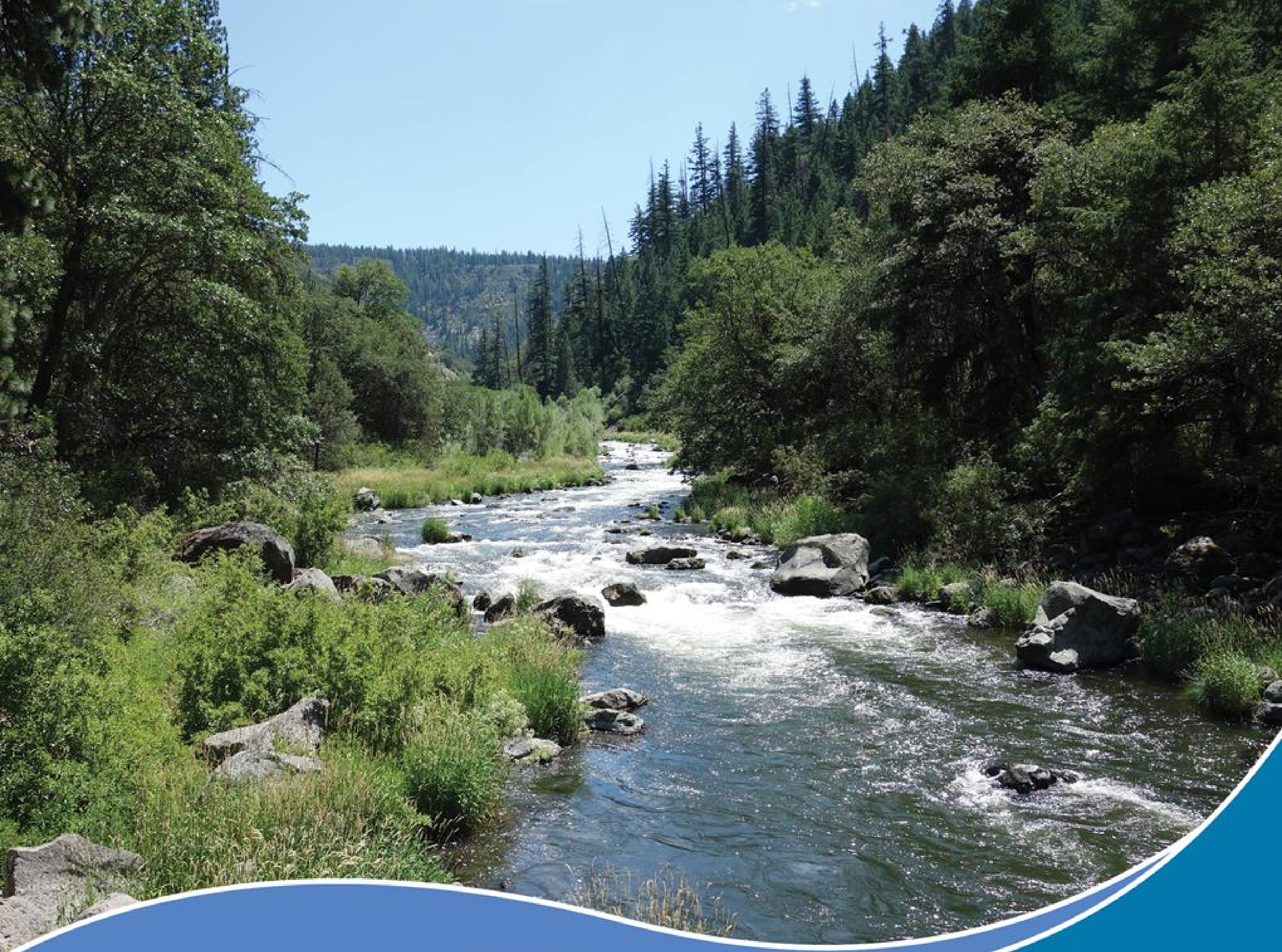

Definite Plan for the Lower Klamath Project

Appendix P – Estimate of Project Costs

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Attachments

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Acronyms and Abbreviations

BOC	Board of Consultants
CA	California
CADD	Computer Aided Design and Drafting
CEQA	California Environmental Quality Act
DB	Design-Builder
EIS	Environmental Impact Statement
EIR	Environmental Impact Report
ENR	Engineering News Record
FERC	Federal Energy Regulatory Commission
FY	Fiscal Year
G&A	General and Administrative
GHG	Green House Gas
GIS	Geographic Information System
KRRC	Klamath River Renewal Corporation
Lbs	pounds
LVPP	Looting and Vandalism Protection Program

m^3	cubic meters
MPE	Most Probable Estimate
MPH	Maximum Probable High
MPL	Minimum Probable Low
MW	Mega Watt
MWh	Mega Watt hour
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
OC	On center
ODC	Other Direct Cost
OR	Oregon
PDB	Progressive Design-Builder
PLS	Pure live seed
RPS	Renewal Portfolio Standard
SF	Square Feet
SWRCB	State Water Resource Control Board
TCP	Traditional Cultural Properties
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey

Chapter 1: Introduction

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1. INTRODUCTION

This report documents the estimated project cost for the Lower Klamath Project (Project), which in addition to construction cost, includes costs for management, administration and legal support, environmental compliance and permitting, engineering design, procurement, mitigation and monitoring before, during and following construction, as well as construction management. The estimated project cost is based on the preliminary design presented in the Definite Plan for the Lower Klamath Project (KRRC 2018) (the Definite Plan), in addition to ongoing coordination and consultation with Project stakeholders and regulatory agencies.

1.1 Report Objectives

Section 7.2 of the Klamath Hydroelectric Settlement Agreement, as amended (KHSA) sets forth required elements of the Definite Plan, which include:

- A detailed estimate of the actual or foreseeable costs associated with: the physical performance of Facilities Removal[1] consistent with the Detailed Plan; each of the tasks associated with the performance of the [Klamath River Renewal Corporation (KRRC)]'s obligations as stated in Section 7.1; seeking and securing permits and other authorizations; and insurance, performance bond, or similar measures, as set forth in Appendix L to this Settlement;
- The [KRRC]'s analysis demonstrating that the total cost of Facilities Removal is likely to be less than the State Cost Cap, which is the total of Customer Contribution and California Bond Funding as specified in Section 4[2]; and
- A detailed statement of the estimated costs of Facilities Removal.

This report addresses these elements of the KHSA and documents both the engineer's opinion of construction cost, based on the project design elements and construction plan summary provided in the Definite Plan, and the total estimated project implementation cost. In addition to reporting the estimated project costs, Most Probable Low (MPL) and Most Probable High (MPH) estimates were prepared using a Monte Carlo analysis to account for uncertainties associated with the estimated project costs and identified project risks. The MPL and MPH estimates represent more optimistic and more conservative opinions of project costs, respectively.

[1] "Facilities Removal" is defined in the KHSA as the "physical removal of all or part of each of the Facilities to achieve at a minimum a free-flowing condition and volitional fish passage, site remediation and restoration, including previously inundated lands, measures to avoid or minimize adverse downstream impacts, and all associated permitting for such actions."
[2] The State Cost cap is $450,000.000.

1.2 Project Scope

The proposed Project (also referred to as the Full Removal alternative) is described in Sections 1, 4, 5, 6 and 7 of the Definite Plan. The Project involves the physical removal of each of the four dam developments (Iron Gate, Copco No. 1 and No. 2, and J.C. Boyle) to achieve at a minimum a free-flowing condition and volitional fish passage, site remediation and restoration, including previously inundated lands, measures to avoid or minimize adverse downstream impacts, and all associated permitting for such actions. Table 1-1 provides an overview of the four dam developments. The Project is located on the Klamath River approximately 200 miles from the Pacific Ocean in the states of Oregon and California (see Figure 1-1). The Definite Plan also describes a "Partial Removal" alternative which is presented for purposes of environmental review. Under the Partial Removal alternative, the objectives of free-flowing river conditions and volitional fish passage will be achieved, but portions of each dam will remain in place, along with ancillary buildings and structures such as powerhouses, foundations, tunnels, and pipes. Section 5 of the Definite Plan discusses the details of infrastructure to remain under this alternative.

Prior to removal of the dams and hydropower facilities, KRRC's contractor will draw down the water surface elevation in each reservoir as low as possible to facilitate accumulated sediment evacuation and to create a dry work area for development removal activities. A number of infrastructure modifications will be necessary to facilitate drawdown. In general, drawdown will begin on January 1 of the drawdown year, and will extend through mid-March of the same year.

Table 1-1 Existing Dam Development Overview

Dam (Sate)	Description	Year Built	Capacity/ Average Annual Production	Max. Surface Area of Reservoir (acres)	Reservoir Storage Capacity (acre-feet)	Dam Type	Dam Height/Length (feet)
J.C. Boyle (OR)	Reservoir, dam, fish ladder, power canal, two turbines and powerhouse	1958	98 MW/ 329,000 MWh	420	3,495 (total) 1,724 (active)	Earthfill	68/ 693
Copco No. 1 (CA)	Reservoir, dam, two turbines and powerhouse	1918	20 MW/ 106,000 MWh	1,000	46,900 (total) 6,235(active)	Concrete	126/ 415
Copco No. 2 (CA)	Division dam, small impoundment, two turbines and powerhouse	1925	27 MW/ 135,000 MWh	40	73 (total) negligible (active)	Concrete	33/ 278
Iron Gate (CA)	Reservoir, dam, one turbine, powerhouse and fish hatchery	1962	18 MW/ 116,000 MWh	944	58,800 (total) 3,790 (active)	Earthfill	173/ 740

After drawdown is accomplished, remaining reservoir sediments will be stabilized to the extent feasible and dam and hydropower facility removal will begin. Full reservoir area restoration will begin after drawdown, extend throughout the year, and possibly extend into the subsequent year. Vegetation establishment could extend several years.

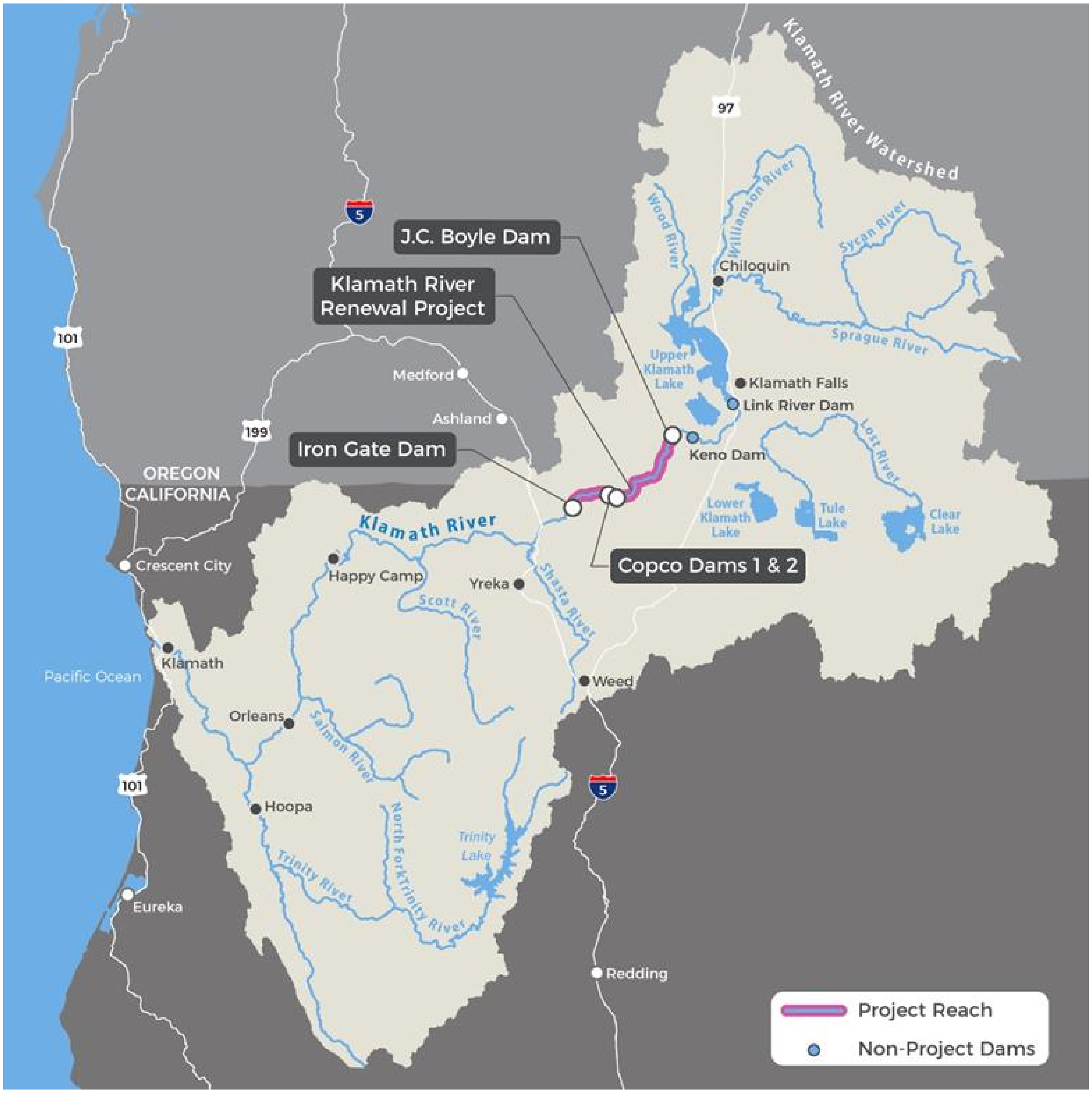

Figure 1-1 Klamath River Watershed and Facilities Locations

Other key project components include measures to reduce Project-related effects to aquatic and terrestrial resources, road and bridge improvements, relocation of the City of Yreka's pipeline across Iron Gate Reservoir and associated diversion facility improvements, as well as demolition of various recreation facilities adjacent to the reservoirs. This estimate does not include costs associated with design and construction of any hatchery improvements associated with the Project (as described in the Definite Plan), and as per the KHSA, these will be funded separately by PacifiCorp.3

1.3 Limitations

The opinion of estimated project costs presented in this report is based on information in the Definite Plan, ongoing coordination and consultation with project stakeholders and regulatory agencies, and market conditions at the time of preparation of the estimate. The construction cost was estimated with the use of a combination of built-up unit prices and statistical unit prices from published and internally developed and maintained historical databases factored for location, contractor markups, and other project-specific criteria. Logic, methods, and procedures for developing costs are typical for the construction industry.

Various limitations need to be considered in the use of both built-up and statistical unit prices. These limitations include the potential for changes in technology, methods, and construction applications; the impact of short-term economic cycles; and the time-lag of reporting databases. Any estimate of unit prices is not intended to predict the outcome of hard dollar results from open and competitive bidding.

AECOM represents that the services were conducted in a manner consistent with the standard of care ordinarily applied as the state of practice in the profession, given the amount of design information available at the time of estimate preparation. No other warranties, either expressed or implied, are included or intended.

Other implementation costs presented in this report, outside of the preliminary design and construction activities, should be considered preliminary, due to the fact that:

- Permitting coordination is currently ongoing. The understanding of anticipated mitigation, monitoring and reporting requirements should be considered preliminary until feedback is received from the agencies on the draft permit applications. KRRC will obtain additional clarity on mitigation, monitoring and reporting once the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) processes are complete.
- KRRC has not yet selected a Progressive Design-Builder (PDB) to finalize the dam removal designs and subsequently complete the associated construction. The current understanding and effort associated with PDB field studies and final design should be considered preliminary until that selection process is complete.

KRRC is undertaking additional due diligence on construction costs, measures to lower construction costs, and measures to manage construction risk. These measures include risk management, selection of a PDB to perform the work, and negotiation of a PDB contract with a guaranteed maximum price for construction. Many risks considered in the Monte Carlo analysis that deal with design and regulatory compliance will be managed or better understood when this process is completed, likely lowering the MPH. These results of these inquiries will be further informed by the review and recommendations of a FERC approved

[3] See Section 7.6.6 of the KHSA.

independent Board of Consultants (BOC) for the Lower Klamath Project. Among other inquires, the BOC will be convened to review and provide recommendations regarding the adequacy of available funding and reasonableness of updated cost estimates for the most probable cost and maximum cost for the Full Removal alternative, and the assumptions made to calculate those estimates. KRRC will incorporate the recommendations of the BOC into a revised Definite Plan.

1.4 Results Summary

Tables 1-2 and 1-3 below summarize the estimate of project costs, for both Full Removal and Partial Removal of the four dams.

Similar to previous project estimates, the results show probabilistic MPL and MPH costs based on the results of Monte Carlo simulations. The right-hand column indicates the estimated project costs, whereas the forecast range from MPL to MPH indicate the range of probabilistic outcomes. The MPL is P10 (likely final project cost in 10% of all scenarios) and the MPH is P90 (likely final project cost in 90% of all scenarios). Details on these methods are described further in Section 2.7 (Monte Carlo Analysis) of this report.

Table 1-2 Results Summary - Full Removal

Cost Category	Forecast Range		Estimated Project Cost
	MPL (P10)	MPH (P90)	
Project Oversight			$29,581,000
Environmental Compliance & Permitting			$8,637,000
Engineering & Procurement			$15,632,000
Construction Management			$10,617,000
Construction	$202,108,000	$268,560,000	$227,980,000
Anticipated Mitigation Measures			$18,407,000
Monitoring & Reporting			$18,405,000
Design & Construction Contingency			$68,394,000
TOTAL	**$346,500,000**	**$507,100,000**	**$397,700,000**

Table 1-3 Results Summary - Partial Removal

Cost Category	Forecast Range		Estimated Project Cost
	MPL (P10)	MPH (P90)	
Project Oversight			$29,581,000
Environmental Compliance & Permitting			$8,637,000
Engineering & Procurement			$15,632,000
Construction Management			$10,617,000
Construction	$169,140,000	$229,250,000	$193,030,000
Anticipated Mitigation Measures			$18,407,000
Monitoring & Reporting			$18,405,000
Design & Construction Contingency			$57,909,000
TOTAL	**$313,500,000**	**$467,800,000**	**$352,200,000**

Chapter 2: Basis of Estimate

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2. BASIS OF ESTIMATE

2.1 Cost Categories

For organizational purposes, the project costs have been summarized using the following cost categories:

- **Project Oversight:** Support services providing administration, project management and controls, contract management, Board of Consultants (BOC), outreach, insurance and legal support.
- **Environmental Compliance and Permitting**: Environmental compliance support and permitting.
- **Engineering and Procurement:** Field studies, engineering design, and construction procurement for the various project work packages. Design and procurement estimates assume a PDB, performance security, construction delivery method for the large dam removal work package.
- **Construction Management:** Full construction management services for implementation of all project components.
- **Construction:**
    - Dam removals: Sequential removal of all four dams, including dam modifications, reservoir drawdown and removal of all associated dam infrastructure (including spillways, fish ladders, intake structures, penstocks, turbine units, electrical installations, buildings)
    - Reservoir area improvements: Removal, grading and shaping of portions of reservoir sediment, bank stability measures
    - Reservoir area restoration: Seeding, planting, weeding, monitoring and maintenance. Hydroseeding methods include by barge along the reservoir bank, by helicopter along steep slopes, by airplane along uneven large areas and by trailer mounted blower for areas easily accessible by truck
    - Yreka water supply improvements: Improvements to the City of Yreka's water supply intake and relocation of their water supply pipeline.
    - Transportation infrastructure: Improvements to, or replacement of, bridges, culverts and road resurfacing to mitigate any project or construction related impact
    - Recreation demolition: Demolition of existing recreation infrastructure and restoration of disturbed area to native vegetation
    - Recreation improvements: New recreation infrastructure (e,g, water access, day-use areas, etc.) to avoid or minimize project impacts
    - Downstream flood improvements: Improvements to existing structures and facilities to avoid or minimize adverse downstream flood-related impacts.

- **Anticipated Mitigation Measures**: Anticipated cultural resource measures, groundwater improvements, and water supply improvements that may be required by regulatory agencies to mitigate Project-related impacts.
- **Monitoring and Reporting:** Proposed aquatic resource, terrestrial resource, water quality, and sediment monitoring and reporting.

2.2 Construction Procurement Approach

KRRC based estimates for the various cost categories on a PDB construction procurement of the large dam removal work package, which includes construction access road and bridge accommodations, dam modifications, dam and hydropower facility removal, recreation demolition and reservoir and other restoration. KRRC will use a qualifications-based selection approach and hire a PDB contractor in late 2018/early 2019, followed by the PDB's completion of the final design in 2019.

There is a possibility that smaller work packages, including downstream flood control improvements, City of Yreka water supply improvements and proposed recreation facilities, may be procured separately using a design-bid-build, or similar, procurement strategy. For these packages, final design will proceed in 2018 and 2019, with request for construction proposals being issued in mid- to late-2019.

2.3 Construction Pricing

The construction estimates summarized herein are intended to capture the most current pricing for materials, wages and salaries, equipment, accepted productivity standards, and typical construction practices, procurement methods, current construction economic conditions, and site conditions for the current level of design. Detailed construction cost breakdowns for both Full Removal and Partial Removal alternatives are provided in Attachment A. Pay item cost detail worksheets, describing the calculation of individual cost estimate line items rates and prices are provided in Attachment B.

Construction cost estimates were prepared based on less than complete designs, and have inherent levels of risk and uncertainties (as discussed in Section 2.7). The following sections discuss the various aspects and assumptions associated with construction pricing for the Project.

2.3.1 Construction Pricing - Direct Costs

Experienced construction cost estimators developed direct cost construction pricing using logic, methods, and procedures for pricing that are typical for the construction industry. Unit rates were established using input from RS Means database, Equipment Watch database and Davis Bacon Wage Determination database. Overall prices were established by taking location, access and construction operation into consideration.

KRRC used the latest Davis Bacon Wage Determination for labor rates and fringes. The area used is based on Siskiyou County, California. The Project is located in a remote location which will require per diem for all employees. This consideration is included within the Contractor's overhead cost and associated percentage

KRRC based equipment costs on the latest understanding of the equipment required to complete the work. Unit prices include equivalent/similar pieces of equipment with present day rates from Equipment Watch Blue Book, and include equipment mobilization. In selecting the rates, Redding, California was used as the nearest available location. Equipment hourly rates include fuel, which is a factored rate of $3.00/gallon based on average retail prices from nearby gas stations. KRRC estimated equipment and material sales tax at 7.75% based on recent sales tax data in Siskiyou County.

The major features and/or items in the estimate, such as the dam modifications, dam removal, and reservoir restoration are fairly well defined. KRRC estimated costs for these items using crew and equipment work-item analysis to develop unit costs, and then multiplying these by the quantity measurement to arrive at work item subtotals. Crew and equipment work-item analysis spreadsheets are presented in Attachment B.

KRRC used vendor quotes for materials such as gates for drawdown, pipelines, instrumentation, and hydroseeding. KRRC based costs for some of the smaller items of work within the estimate on the experience and judgment of the estimator using historical data from similar types of construction, factored for location, size, and other Project-specific criteria.

2.3.2 Construction General Requirements

As discussed in more detail below, the following markups were applied into the contractor's direct costs to account for general requirements:

- PDB Contractor's overhead at 15%
- PDB Contractor's profit and risk at 8%
- PDB Contractor's markup on subcontractors at 10%
- PDB Contractor's insurance at 1%
- PDB Contractor's bond at 1%

Contractor Overhead

KRRC calculated construction overhead for this Project using a slightly higher percentage than normal due to the remoteness of the Project, including establishing and maintaining workers' accommodation facilities, travel compensation, per diem payments and labor rate market conditions caused by the size of the Project in the remote location.

Construction overhead includes salaried payroll costs (salary, insurance, taxes, and fringe benefits) for management, supervisory, administrative, and safety employees. These employees include the Contractor's jobsite project management, documentation control, submittal preparation, surveying, field engineering, and quality assurance costs. Recurring jobsite overhead expenses such as office rentals, utility bills, and maintenance expenses for jobsite facilities are also included in the general requirements, as are non-recurring expenses such as the bonds and insurance, purchase of office, engineering, and safety equipment, and outside engineering and surveying expenses.

The Contractor overhead percentage (15% percentage of direct construction cost) amounts to approximately $30M over the construction duration. This is approximately equivalent to the following from the estimate of project costs (Full Removal):

- PDB Contractor's project management 2019 $3M
- PDB Contractor's project management 2020-2021 $10M
- Establish and maintain workers accommodations $6M
- Offices & facilities for PDB Contractor $4M
- Offices & facilities for contract manager $4M
- Temporary facilities $3M

Contractor Profit and Risk Markups

KRRC derived a profit and risk markup on direct construction costs of 8% by using the United States Army Corps of Engineers (USACE) Profited Weight Guidelines following the steps listed below. Figure 2-1 shows the calculation summary using the reference guidelines. The resulting amount included in the estimated project cost for Contractor's profit and risk compensation is approx. $17M.

- Risk: Where the work involves no risk or the degree of risk is very small, the weighting is 0.03; as the degree of risk increases, the weighting increase up to a maximum of 0.12. Lump sum items will have, generally, a higher weighted value than unit price items for which quantities are provided. Considerations include the portion of work to be done by subcontractors, nature of work, where work is to be performed, reasonableness of negotiated costs, amount of labor included in costs, whether negotiation is before or after performance of work, etc.
- Difficulty: If the work is most difficult and complex, the weighting is 0.12 and is proportionately reduced to .03 on the simplest jobs. This factor is tied in to some extent with the degree of risk. Considerations include the nature of the work, schedule, by whom it is done, where it is done, etc.
- Size of Job: Jobs not in excess of $100,000 are weighted at 0.12. Jobs estimated between $100,000 and $5,000,000 are proportionally weighted from 0.12 to .05. Jobs from $5,000,000 to $10,000,000 are weighted at 0.04 and work in excess of $10,000,000 at 0.03.
- Duration: Jobs in excess of 24 months are weighted at 0.12. Jobs of lesser duration are proportionately weighted to a minimum of .03 for jobs not to exceed 30 days. The period applies to only the change -- not the contract duration.
- Investment: Weighted from 0.03 to 0.12 on the basis of below average, average, and above average. Considerations include the amount of subcontracting, mobilization payment item, Government-furnished property, method of making progress payments, etc.

- Government Assistance: Weighted from 0.12 to 0.03 on the basis of average to above average. Considerations include use of Government-owned property, equipment and facilities, expediting assistance, etc.
- Subcontracting: Weighted inversely proportional to the amount of subcontracting. Where 80% or more of the work is to be subcontracted, the weighting is to be 0.03 and such weighting proportionally increased to 0.12 where all the work is performed by the Contractor's own forces.

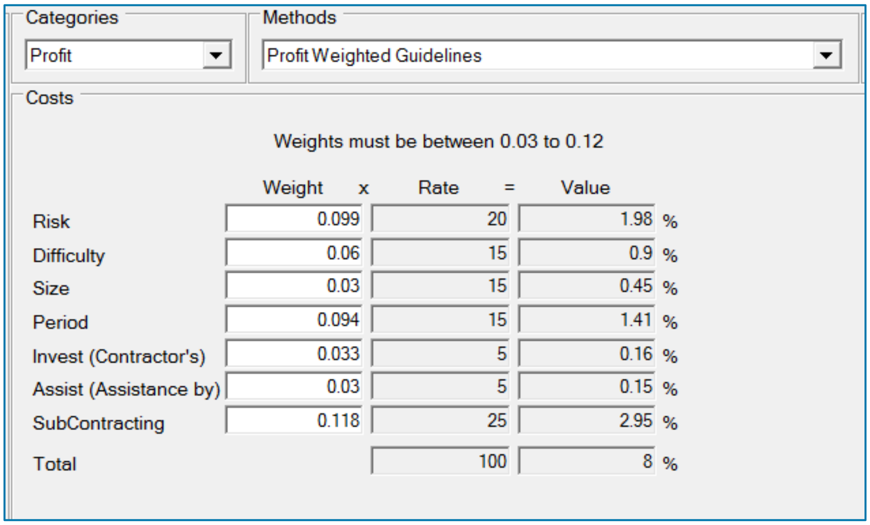


Figure 2-1 Contractor Profit and Risk Calculation Summary

Risks identified on the risk register as transferred to the PDB Contractor are assumed to be covered within this amount. No allowance for risks categorized as transferred to the PDB Contractor are included in other project contingencies.

Subcontractor Markups

KRRC selected a subcontractor markup of 10% as derived by using industry standard construction subcontract requirements on similar projects.

Insurance Markups

KRRC selected an insurance markup of 1% of direct construction cost as derived by using industry standard insurance requirements on similar projects. Insurance markup can vary to account for work complexity, procurement lead time, etc. However, since the project scope is primarily demolition, KRRC considers a 1% insurance markup appropriate.

Bond Markups

KRRC selected a bonding markup of 1% of direct construction cost as derived by using industry standard bond requirements on similar projects.

2.3.3 Quantities

Detailed quantity takeoffs made for the earthworks items (excavation, fill and erosion protection) were computer-generated (and independently checked) using the surfaces presented in the drawings, and represent neat-line quantities. Earthwork volumes (cut, fill, balance) and other quantities are provided in Section 5 and associated figures of the Definite Plan.

2.3.4 Construction Schedule

KRRC based the estimate on the construction schedule and the construction plan described in the Definite Plan. As discussed in the plan, the schedule is predicated on the following:

- Construction of City of Yreka water supply improvements will be completed in 2020 (prior to drawdown) and may be under a separate contract from the PDB Contract for the dam removal work
- Construction of downstream flood control improvements will be completed in 2020 prior to drawdown) and may be under a separate contract from the PDB Contract for the dam removal work
- Construction of the access road improvements will be completed in 2020 (prior to drawdown)
- An effective Date of Agreement (guaranteed maximum price) for the dam removal PDB on or before February 15, 2020
- Lineal and concurrent activities
- Equipment application and production
- The ability to drawdown J.C. Boyle, Copco No. 1 and Iron Gate reservoirs at the beginning of 2021
- Major earthworks and removal activities are assumed to be performed using two 10-hour shifts, six days per week
- In-stream construction window in Oregon is assumed to be from July 1 through September 30
- In-stream construction window in California is assumed to be from June 15 through October 15

The duration of many of the schedule activities are determined from the labor and equipment productivity associated with the estimate pay item sheets.

The access road, dam modification, water supply, and downstream flood control construction will be completed during an estimated 6- to 8-month period in 2020, since these activities require completion prior to drawdown and facility removal. Subsequent dam removal and associated construction will occur during 8 months of work in 2021, with restoration related construction activities likely extending through 2022. Monitoring and reporting will extend for 5 years after construction completion.

2.4 Consulting Services Pricing

Outside of construction costs, other implementation activities such as project oversight, field studies, design, permitting, mitigation measures and monitoring generally involve labor and associated other direct costs (ODCs). ODCs can include office space, travel, meals, postage, specialty reproduction, and vendor quotes for materials, supplies or services. For each of the implementation activities referenced above, KRRC developed independent estimates using standard labor rates and ODC values based on the latest understanding of the scope or work for the life of the Project. Details for each cost category are provided in Section 3. KRRC used a standard labor rate sheet for an environmental/engineering consulting firm, as shown below in Table 2-1, to develop the majority of the other implementation costs listed above. In some cases, KRRC used specialty rates to develop estimates for specialty activities such as project oversight and legal support.

Table 2-1 Environmental/Engineering Labor Rate Sheet

Labor Classification	Hourly Rate	Labor Classification	Hourly Rate
Senior Technical Advisor	$285.00	Field Technician	$75.00
Principal	$285.00	Junior Field Technician	$55.00
Project Manager	$230.00	Certified Industrial Hygienist	$165.00
Principal Engineer	$200.00	Senior Data Management	$130.00
Senior Engineer	$180.00	Data Management	$85.00
Engineer	$145.00	Senior GIS/CADD/Graphics	$120.00
Junior Engineer	$100.00	GIS/CADD/Graphics	$90.00
Principal Scientist/Planner	$180.00	Technical Editor	$105.00
Senior Scientist/Planner	$160.00	Community Relations Specialist	$110.00
Scientist/Planner	$120.00	Project Controls/Procurement	$95.00
Junior Scientist/Planner	$95.00	Administrative Assistant	$75.00
Senior Field	$110.00	Clerical/Support	$65.00

The hourly rates set forth in this schedule of fees and charges is valid from January 1, 2017 through December 31, 2017. The Hourly Rates are adjusted annually on January 1 of each subsequent year. The new Schedule of Fees and Charges will apply to existing and new assignments. For work extends beyond December 31, 2017 a 3% annual escalation on hourly rates will apply.

2.5 Escalation

KRRC based estimates on contemporary market information at the time of estimate preparation. As such it is necessary to include escalation to account for cost increases over the duration of the Project, particularly as this Project spans multiple years. KRRC escalated each line item in the cost estimate based on scheduled construction and other implementation activities.

KRRC used an escalation rate of 4% per year. This is based on cost index references and current cost trends observed in the industry. As shown in the below Engineering News Record (ENR) Historic Cost Index (Table 2-2), the last few years have seen a consistent uptrend in escalation, including the beginning of 2018. Considering this trend, along with other published historical data and professional judgment, it is reasonable to expect escalation to average out at around 4% per year over the duration of the Project.

Table 2-2 ENR Historic Cost Index

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL AVG	AVERAGE ANNUAL INCREASE
1990	4680	4685	4691	4693	4707	4732	4734	4752	4774	4771	4787	4777	4732	
1991	4777	4773	4772	4766	4801	4818	4854	4892	4891	4892	4896	4889	4835	2.177%
1992	4888	4884	4927	4946	4965	4973	4992	5032	5042	5052	5058	5059	4985	3.102%
1993	5071	5070	5106	5167	5262	5260	5252	5230	5255	5264	5278	5310	5210	4.514%
1994	5336	5371	5381	5405	5405	5408	5409	5424	5437	5437	5439	5439	5408	3.800%
1995	5443	5444	5435	5432	5433	5432	5484	5506	5491	5511	5519	5524	5471	1.165%
1996	5523	5532	5537	5550	5572	5597	5617	5652	5683	5719	5740	5744	5620	2.723%
1997	5765	5769	5759	5799	5837	5860	5863	5854	5851	5848	5838	5858	5826	3.665%
1998	5852	5874	5875	5883	5881	5895	5921	5929	5963	5986	5995	5991	5920	1.613%
1999	6000	5992	5986	6008	6006	6039	6076	6091	6128	6134	6127	6127	6059	2.348%
2000	6130	6160	6202	6201	6233	6238	6225	6233	6224	6259	6266	6283	6221	2.674%
2001	6281	6272	6279	6286	6288	6318	6404	6389	6391	6397	6410	6390	6343	1.961%
2002	6462	6462	6502	6480	6512	6532	6605	6592	6589	6579	6578	6563	6538	3.074%
2003	6581	6640	6627	6635	6642	6694	6695	6733	6741	6771	6794	6782	6694	2.386%
2004	6825	6862	6957	7017	7065	7109	7126	7188	7298	7314	7312	7308	7115	6.289%
2005	7297	7298	7309	7355	7398	7415	7422	7479	7540	7563	7630	7647	7446	4.652%
2006	7660	7689	7692	7695	7691	7700	7721	7722	7763	7883	7911	7888	7751	4.096%
2007	7880	7880	7856	7865	7942	7939	7959	8007	8050	8045	8092	8089	7966	2.774%
2008	8090	8094	8109	8112	8141	8185	8293	8362	8557	8623	8602	8551	8310	4.105%
2009	8549	8533	8534	8528	8574	8578	8566	8564	8586	8596	8592	8641	8570	3.081%
2010	8860	8672	8671	8677	8761	8805	8865	8858	8857	8921	8951	8952	8857	3.349%
2011	8938	8998	9011	9027	9035	9053	9080	9088	9116	9147	9173	9172	9070	2.405%
2012	9176	9198	9268	9273	9290	9291	9324	9351	9341	9376	9398	9412	9308	2.624%
2013	9437	9453	9456	9484	9516	9542	9552	9545	9552	9689	9666	9668	9547	2.564%
2014	9664	9681	9702	9750	9796	9800	9835	9846	9870	9886	9912	9936	9806	2.716%
2015	9972	9962	9972	9992	9975	10039	10037	10039	10065	10128	10092	10153	10035	2.335%
2016	10132	10181	10242	10279	10315	10337	10379	10385	10403	10434	10442	10530	10338	3.019%
2017	10542	10559	10667	10678	10692	10703	10789	10826	10823	10817	10870	10873	10737	3.856%
2018	10878	10889	10959										10909	5.520%

Base: 1913=100

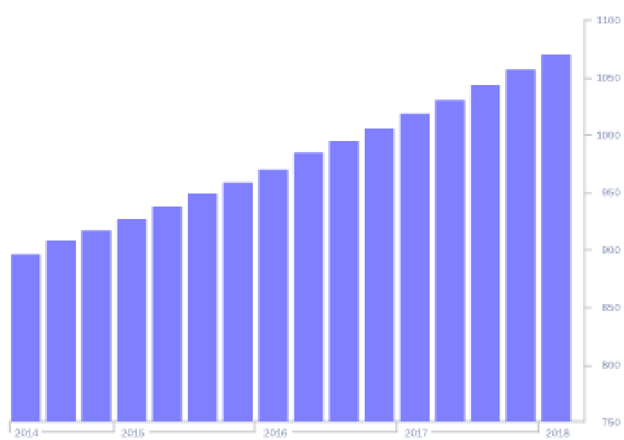
Table 2-3 Turner Construction Building Cost Index

Turner Building Cost Index

2018 First Quarter Forecast

"In a construction market that continues to show high levels of activity, the first quarter saw modest growth in raw material prices. Additionally, we are seeing a surge in steel driven by rising demand and limited offshore supply."

Attilio Rivetti
Vice President



Quarter	Index	Δ%
1st Quarter 2018	**1071**	**1.23**
4th Quarter 2017	1058	1.34
3rd Quarter 2017	1044	1.26
2nd Quarter 2017	1031	1.18

Year	Average Index	Δ%
2017	1038	5.0
2016	989	4.7
2015	943	4.5
2014	902	4.4
2013	864	4.1
2012	830	2.1
2011	812	1.6
2010	799	-4.0
2009	832	-8.4
2008	908	6.3
2007	854	7.7
2006	793	10.6
2005	717	9.5

The Turner Building Cost Index is determined by the following factors considered on a nationwide basis: labor rates and productivity, material prices and the competitive condition of the marketplace.

2.6 Design & Construction Contingency

Design contingencies are intended to account for three types of uncertainties which directly affect the estimated cost of a project as it advances from the planning stage through final design. These include: (1) unlisted items, (2) design and scope changes, and (3) cost estimating refinements. Based upon the apparent completeness of the listed items for the dam removal estimates, the design contingency was set at ±10 percent of the construction cost, which is a typical value for a the level of design presented in the Definite Plan, particularly given the fact that a large percentage of the demolition work is means and methods driven, as opposed to detailed design

This estimate of project costs includes a percentage allowance for construction contingencies to cover differences in actual and estimated quantities, unforeseeable difficulties at the site, changed site conditions, possible changes in plans, and other uncertainties during the construction period. The allowance is based on engineering judgment of the major pay items in the estimate, reliability of the data, adequacy of the estimated quantities, and general knowledge of the site conditions. KRRC used a value of ±20 percent of the construction cost for construction contingencies for the dam removal estimates, which is a typical value for this stage of project development.

KRRC applied the design and construction contingencies (total of 30%) discussed above as a percentage of the total construction cost, and added to the total estimate of project costs.

2.7 Monte Carlo Analysis

KRRC completed a Monte Carlo analysis to analyze uncertainties and risk, to be used as the basis for development of the MPL and MPH estimates.

The probabilistic range of costs for each estimate line item was determined with the use of '@Risk' Monte Carlo analysis software. The Monte Carlo analysis involves determining the impact and likelihood of occurrence of identified and quantified uncertainties and risks by running simulations to identify the range of possible outcomes for a number of scenarios - 10,000 scenarios in the case of this Project. A random sampling is performed in the simulation by using uncertain risk variable inputs to generate the range of outcomes with a confidence measure for each outcome.

Levels of probability are described from P1 to P100, where the number following the 'P' represents the percentage of most probable outcomes. For example, the P1 estimate amount will only cover the lowest 1% of the possible cost outcomes, whereas P100 will cover the maximum estimate amount determined from running the 10,000 scenarios. A P80 estimate covers the most likely final project cost in 80% of all scenarios, and is often used by the construction industry (Barreras 2011), including the USACE ("Per regulation and guidance, the P80 confidence level is the normal and accepted cost confidence level"), to calculate the amount of risk contingency to carry on a project.

Due to the unique nature of this Project and the KRRC, KRRC selected a conservative P90 to represent the MPH for the Project. The P90 estimate covers the most likely final project cost in 90% of all scenarios. KRRC selected a P10 to represent the MPL.

2.8 Ongoing Due Diligence

2.8.1 General

KRRC is undertaking additional due diligence on construction costs, measures to lower construction costs, and measures to manage construction risk. KRRC will complete additional engineering, select a design-build contractor, negotiate a construction agreement with the Contractor, establish a guaranteed maximum price for the work to be performed, implement its insurance programs, and establish the requirements for all bid bonds, payment bonds, and the performance bond. Many risks considered in the Monte Carlo analysis that deal with design and regulatory compliance will be mitigated or better understood when this process is completed, likely lowering the MPH significantly.

2.8.2 Independent Board of Consultants (BOC)

The FERC approved the BOC for the Lower Klamath Project on May 22, 2018. Among other things, FERC's letter of approval included a plan and schedule to obtain BOC review of the estimate of project costs and MPH estimates for the Full Removal alternative, adequacy of available funds for facilities removal, adequacy of the proposed contingency reserve, and adequacy of the proposed insurance and bonding arrangements. The five-member BOC includes Dan Hertel, PE (Engineering Solutions, LLC), James Borg, PE (D&H Concepts, LLC), Craig Findlay, PhD, PE, GE (Findlay Engineering, Inc.), Mary Louise Keefe, PhD (R2 Resource Consultants, Inc.), Ted Chant, PE (Chant Limited) and Robert Muncil, ARM (Cool Insurance Agency, Inc.). KRRC plans to convene the BOC on or before August 1, 2018.

The Definite Plan will be further informed by the review and recommendations of the BOC. KRRC will incorporate the recommendations of the BOC into a revised Definite Plan and this Appendix P will be updated accordingly.

Chapter 3: Cost Category Summaries

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3. COST CATEGORY SUMMARIES

The following sections provide detailed summaries of methods, assumptions and results of the estimate development for the various cost categories and subcategories.

3.1 Project Oversight

Project oversight and administration costs generally include costs associated with KRRC set-up and corporate insurance, management labor and travel, accounting and administrative support, project controls, contract management, BOC participation and facilitation, legal support, and outreach. Oversight costs exclude technical services, engineering, mitigation measures, construction contracting and land survey contracting. Table 3-1 summarizes estimated project costs for project oversight across the various project phases. Project oversight costs are the same for the Full and Partial Removal alternatives.

KRRC developed labor estimates for each activity using the latest understanding of management requirements in any given year, and applicable industry labor rates. KRRC developed ODCs using an understanding of actuals spent to date and requirements to continue management efforts into the future. ODCs include office space, travel, meals, postage, specialty reproduction, and vendor quotes for materials, supplies or services.

Table 3-1 Project Oversight Estimate Per Phase

Project Oversight	July 2016 - Jun 2017 (1 year)	July 2017 - Dec 2019 (2.5 years)	Jan 2020 - Jun 2022 (2.5 years)	Jul 2022 - Jun 2027 (5 years)	Total
Management Labor, ODCs & Insurance	$ 722,000	$ 3,653,000	$ 4,469,000	$ 832,000	$ 9,676,000
Accounting and Administation	$ 1,139,000	$ 2,777,000	$ 3,189,000	$ 811,000	$ 7,916,000
Contract Management and Controls	$ 1,110,000	$ 1,738,000	$ 373,000	$ 86,000	$ 3,307,000
Board of Consultants Process	$ -	$ 906,000	$ 494,000	$ -	$ 1,400,000
Legal Support	$ -	$ 3,052,000	$ 1,294,000	$ 241,000	$ 4,587,000
Outreach	$ 460,000	$ 1,102,000	$ 1,051,000	$ 75,000	$ 2,688,000
					$ 29,580,000

Note: Numbers based on 2018 dollars and exclude escalation

Table 3-2 summarizes average Full Time Equivalent (FTE) staffing for the various activities and line items. FTE numbers give a general understanding of how many full time staff may be working on each activity throughout each year or phase. KRRC calculated FTEs by dividing annual labor costs by the total working hours per year/phase and the average labor rate for each activity. FTE values for the BOC were calculated using working hours for a quarter of any given year, since BOC members are not full-time employees.

Project oversight FTEs are generally highest from 2019 through 2021, as the KRRC will be managing numerous contracts for engineering and construction of the various project components.

Table 3-2 Project Oversight Average FTEs Per Phase

Project Oversight	July 2016 - Jun 2017 (1 year)	July 2017 - Dec 2019 (2.5 years)	Jan 2020 - Jun 2022 (2.5 years)	Jul 2022 - Jun 2027 (5 years)
Management Labor, ODCs & Insurance	1.1	2.4	2.9	0.2
Accounting and Administation	3.4	3.3	3.8	0.5
Contract Management and Controls	4.4	2.8	0.6	0.0
Board of Consultants Process	-	2.3	1.2	-
Legal Support	-	1.7	0.7	0.1
Outreach	1.0	1.0	0.9	0.0

3.2 Environmental Compliance and Permitting

KRRC's plan for compliance with applicable laws and regulations is provided at Section 1.3 of the Definite Plan. Cost estimates reflected in this Appendix P are based upon implementation of that plan, and further assume that the license surrender order to be issued by the FERC will authorize implementation of the Definite Plan (as proposed) and will not impose any conditions that conflict with or are materially inconsistent with the Definite Plan. In additional to FERC 's surrender order (which will incorporate any conditions or requirements of the National Environmental Policy Act, California § 401 Clean Water Act Water Quality Certification, Oregon § 401 Clean Water Act Water Quality Certification, the Endangered Species Act, the Magnuson-Stevens Fishery Conservation and Management Act and the National Historic Preservation Act), the California § 401 Clean Water Act Water Quality Certification to be issued by the California State Water Resources Control Board will include and address any measures needed to comply with the CEQA. This report also assumes that implementation of the Definite Plan will require a Section 404 individual permit from the USACE, coverage under an National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permits for construction-related stormwater discharges to surface waters in California and Oregon, and various other state and local permits required by applicable law. Table 3-3 summarizes estimated environmental compliance and permitting costs across the applicable project years. Environmental compliance and permitting costs are the same for the Full and Partial Removal alternatives.

KRRC developed labor estimates for each activity using the latest understanding of management requirements in any given year, and applicable industry labor rates. KRRC developed ODCs using an understanding of actuals spent to date and requirements to continue permitting and associated field efforts into the future. ODCs include travel, meals, and vendor quotes for materials, supplies or services.

Table 3-4 summarizes average FTE staffing for the various activities and line items. FTE numbers give a general understanding of how many full time staff may be working on each activity throughout each year or phase. KRRC calculated FTEs by dividing annual labor costs by the total working hours per year and the average labor rate for each activity.

Environmental compliance and permitting FTEs are generally highest in 2018 while numerous biological surveys are being completed along with development of materials to support FERC.

Table 3-3 Environmental Compliance Estimate Per Year

Permitting Activity	2017	2018	2019	2020	2021	2022	Subtotal
Permitting Approach	$ 90,000	$ 50,000	$ -	$ -	$ -	$ -	$ 140,000
Biological Surveys	$ 50,000	$ 960,000	$ 800,000	$ -	$ -	$ -	$ 1,810,000
Federal Permitting	$ 468,000	$ 1,335,000	$ 643,000	$ 427,000	$ 427,000	$ 214,000	$ 3,514,000
State Permitting	$ 115,000	$ 573,000	$ 28,000	$ -	$ -	$ -	$ 716,000
Local Permitting	$ 66,000	$ 445,000	$ 28,000	$ -	$ -	$ -	$ 539,000
TOTAL	**$ 789,000**	**$ 3,363,000**	**$ 1,499,000**	**$ 427,000**	**$ 427,000**	**$ 214,000**	**$ 6,719,000**

Note: Numbers based on 2018 dollars and exclude escalation

Table 3-4 Environmental Compliance Average FTEs Per Year

Permitting Activity	2017	2018	2019	2020	2021	2022
Permitting Approach	0.3	0.1	-	-	-	-
Biological Surveys	0.0	3.7	3.0	-	-	-
Federal Permitting	1.4	4.0	1.9	1.3	1.3	0.6
State Permitting	0.3	1.7	0.1	-	-	-
Local Permitting	0.2	1.3	0.1	-	-	-

3.3 Engineering and Procurement

Engineering and procurement includes all activities required to complete the final project engineering designs and procure construction contractors to complete the construction. Section 2.2 describes the construction procurement approach for the Project, and is a basis for the procurement estimates provided herein.

The first step in the design process is to complete the necessary field work to obtain design data to support the design analyses and drawings. The following activities fall into this category:

- Topographic/Bathymetric Surveys: Obtain updated data of topographic and reservoir bathymetric conditions at the Project
- Geotechnical Investigations: Obtain geologic information to evaluate reservoir rim stability and other geologic conditions to support design components
- Hazardous Material Investigation: Complete phase 1 hazardous material assessments for existing hydropower and other pertinent project features
- Biological Reconnaissance: Obtain initial understanding of existing biological conditions that may affect proposed design layout
- Engineering Reconnaissance: Obtain understanding of existing site facilities and infrastructure to inform design and demolition activities
- Groundwater Monitoring: Obtain groundwater well data adjacent to reservoirs to assess potential impacts associated with reservoir drawdown

The next step in the design process is to refine the preliminary designs based on the latest field data and input from regulatory and other stakeholders. This refined design will serve as the basis for environmental and regulatory reviews. Primary project components are listed below, and described in detail in the Definite Plan.

- Dam & hydropower demolition
- Reservoir restoration
- Road and bridge improvements
- Relocation of the City of Yreka's pipeline across Iron Gate Reservoir and associated diversion facility improvements
- Demolition [and replacement] of various recreation facilities adjacent to the reservoirs
- Recreation improvements
- Downstream flood control improvements
- Groundwater system improvements
- Fish hatchery modification and improvements (not included in estimate since funded separately by PacifiCorp)
- Cultural resource measures (to protect identified historic, cultural, and tribal resources)
- Groundwater improvements (well improvements adjacent to the reservoirs, if needed)

After preliminary design, the final engineering plans and specifications are developed. As described in Section 2.2, the PDB will complete final design of the large dam removal work package (access road improvements, dam modifications, access road improvements, dam and hydropower removal, and reservoir restoration), while final design of other components may be completed by a separate engineering entity.

The final activity for the engineering team(s) will be to provide engineering support during construction for quality control purposes.

Table 3-5 summarizes estimated engineering and procurement costs across the applicable project years. Engineering and procurement costs are the same for the Full and Partial Removal alternatives.

KRRC developed labor estimates for each activity using the latest understanding of engineering and procurement requirements in any given year, and applicable industry labor rates. KRRC developed ODCs using an understanding of actuals spent to date and requirements to continue engineering and procurement efforts into the future. ODCs include travel, meals, and vendor quotes for materials, supplies or services.

Table 3-5 Engineering & Procurement Estimate Per Year

Engineering & Procurement Activity	2017	2018	2019	2020	2021	2022	Subtotal
Design Data	$ 537,000	$ 1,455,000	$ -	$ -	$ -	$ -	$ 1,992,000
Preliminary Design	$ 1,909,000	$ 1,796,000	$ 125,000	$ 25,000	$ 25,000	$ -	$ 3,880,000
Final Design & Eng. Construction Support	$ -	$ 100,000	$ 6,120,000	$ 1,256,000	$ 1,094,000	$ 178,000	$ 8,748,000
Procurement	$ 37,000	$ 524,000	$ 348,000	$ 103,000	$ -	$ -	$ 1,012,000
TOTAL	**$ 2,483,000**	**$ 3,875,000**	**$ 6,593,000**	**$ 1,384,000**	**$ 1,119,000**	**$ 178,000**	**$ 15,632,000**

Note: Numbers based on 2018 dollars and exclude escalation

Table 3-6 summarizes average FTE staffing for the various activities and line items. FTE numbers give a general understanding of how many full time staff may be working on each activity throughout each year or phase. KRRC calculated FTEs by dividing annual labor costs by the total working hours per year and the average labor rate for each activity.

FTEs are highest for engineering design in 2019, when multiple engineering design teams will be developing final design packages for the various project components.

Table 3-6 Engineering & Procurement FTEs Per Year

Permitting Activity	2017	2018	2019	2020	2021	2022
Design Data	1.6	4.4	-	-	-	-
Preliminary Design	5.6	5.3	0.3	-	-	-
Final Design & Eng. Construction Support	0.0	0.3	18.3	3.8	3.3	0.5
Procurement	0.1	1.3	1.3	-	-	-

3.4 Construction Management

The estimate and proposed construction management (CM) approach for the Project is based on the information available at the time of the development of this analysis and on the assumption that the dam removal construction will be performed under a PDB contract and that other project components may be constructed through the implementation of conventional contracting methods (e.g. design-bid-build (DBB)).

KRRC estimated construction management to support all construction commencing mobilization in early 2020, dam modifications and commencement of work on construction of other components such as access road and bridge work, waterline relocation and downstream flood control improvements. Support continues through reservoir drawdowns into 2021 and ramps-up in the second year of construction for the parallel demolition of dams, and reservoir restoration.

The proposed CM approach is based on the assumption that two construction management offices located at the Iron Gate and Copco areas will be established for 2020, with a third office established in 2021 for the J.C. Boyle area. The estimate also reflects the traveling constraints between each of the sites under the prospective contracts.

The principal construction management office will be located near the existing Iron Gate dam, where the Senior Construction Manager is located. There will be one Project Control Manager, one Scheduler and one Field Contract Administrator to support the construction, who will likely be located in the Iron Gate dam offices. KRRC considers establishing the principal office at this location advantageous as the excavation work at Iron Gate is one of the more labor-intensive critical path aspects to the construction. Secondary construction management offices will each be headed up by a separate Construction Manager. Costs for these facilities are included in the construction Contractor's general conditions.

Third-party inspection oversight on the PDB is an important factor in construction management of a sensitive high-visibility project such as this. Inspectors will provide oversight of Contractors' safety, quality, environmental, cultural and scope compliance. They will also make timely observations of construction progress and conditions, to support identification of potential productivity issues, and support avoidance and evaluation of potential change work.

KRRC assumed that some construction work may occur outside normal working hours, and is likely required for excavation of Iron Gate dam and demolition of Copco No. 1 dam. A second shift Dam Removal Inspector has been included for 7 months to allow for this likelihood.

A Safety Manager and Quality Manager are included at 40 hours/month each to provide audits of contractor and construction management practices against established procedures and standards.

KRRC calculated labor costs based on applicable industry contract rates where available and escalated them at 3% annually. KRRC based all labor costs on a 40 hour work week, except for inspector labor costs which are based on a 50 hour work week. An allowance of 20% on labor has been included to cover ODCs including travel, lodging and other remuneration associated with the remote sites.

The estimated project cost assumes that cultural resources and environmental monitoring will be required. These costs are not captured in the CM section, but are included elsewhere in this estimate.

Table 3-7 summarizes estimated construction management costs on a per-year basis, per labor category and shows ODCs included in the estimate. Construction management costs are the same for the Full and Partial Removal alternatives.

Table 3-8 show staff included in this estimate, where 1.00 = one FTE for one month.

Table 3-7 Construction Management Estimate Per Year

Construction Management Staff	Hrs/ week	2020	2021	2022	Total
Sr. Construction Manager (1 person)	40	$ 441,852	$ 508,019	$ 43,605	$ 993,477
Construction Manager (2 people)	40	$ 410,262	$ 916,948	$ 80,378	$ 1,407,588
Administrative Assistant (3 people at peak)	40	$ 277,025	$ 482,882	$ 45,214	$ 805,121
Field Contract Administration (1 person)	40	$ 283,162	$ 327,748	$ 28,132	$ 639,042
Lead Dam Removal Inspector (3 people at peak)	50	$ -	$ 1,090,055	$ -	$ 1,090,055
Second Shift Dam Removal Inspector (1 person)	50	$ -	$ 305,215	$ -	$ 305,215
Yreka Water Supply Inspector (0.5 person)	50	$ 148,163	$ -	$ -	$ 148,163
Rec Improvements Inspector (0.5 person)	50	$ 148,163	$ 174,409	$ -	$ 322,572
Flood Improvements Inspector (0.5 person)	50	$ 148,163	$ 174,409	$ -	$ 322,572
Bridges and Roads Inspector (1 person)	50	$ 370,407	$ 436,022	$ 37,425	$ 843,854
Specialty Inspectors (1 person)	50	$ -	$ 339,128	$ -	$ 339,128
Scheduler (1 person)	40	$ 282,846	$ 327,748	$ 28,132	$ 638,726
Project Control Engineer (1 person)	40	$ 282,846	$ 327,748	$ 28,132	$ 638,726
Safety Manager (0.25 person)	40	$ 79,485	$ 89,312	$ 7,666	$ 176,463
Quality Manager (0.25 person)	40	$ 79,485	$ 89,312	$ 7,666	$ 176,463
ODCs at 20%	-	$ 590,372	$ 1,117,791	$ 61,270	$ 1,769,433
TOTAL		$ 3,542,231	$ 6,706,749	$ 367,620	$ 10,616,599

Note: Numbers based on 2018 dollars and exclude escalation

Table 3-8 Construction Management FTEs Per Month

	2020												2021												2022		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
CONSTRUCTION MANAGEMENT																											
Combined Construction Management																											
Sr. Construction Manager	0.25	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-
Administrative Assistant	-	0.50	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.50	2.50	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	-	-
Field Contract Administration	-	0.67	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-
Lead Dam Removal Inspector	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	-	-	-
Second Shift Dam Removal Inspector	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-	-	-	-
Yreka Water Supply Inspector	-	0.25	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rec Improvements Inspector	-	0.25	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-	-	-
Flood Improvements Inspector	-	0.25	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-	-	-
Specialty Inspectors	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-	-
Scheduler	-	0.67	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-
Project Control Engineer	-	0.67	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-
Safety Manager	-	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	-	-
Quality Manager	-	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	-	-
ODCs at 20%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	2020												2021												2022		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
CONSTRUCTION MANAGEMENT																											
Iron Gate																											
Sr. Construction Manager	0.25	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0		
Administrative Assistant	-	0.25	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0		
Field Contract Administration	-	0.17	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Lead Dam Removal Inspector	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-		
Second Shift Dam Removal Inspector	-	-	-	-	-	-	-	-	-	-	-	-	-	-		1.00	1.00	1.00	1.00	1.00	1.00	1.00			-		
Yreka Water Supply Inspector	-	0.25	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-	-	-	-	-	-	-	-	-	-	-	-	-		
Rec Improvements Inspector	-	0.25	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-		
Flood Improvements Inspector	-	0.25	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	-		
Specialty Inspectors	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	-		
Scheduler	-	0.17	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Project Control Engineer	-	0.17	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Safety Manager	-	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.1		
Quality Manager	-	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.1		

Table 3-8 Construction Management FTEs Per Month (continued)

	2020												2021												2022		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
CONSTRUCTION MANAGEMENT																											
Copco1 & 2																											
Construction Manager	0.33	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0		
Administrative Assistant	-	0.25	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0		
Field Contract Administration	-	0.17	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Lead Dam Removal Inspector	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-		
Bridges and Road Improvements	-	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0		
Specialty Inspectors	-	-	-	-	-	-	-	-	-	-	-	-			0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	-		
Scheduler	-	0.17	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Project Control Engineer	-	0.17	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Safety Manager	-	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.1		
Quality Manager	-	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.1		

	2020												2021												2022		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
CONSTRUCTION MANAGEMENT																											
JC Boyle																											
Construction Manager	-	-	-	-	-	-	-	-	-	-	-	-	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0		
Administrative Assistant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.50	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0		
Field Contract Administration	-	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Lead Dam Removal Inspector	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-		
Specialty Inspectors	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	-		
Scheduler	-	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Project Control Engineer	-	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.3		
Safety Manager	-	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.1		
Quality Manager	-	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.1		

3.5 Construction

3.5.1 Dam Removal

The dam removal scope for Full and Partial Dam Removal alternatives is defined in Section 5 of the Definite Plan and was used as the basis for this estimate. Estimates were developed using the methods and schedule constraints summarized in Section 2.3 of this report. Escalation was applied per Section 2.5.

Pertinent assumptions from the Definite Plan are as follows:

- KRRC confirmed or updated quantities where new information was available, and as described in Section 5 of the Definite Plan.
- Estimate and schedule assumes that a second shift will be required for Copco No. 1 and Iron Gate demolition. KRRC assumed two 10-hour shifts, 5 days a week.
- Estimate and schedule assumes that work days are 8 hours per day, 6 days a week for Copco No. 2 and J.C. Boyle demolition.
- All concrete demolition debris will be hauled to onsite disposal area as described in more detail in Section 5 of the Definite Plan for Decommissioning (KRRC 2018).
- All earth work material from excavation activities will be hauled to onsite disposal area as described in more detail in Section 5 of the Definite Plan for Decommissioning (KRRC 2018).
- All concrete and earthwork demolition material will be processed during demolition activity and there is no process equipment (crusher, screener, and stacker) operated at disposal areas.
- One general PDB will be used to manage the entire design build process, but subcontractors will be used for certain specialized activities.

3.5.2 Reservoir Earthwork & Engineered Structures

This estimate assumes that a small percentage of sediment that remains in the reservoirs after drawdown will be mechanically excavated and placed elsewhere in the proposed floodplain area. Earthwork excavation volumes within the reservoir are based on surface models from historical site surveys compared to recently collected bathymetric data. KRRC developed labor rates, equipment rates, and materials costs from a combination of actual costs from past similar projects and RS Means Heavy Civil publication.

This estimate assumes the following:

- Earth excavation and subsequent fill (or disposal) will happen at the same time so that material is handled only once and placed on-site in the final location with minor grading and compaction. KRRC based volume estimates on neat line quantities using digital surface models.
- All excavated material is suitable for in-water disposal and will be disposed of on-site.

- Estimates include equipment and road access into site, assuming 3,000 linear feet (LF) on center (OC) or 0.56 miles per site (6 sites).

KRRC proposes elements for bank stability and channel fringe complexity, and will include a process-based restoration and velocity variations along bank line by adding large wood complexity for resting zone, feeding seams, cover and velocity refugia. KRRC based restoration areas and treatments on expected conditions after drawdown and may change based on actual conditions.

Areas identified for reservoir earthwork activities and engineered stability elements are described and shown in plan in Appendix H, Restoration Plan of the Definite Plan.

3.5.3 Restoration

Restoration activities can be broken into three primary categories: (1) Earthwork/engineered improvements (Section 3.5.2), (2) pre-drawdown activities, and (3) post drawdown activities. The following text summarizes key assumptions that are pertinent to the estimate development for the second two categories. A full description of these components can be found in Appendix H, Restoration Plan of the Definite Plan.

Pre-drawdown activities include seed collection, seed propagation and weed eradication, as further summarized below. In addition to the work described below, KRRC assumes completion of an RFP process to select a contractor or vendor for each activity.

1. **Seed Collection:** The main component of the revegetation process will be locally eco-typic seed of native plants for four different planting zones (bank wetland, bank riparian, floodplain riparian, and upland) based on hydrology. The seed will preserve the genetic integrity of the site and provide species and genetics best suited for this specific landscape. Collection of locally eco-typic seed subsequently grown by commercial growers to produce large amounts of seed or plant material will require advanced planning and will be implemented during the pre-dam removal period. To produce 50,000 lbs of pure live seed (PLS) in each of the four growing years before the 2022 fall season (totaling 200,000 lbs.), it is assumed that 3-7 lbs. of PLS/acre of wild collected seed will produce 2,000 LBS PLS/ acre. KRRC based this estimate upon propagation rate quotes obtained from BFI Native seed and Pacific Coast Seed. Conservatively, the higher seeding rate of 7 lbs PLS/acre is assumed to be planted on 25 acres at the seed propagation farm totaling the 175 lbs PLS of seed needed each year and resulting in the expected 50,000 lbs PLS if 2,000 lbs PLS is produced per acre on 25 acres. The cost of collecting 1 pound of wild seed ranges from low $1,000 to high $1,800. The seed must then be cleaned, stored in climate control warehouses and in some cases pre-treated. Seed pre-treatment may include scarification, stratification, imbibition, and others. Wild collected seed will be substantially more expensive than propagated seed due to additional cleaning costs.
2. **Seed Propagation:** In order reach the goal of 200,000 lbs. of PLS over 4 years, 25 acres of land will need to be rented to propagate collected seed (with an assumed minimal yield of 2,000 lbs PLS/acre) to produce 50,000 lbs per year. KRRC based the yield and other unit cost estimates on

information received from BFI, J Herbert Stone nursery, Pacific Coast Seed and the local forest service office.

3. **Weed Eradication:** The objective will be to implement a combination of weed control techniques that minimize the extent of environmental degradation and reduce the impact of chemical inputs on humans and non-target organisms. To identify the populations of existing invasive species, a field survey will be conducted at the site, geo-locating all invasive species. Assuming 100% of the project area outside of the existing reservoirs needs to be surveyed, it will take approximately 900 hours to survey the area. For a Scientist and Principal Scientist, the estimated cost is $135,000 plus approximately $2,247 for gas & mileage and $21,000 for per diems and accommodations. In the years before drawdown, KRRC assumed that 30% of the site above the water line of the reservoir (85- acres) will require invasive species eradication. KRRC based this percentage on estimates from surveys performed in the fall of 2017. Once drawdown occurs, the acreage of the site with vegetation will increase along with the need for invasive species control. For two years after drawdown, KRRC assumed 300 acres to potentially require weed eradication treatment.

Post-drawdown activities include pioneer seeding, pole cutting and salvaged plant collection, revegetation in each planting zone, followed by establishment period and long-term maintenance. Each activity is further summarized below:

1. **Pioneer Seeding:** Establishing a pioneer crop on the site, soon after drawdown of the reservoirs, is essential to preventing erosion, planting inhospitable moist substrate, preventing invasive species from establishing at the site and building up soil biota and structure. The pioneer seed mix is intended to take advantage of less expensive native seed. The seed generated in large amounts during propagation (overstock), and sterile non-native seed (sterile wheat and Regreen) that can readily establish in the sediment and will be less of a risk if it is washed out due to spring flooding or if it freezes in the early months of the year. Once river and soil conditions have stabilized, a fall broadcast seeding will be applied including locally ecotypic, native and diverse seed stock for each planting zone. Broadcast aerial seeding will be performed from helicopter(s), and is a very cost-efficient method of application. KRRC based pricing on an estimate from Ben Timberland (Timberland Helicopters, Inc, Ashland, OR) on the hourly rate of $950/hr. at the rate at which the operator can distribute the seed. KRRC assumed that the seed weighs on average 14 lbs/cubic foot, with a seed bucket that holds 27 cubic feet of seed, 12 minutes is assumed for each bucket. For distributing 100 lbs. PLS per acre, KRRC estimated to be 140 hours totaling 133,000 for a medium cost. The cost of seed per pound is based on cost for readily available seed from nurseries we anticipate working within the Project (i.e., California brome = $8-9 per PLS).
2. **Pole Cuttings and Salvaged Plants:** The establishment of habitat will greatly accelerate with the installation of pole cuttings, as well as transplantation of salvaged plants. These plants will also help prevent erosion and add species diversity to the site. KRRC's contractor will collect pole cuttings and potentially store them, short-term, prior to installation. 'Salvaged plants' will be transplanted on site; therefore their costs are not associated with contract growing and nursery care. KRRC assumed that the contractor will absorb the cost of an expected 30% mortality rate of the pole cuttings. KRRC's contractor will collect pole cuttings from areas surrounding the site. In order to increase the number of pole cuttings available, in the year prior to drawdown, contractors will selectively cut back pole

cutting species marked for plant salvage. This will promote an ample supply of young growth that can be harvested as needed the following year. It is assumed that the harvest and installation will be simultaneous, limiting the need for storage off-site. The number of pole cuttings allotted will vary by zone. Each 100 square foot area, for both the bank riparian and bank wetland zones, will include five pole cuttings. For the floodplain riparian zone, each 100 square foot area will contain one pole cutting.

3. **Revegetation**

   a) Emergent Wetland Planting Zone: Revegetation for emergent wetlands will be installed instream along the river's edge. This vegetation will consist of 100% salvaged plants, taken from the rim of the reservoirs. During the first year, KRRC assumes salvaged plants at 20 LF OC along the edges of the river. The following spring, once the plants have established, KRRC's contractor will harvest propagules from installed salvaged plants and will then be planted at 10 LF OC between the plants from the prior year. KRRC based cost estimates for plant layout per acre on estimates from Caltrans and RS Means.

   b) Bank Wetland Planting Zone: Bank wetland zones will be delineated as areas suitable for plant growth approximately between the base flow and 2-year flood event water surface elevations (Q2) of the Klamath River. These areas will consist of salvaged plants and pole cuttings. KRRC expects 50 percent of this area to be restored. KRRC's contractor will transplant salvaged plants to this zone from the existing reservoir edge. KRRC based cost estimates for this work on RS Means and Caltrans data for the operation of a backhoe with a bucket and the plantings for pole cuttings. KRRC's contractor will install pole cuttings in this initial stage of planting in the spring after drawdown. KRRC's contractor will perform plant layout for all plants by the Contractor's crews marking each planting spot with a pinflag for an overall review by a restoration ecologist. KRRC's contractor will aerial seed the pioneer crop in all zones early in the drawdown year creating fast-growing erosion control before the river stabilizes. Once the pioneer crop has grown, KRRC's contractor will either roll or mow it to help open the soil to sunlight and create a habitat for the fall broadcasting of ecotypic native seed. In the early spring of the following year, KRRC's contractor will layout and install one pole cutting per 100 square foot (SF).

   c) Bank Riparian Planting Zone: The Bank Riparian Zone will extend approximately from the 2-year (Q2) to the 25-year (Q25) flood water surface elevations (Q-lines) of the Klamath River. KRRC expects 50 percent of this area to be available for restoration. It will be the most critical zone for rapid re-establishment of riparian habitat, short-term stability of the channel and banks, and for long-term establishment of an important transitional area between the riverine features and floodplain habitat areas. Planting densities within the riparian-bank areas will be variable, however, the substantial density of initial planting will be important to prevent invasion by reed canary grass (*Phalaris arundinacea*), a highly invasive non-native hybrid that is widespread around the reservoirs. The Bank Riparian zone will have a similar treatment to the Bank Wetland; with the same plant material and spacing. After drawdown, KRRC's contractor will transplant the plants from the rim of the reservoir to the river's edge. In the pioneer seeding process, KRRC's contractor will mainly apply mycorrhiza, with the seed in this area. In the fall, the area will be broadcast seeded with ecotypic zone selected seed. KRRC's contractor will install an additional pole cutting in the following spring. Selected areas will be fenced off to deter deer predation and to serve as a seed bank to areas without fencing. Costs for fencing and installation and based on Caltrans data.

d) Floodplain Riparian Planting Zone: Floodplain riparian zones will be delineated as those areas suitable for revegetation that occur approximately between the 25-year (Q25) and 100-year (Q100) flood water surface elevations of the Klamath River. The Riparian Floodplain Planting Zone will be planted similarly to the Bank Riparian Planting Zone; however, the plant densities will decrease, producing a decrease in plant layout costs for this zone. For each 100 SF area, there will be one pole cutting and one seed plant installation in the second year. The cost of Construction/Installation maintenance decreases slightly from Bank Riparian area; it will have an18-month duration, until Plant Establishment. This section also includes emergency overhead irrigation in the high price estimate. KRRC based unit prices for this on a quote from Rain for Rent for the entire site. Costs include $60k for setup and design, $40k/month rent and $30k to disassemble the irrigation system, and a 5-month rental ($320K) and an uncertainty factor of 2 for 1,790 acres (costs pro-rated from the estimate for the Project). KRRC based costs for this on a quote from Rain for Rent that includes design and rental of all equipment.

e) Uplands below Rocky Wake Zone: The area between the upper edge of the Riparian Floodplain Planting Zone and the lower edge of the Rocky Wake Planting Zone constitutes the Uplands below the Rocky Wake Planting Zone. This area is the only formerly submerged area where upland vegetation will grow on sedimentary substrate. KRRC expects 50 percent of this area to be restored. The restoration process will be the same as for the planting zones below; mycorrhizal inoculant will be in the pioneer seed mix in the spring, broadcast seeding of the native ecotypic seed will be conducted in the fall 2021, and a spring 2022 with deer fence, emergency irrigation, and construction/installation maintenance. However, plantings in this zone will consist of four woody plants per 100 SF. Species will include acorns, juniper berries, pine nuts fir and various shrubs. KRRC's contractor will install these plants with cocoon irrigation planters that will irrigate the plants and slowly deteriorate as the plant becomes self-sustainable. KRRC's contractor will use an auger to create a planting pit approximately 2 feet in diameter and 1 foot deep. KRRC based installation costs upon Saylor's installation cost.

f) Rocky Wake Planting Zone: The Rocky Wake Planting Zone is the area of wake and wave action erosion around the edge of the existing reservoirs. Fluctuations of water level and wave action in the reservoir has eroded soil in a band or 'bathtub ring' leaving exposed rocky substrate, bedrock, areas that lack in vegetation. KRRC assumed that only 20% of this area is feasible to restore. Soil amendments consisting of mycorrhizal inoculant will be added at the time of seeding. After the pioneer crop is broadcast seeded in the spring, the grown vegetation will be mowed or rolled in preparation for the fall broadcast seeding of the ecotypic seed. The plant selection and densities will be the same as the uplands below rocky wake zone. KRRC's contractor will place deer fence in selected areas within the zone to create areas free of deer predation. These areas will serve as seed banks for the rest of the site if predation becomes severe. Additionally, overhead irrigation is included in the high estimation cost.

g) Disturbed Uplands Planting Zone: The Disturbed Uplands Planting Zone will consist of the existing developed areas proposed for demolition and recreational areas that will be removed after drawdown occurs. The revegetation schedule remains the same. However, the initial soil preparation may vary. These areas will most likely have highly compacted areas due to the existence of concrete or vehicular traffic on gravel areas. In these areas, it is assumed that 75% of the recreation area will need de-compaction. KRRC's contractor will cross rip compacted areas (before fall seeding) to a depth of 24 inches to loosen the soil and prepare it for seeding and planting. After de-compaction, KRRC expects this area to have healthy viable soils, so it is assumed that 90% of the area will be restored.

h) Upland Stockpiles Planting Zone: Upland Stockpiles Planting Zones include areas where materials from the dam removal will be deposited. The topsoil in these areas will be heavily compacted. The revegetation process for these areas will be the same as for the Disturbed Uplands Planting Zone, however, 100% of this zone will have to be de-compacted, slightly increasing it's per acre cost. KRRC based estimates for this treatment on RS Means data for $110 to rip soil with a bulldozer.

i) Undisturbed Uplands Planting Zone: The Undisturbed Uplands Planting Zone will consist of areas above the Rocky Wake Zone that may be only minimally disturbed by the eradication of invasive exotic species. These areas will go through active weed removal for at least 3 years before drawdown. KRRC's contractor will reseed potential bare and disturbed patches resulting from invasive species eradication with a native upland seed mix via broadcasting. The majority of these areas will have existing native vegetation and only 30% is expected to need restoration.

4. **Establishment Period Maintenance**: KRRC assumes that the Project will be monitored and maintained for 5 consecutive years. Maintenance and monitoring, during the first plant establishment year is crucial to achieving revegetation performance criteria established in the revegetation plan and agreed to with regulatory agencies. The quality of establishment maintenance and monitoring will determine whether the project area will be taken over by invasive exotics or by heathy native plants. KRRC's contractor will perform monthly establishment maintenance and monitoring from November 1 through April 1 and bi-weekly the rest of the year, totaling approximately 20 visits during this critical first year. During each visit, botanists will be surveying the project area for a number of performance criteria related objectives. Plant species diversity and cover, the growth and health of woody vegetation, acres of wetlands, and noxious weed coverage may be monitored. The location of individual species or areas of species will be geo-located. Other monitoring items may include the minimum coverage of woody shrubs and trees in key restoration areas. KRRC based the labor rate for monitoring on the mean hourly rate of a Scientist and Principal Scientist, resulting in a probable cost of $139,884 for each visit, equaling about 932 hours of monitoring surveys at a rate of 2.5 acre/hour. Maintenance will follow monitoring, and may include re-seeding/re-planting of native vegetation (as necessary), invasive plant management, herbivore control, irrigation maintenance and other activities as situations arise (e.g., implementation of erosion repairs). KRRC based rates for these items roughly on quoted rates for invasive species removal in the area ($3,000/acre).
5. **Long-term Maintenance:** After Establishment Period Maintenance and Monitoring, long-term monitoring will continue for 4 years. For monitoring, the cost per visit and the rate of surveying is consistent throughout at 2.5 acres/hour (assuming the mean hourly rate of a Scientist and Principal Scientist). Tasks outlined in the Establishment Maintenance activity will also continue throughout this period. However, KRRC anticipates both the number of visits and maintenance needs (i.e. hourly

cost) to decrease. In Year Two (2024), there are bi-monthly surveys from November through April and monthly surveys the rest of the year, totaling 10 visits. In the second year, the number of acres in need of treatment is 80% of the total acreage, and cost of maintenance is 80% of the establishment monitoring. In Year Three (2025) there are 5 visits, one visit between November and April and bi-monthly the rest of the year. The number of acres and the cost of maintenance are 60% of the total acreage and cost of the establishment maintenance. In Year Four (2026) there are 4 visits and the acres and cost decrease to 40%. And in Year Five (2027), the final year, visits are down to twice a year and the percentage of land in need of maintenance and the rate cost is down to 20%. At this point the site should be close to natural conditions and meet the performance criteria for the upland, riparian floodplain, riparian bank, and wetland zones, as well as for invasive exotic plant presence.

3.5.4 Yreka Water Line Replacement

KRRC assumed for development of this estimate that an underground pipeline will be constructed to relocate the City of Yreka's water supply line currently crossing Iron Gate reservoir. This relocation option is discussed in detail in Section 7.5 of the Definite Plan.

The scope for replacing the Yreka Water Line will involve installation of two micro-tunneling pits on either side of the Klamath River. Once these pits are fully excavated and shored, micro tunneling equipment will install a 36" steel casing below the river bed. Once the casing is installed, a new 24-inch waterline will be installed to take the place of the river crossing section of the existing water line. On either side of the Klamath River, the new pipe will be installed using an open cut excavation method. Once the waterline is completely installed, tested and active, the micro tunneling pits and the open excavation are to be backfilled with existing material. Once the backfill operation is complete, the existing waterline will be removed and recycled.

The cost estimate for the Yreka Water Line Replacement was developed using the RS Means database with a city cost index adjustment of Redding, California. Crew output for each operation was adjusted to account for access, location, and construction operation. KRRC assumed that a pile and lagging wall will be used to shore micro tunneling pits and it will be installed simultaneously with the excavation operation.

3.5.5 Transportation Improvements

This section describes the proposed road improvements and maintenance activities that are the basis for the estimate of project costs. It is based on design information provided in Sections 5 and 7.4 of the Definite Plan. Several road, intersection, structure and culvert improvements are proposed as part of the Project to:

- Facilitate access for project-related vehicles and equipment associated with dam removal
- Provide safety measures for both public and project roads used during the dam removals
- Return roads used by project-related vehicles to the respective owners and users in an acceptable state, restoring any reduction in function attributed to the Project

The improvements will be implemented at various phases throughout the Project. Some will require completion prior to the dam removals (related to construction access), and others will be contingent on a future assessment of road elements once reservoir drawdown or hauling activities are complete (maintenance activities). There will also be some ongoing activities throughout the Project to maintain roads heavily trafficked by project construction vehicles.

Table 3-9 provides a summary of all pertinent road segments, bridges, and culverts and the associated improvements or maintenance. Table 3-10 summarizes maintenance and rehabilitation cost assumptions associated with roads being used for construction access. Section references within the table are to the sections within the Definite Plan.

Table 3-9 Transportation Improvements

Location	Improvements (Section References to Definite Plan (KRRC 2018))	Purpose		
		Construction Access	Drawdown Related	Maintenance/ Rehabilitation
J.C. Boyle				
The Dalles California Highway (US97)	• Pavement rehabilitation unlikely during or post-Project (Section 5.2.2)			X
Green Springs Highway (OR66)	• Pavement rehabilitation unlikely during or post-Project (Section 5.2.2)			X
Keno Worden Road	• Pavement rehabilitation unlikely during or post-Project (Section 5.2.2)			X
Topsy Grade Road	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Culvert at Unnamed Creek	• Potential sediment removal and downstream erosion protection (Section 7.4.3)		X	
J.C. Boyle Dam Access Road from OR66	• Re-grading uneven or rutted areas (Section 5.2.2)	X		
Junction of OR66 and J.C. Boyle Dam Access Road	• Intersection widening (Section 5.2.2) • Tree removal (Section 5.2.2) • Signage (Section 5.2.2)	X		
Timber Bridge	• Remove (Section 5.2.2)	X		
Power Canal Access Road	• Periodic roadway maintenance grading during construction (Section 5.2.2)	X		
J.C. Boyle Disposal Access Road	• Re-grading (Section 5.2.2) • Minor widening (Section 5.2.2)	X		
Copco and Iron Gate				
Copco Road (I-5 to Ager Road)	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Copco Road (Ager Road to Lakeview Road)	• Potential pavement rehabilitation during or post-Project (Section 5.2.2)			X
Dry Creek Bridge	• Temporary bridge for construction access during Project (Section 5.2.2)	X		

Location	Improvements (Section References to Definite Plan (KRRC 2018))	Purpose		
		Construction Access	Drawdown Related	Maintenance/ Rehabilitation
Copco Road (Lakeview Road to Daggett Road)	• Roadway maintenance during construction (Section 5.2.2) • Potential pavement rehabilitation during or post-Project (Section 5.2.2)	X		X
Unnamed Culverts between Brush Creek and Scotch Creek	• Potential rehabilitation or replacement post-construction (Section 7.4.3)			X
Scotch Creek Culvert	• Replace (Section 7.4.3)		X	
Camp Creek Culvert	• Replace with bridge (Section 7.4.3)		X	
Jenny Creek Bridge	• Replace (Section 7.4.3)		X	
Copco Road (Daggett Road to Copco Access Road)	• Potential road surface maintenance during or post-Project (Section 5.2.2)			X
Fall Creek Bridge	• Replace (Section 5.2.2)	X		
Copco Road (Copco Access Road to Copco Road Bridge)	• Potential road surface maintenance during or post-Project (Section 5.2.2)			X
Beaver Creek and E.F. Beaver Creek Culverts	• Potential erosion protection (Section 7.4.3)		X	
Raymond Gulch Culvert	• Potential erosion protection (Section 7.4.3)		X	
Copco Road Bridge	• Potential abutment erosion protection (Section 7.4.3)		X	
Copco Access Road	• Clear, grub and regrade (Section 5.2.2) • Minor widening into hillside if possible (Section 5.2.2) • Remove after construction is complete and restore area to native vegetation	X		
Copco Cove Access	• Minor works to enable barge mobilization (Section 5.2.2)	X		
Culverts at Unnamed Creeks (Copco Lake)	• Potential erosion protection (Section 7.4.3)		X	

Location	Improvements (Section References to Definite Plan (KRRC 2018))	Purpose		
		Construction Access	Drawdown Related	Maintenance/ Rehabilitation
Ager Beswick Road	• None (Section 5.2.2)			
Mallard Cove Boat Ramp Access	• Minor works to enable barge mobilization (Section 5.2.2)	X		
Daggett Road	• Minor grading improvements (Section 5.2.2) • Potential road surface maintenance during and post-Project (Section 5.2.2)	X		X
Daggett Road Bridge	• Replace (Section 5.2.2)	X		
Lakeview Road (Copco Road to Iron Gate disposal site)	• Potential road surface maintenance during and post-Project (Section 5.2.2)			X
Lakeview Road Bridge	• Replace (Section 5.2.2)	X		
Iron Gate Powerhouse Access Road	• Signage • Potential road surface maintenance during construction (Section 5.2.2) • Remove after construction is complete and restore area to native vegetation (Section 5.2.2)	X		X
Iron Gate Left Abutment Access Road	• Remove after construction is complete and restore area to native vegetation (Section 5.2.2)	X		
Iron Gate Upstream Left Abutment Access Road	• Remove after construction is complete and restore area to native vegetation (Section 5.2.2)	X		
Other Locations	•			
Pedestrian Bridge #1	• Will likely need to be removed by KRRC (Section 7.2). Cost estimate includes demolition only.			X
Pedestrian Bridge #2	• Evaluation will be performed by KRRC to determine whether removal or replacement will be required (Section 7.2). Cost estimate includes demolition only.			X

Table 3-10 Road Maintenance Assumptions

Location	Maintenance/Rehabilitation Assumptions
J.C. Boyle	
The Dalles California Highway (US97)	• None
Green Springs Highway (OR66)	• None
Keno Worden Road	• None
Topsy Grade Road	• Pre and post-construction 0.9 miles of 9-inch aggregate base section repair
J.C. Boyle Dam Access Road from OR66	• Pre-construction improvements include minor cut/fill, 0.25 miles of new 9-inch aggregate base section and 0.7 miles of 9-inch aggregate base section repair; Post-construction improvements include 0.6 miles of 9-inch aggregate base section repair
Power Canal Access Road	• Pre and post-construction 1.5 miles of 9-inch aggregate base section repair
Powerhouse Access Road	• None
J.C. Boyle Disposal Access Road	• Minor regrading & widening
Copco and Iron Gate	
Copco Road (I-5 to Ager Road)	• Post-construction 1 mile new asphalt overlay
Copco Road (Ager Road to Lakeview Road)	• Pre-construction improvements include 0.5 miles of crack sealer, and 0.75 miles of new asphalt section; Post-construction improvements include 1.0 miles of new asphalt overlay
Copco Road (Lakeview Road to Daggett Road)	• Pre-construction improvements include 1.0 mile of crack sealer, and 1.5 miles of new asphalt section; Post-construction improvements include 2.0 miles of new asphalt overlay
Copco Road (Daggett Road to Copco Access Road)	• Pre and post-construction 1.5 miles of 9-inch aggregate base section repair
Copco Road (Copco Access Road to Copco Road Bridge)	• Pre and post-construction 1.5 miles of 9-inch aggregate base section repair • Post-construction 0.25 mile overlay and minor riprap
Copco Access Road	• Pre-construction 2,500 CY cut/fill and 0.9 miles 9-inch aggregate base overlay • Remove after construction is complete and restore area to native vegetation
Ager Beswick Road	• None
Mallard Cove Boat Ramp Access	• Minor works to enable barge mobilization
Daggett Road	• None
Lakeview Road (Copco Road to Iron Gate disposal site)	• Post-construction improvements include 0.7 miles 6-inch aggregate base overlay
Iron Gate Powerhouse Access Road	• Remove after construction is complete and restore area to native vegetation

Location	Maintenance/Rehabilitation Assumptions
Iron Gate Left Abutment Access Road	• Remove after construction is complete and restore area to native vegetation
Iron Gate Upstream Left Abutment Access Road	• Remove after construction is complete and restore area to native vegetation

3.5.6 Recreation Plan

Costs associated with demolition of existing recreation facilities are included in the dam removal cost category. This section summarizes assumptions associated with construction of any new recreation facilities connected with the Project. Although the final recommendation for proposed recreation facilities has not been made, a list of possible improvements have been scoped for inclusion in this cost estimate.

Recreation costs were derived from itemized estimates for the various recreation facilities listed in Table 3-11. Rates and prices are derived from a combination of historical contracting information including Lake Berryessa Recreation Area Renovation project, and RS Means. Estimated project costs assume operation and maintenance support at each facility for up to 5 years.

Table 3-11 Assumptions For New or Improved Recreation Facilities

Dam (Sate)	Description
Campgrounds	
Jenny Creek Campground Expansion	Expand campground and upgrade facilities including new restroom, 5 picnic tables, 2 fire grates, 5 trash bins and minimal earthwork
Topsy Campground Upgrade	Replace or redesign boat ramp for river access
New Campground	New 20-site campground in TBD location (includes picnic tables, fire grates, trash bins and restroom)
Day-use Areas	
Fall Creek Day-use Area Upgrade	Upgrade facilities and reconstruct trail leading to Fall Creek waterfall
Iron Gate Hatchery Day-use Area Upgrade	Reconstruct day use site to provide additional facilities and a boat ramp
New Day-use Areas	Provide up to two day-use sites with river access at TBD defined locations. Includes new picnic table, fire grate, and trash bins. One of the sites may be located at the J.C. Boyle powerhouse and substation
River Access	
Fishing River Access Points	Up to two river access points at TBD locations. Sites include signage, portable toilets and trash receptacles
Boating River Access Ramps	Up to two river boating access points at TBD locations. Sites include access and boat ramps
Trails	
J.C. Boyle to Iron Gate walking trail	Up to 20 miles of non-motorized trail from J.C. Boyle to Iron Gate. Includes up to two viewing areas and/or interpretive signage

Dam (Sate)	Description
Walking Trails for River Access	Non-motorized side trails off main trail for access river

3.5.7 Downstream Flood Control Improvements

This section summarizes the assumptions used to develop costs associated with any required downstream flood control improvements. The analysis that led to the selection of improvements is discussed in Section 7.7 of the Definite Plan.

The cost estimate includes elevating 36 habitable homes and other structures. The rate used assumes that it will take five days to raise each house, with subcontractor costs based on the average cost of raising a building in California. Additional cost was included to add two sets of stairs per house, and supporting labor team for ancillary work associated with flood proofing.

3.5.8 Public Health and Safety Measures

The estimate includes costs for cattle exclusion fencing at reservoir sites where the former reservoirs will no longer be able to serve as a natural barrier to livestock, and for the protection of revegetation efforts against damage. Fencing will likely be four-wire fence with metal T-posts at 12 LF intervals.

Fencing quantities have been determined from a detailed analysis of fencing lengths in GIS, focused on fencing the reservoir restoration areas while avoiding fencing along portions of the perimeter with steep topography above the reservoir, forest and housing. As the scope is developed further, additional definition may be obtained by considering where fences might need to tie into property boundary fences (if they exist) or where steep topography just below the reservoir surface might act as a barrier.

3.6 Anticipated Mitigation Measures

The following sections summarize cost assumptions associated with anticipated regulatory mitigation measures for groundwater wells, downstream water intakes and cultural resources.

3.6.1 Groundwater Improvements

Groundwater well improvements adjacent to the reservoirs may be necessary if reservoir drawdown has a negative impact on existing well water levels. A groundwater well management plan is contained in Appendix N of the Definite Plan and is the basis for the estimate.

The current estimates assume public outreach will be completed with relevant property owners, and subsequent installation and monitoring of up to five (5) new 60-foot deep, 3-inch diameter monitoring wells will be completed. Well drilling costs assume PVC casing and hard rock geology. Wells will be monitored monthly for water level and water quality constituents over a 3-year period.

The estimate assumes up to 20 wells will ultimately require replacement. Costs include drilling of new wells and abandonment of existing wells. The estimate also assumes temporary water will be provided for up to 30 days during well installation.

3.6.2 Downstream Water Supply

Sediment buildup during reservoir drawdown may affect some downstream water supply intakes as needed, the KRRC will excavate affected intakes to clear them of aggraded sediment materials, and provide temporary settling basins or groundwater wells if potable water supply is impacted. Jetting and vacuum technologies such as those used for cleaning storm drains and sewers will be used to remove sediment at intakes. Temporary settling basins may also be used to remove silt and sediment prior to the primary treatment performed by the water right holder.

There are approximately 50 water diversions off the Klamath River that could be affected. The USBR believed between 7 and 18 intakes would require maintenance. As some intakes have been added after the 2012 EIS/R, this estimate is based on the higher end of the range as the most probable number of intakes that could require maintenance actions.

In some cases, where diversions are used primarily for irrigation, the KRRC may need to pay for lost or damaged crops. Water rights holders reported alfalfa and pasture as the majority crop types irrigated with the diverted water during the drawdown period. In 2012, the average return for alfalfa produced in Siskiyou County was approximately $1,200 per acre, where the average yield was approximately 6 tons per acre (UCCE 2012). Assuming all 129 acres will be affected, the cost will be approximately $154,800.

Supplying livestock with water requires providing a stock water tank and water. A 500 gallon stock water tank is estimated.

Table 3-12 Assumptions For Downstream Water Supply

Cost Level	Elements Included in Cost Estimate
MPE	Intake excavation for 18 intakes Water supply for domestic use for 8 water rights (claimed or registered rights with reported diversions) Temporary settling basins at 18 intakes Temporary groundwater wells at 18 intakes
Direct Crop Loss Mitigation	Payment for lost hay crops on 129 acres of irrigated lands.
Stock watering	Provide 500 gallon water tank and 1,500 gallons of water per month.

References:

- UCCE (University of California Cooperative Extension). 2012. Sample Costs to Establish and Produce Alfalfa Hay – Intermountain Siskiyou County, Scott Valley- Mixed Irrigation. Accessed February 27, 2018. Available at: https://coststudyfiles.ucdavis.edu/uploads/cs_public/a6/b3/a6b35d9d-bd82-495c-86b1-1987dd6154ae/alfalfa_im_scott2012.pdf

- County Road 67 Sediment Trap Maintenance Pilot Project 2013-2014, Douglas County CO. CH2M, Denver CO. Available at: http://www.vactor.com/Portals/0/PDF/hxx/HXX_Brochure_WEB_11.16.pdf
- League of Oregon Cities and the Community Planning Workshop at the University of Oregon. Water, Wastewater and Stormwater Rate Survey. March, 2015.
- Raftelis Financial Consultants, Inc. and California-Nevada Section of the American Water Works Association. 2015 California-Nevada Water and Wastewater Rate Survey.

3.6.3 Cultural Resources

Cultural resources mitigation and protective measures may be required during drawdown, throughout the dam removal and reservoir restoration durations, and post-construction. Activities will likely involve short- and long-term cultural site monitoring, inadvertent discovery of cultural resources, among others. Additional information about the potential scope of activities is available in Appendix L of the Definite Plan.

Site monitoring and resolution of inadvertent discoveries of cultural resources and human remains will follow protocols established during agency and tribal consultations, as documented in the Historic, Cultural, and Tribal Resources Management Plan discussed in Appendix L, as well as actions developed and approved during consultations under Section 106 and agreed to during consultations with California-recognized tribes.

The cultural resource mitigation and protective measures estimate is based on the following assumptions associated with agency and tribal outreach, drawdown and post-drawdown surveys/inspections, curation fees, discovery contingencies and associated protection and mitigation measures.

Agency and Tribal Outreach

During the two-year construction period starting with reservoir drawdown, management of cultural resources and associated mitigation will require ongoing agency and tribal outreach, consultation, and meeting attendance.

Post-construction, long-term cultural resources management and monitoring activities are estimated for a 3-year period, and based on the Historic, Cultural, and Tribal Resources Management Plan.

Drawdown Surveys

Archaeological and cultural inventories are planned for the J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate reservoir zones during (1) the course of drawdown activities, and (2) post-drawdown reservoir areas as soon as surface conditions permit. Cost assumptions associated with each are listed below:

- Drawdown Shoreline Survey: To the extent possible, and in consideration of safety factors, periodic pedestrian archaeological inventory will be conducted along the reservoir shorelines as drawdown occurs. The principal goal of this shoreline survey is to identify and reduce looting and disturbances of known and currently unknown cultural resources. Inventory methods for this shoreline survey are still under development, but may include low-elevation aerial surveys (e.g., drones, helicopter) or barge surveys, if feasible, that target areas subject to slumping or those that are not sufficiently dried to allow safe access via foot-traffic and survey vehicles. A team of one archaeologist and one tribal monitor will conduct the shoreline inventory at each reservoir, for three teams (J.C. Boyle, Copco No.1 and 2, and Iron Gate). The estimate allows for weekly reconnaissance for six people for a 2-month period before the post-drawdown pedestrian inventory of the reservoir areas can begin.

- Post-drawdown Reservoir Survey: Archaeological inventory will be conducted of the post-drawdown reservoir areas after water has receded and soils have sufficiently dried to allow for pedestrian survey. Based on current estimates, the former reservoir footprints encompass a total of 2,275 acres. Archaeological pedestrian inventory will focus on reservoir areas covered by 0-4 feet of sediment, where water-induced erosion has the greatest potential to reveal buried archaeological deposits. The 0-4 foot sediment area is estimated as encompassing about 1,500 acres. Selected deep probing may be used in areas of high archaeological sensitivity that exceed sediment depth of 4 feet. Using a standard rate of 25 acres per person per day, 1,500-acre survey will require approximately 60 person/days to complete. Assuming an average of one site per every 50 acres inventoried, 30 archaeological sites would require recordation, which in turn will require an additional 60 person/days of effort.

Construction Surveys

Construction cultural resource monitoring is associated with implementation of the reservoir restoration plan during 2021 and 2022. The restoration plan involves removal of some portion of the remaining reservoir sediments to re-expose some high value pre-inundation river terraces. The Klamath River corridor and its associated terraces are areas of high archaeological and tribal resource sensitivity, and any subsurface disturbances associated with exposing the pre-inundation landscape (within approx. 5 vertical feet) will minimally require cultural resources monitoring.

Two teams comprised of archaeologists and tribal monitors, will participate during the course of any reservoir restoration actions. The estimate allows for monitoring for four people for a period of one year (FY 2021-2022). If cultural resources are inadvertently discovered during the restoration area monitoring activity, their recordation and evaluation will continue under Discovery Contingencies (see below).

Post-Construction Surveys

Post-construction cultural resources management and monitoring reflects compliance with mitigation of tribal cultural impacts, will be developed in the Historic, Cultural and Tribal Resources Management Plan, will require ongoing consultation with affected tribes, including meetings to identify site-specific mitigation as new sites are exposed or discovered; needs for additional survey; development and implementation of a Looting and Vandalism Protection Program (LVPP), including long-term monitoring and site documentation; tribal issue facilitation; and long-term assistance with implementation of the Programmatic Agreement. These requirements are expected to include efforts beyond those covered under more routine agency and tribal consultation.

The LVPP provisions for archaeological and tribal monitoring is estimated to occur for a maximum of 3 years following completion of ground disturbance activities. Monitoring frequency is currently estimated at quarterly. The estimate for LVPP monitoring allows for two, 2-person crews, comprised of one archaeologist and one tribal monitor, for a 2-week period every quarter, for a total of 12 quarters. Additional non-field related costs are included for ongoing agency and tribal consultation and meetings.

Curation Fees

Curation fees have been included in the estimate for artifacts recovered during phase II and phase III fieldwork. As currently estimated, archaeological investigations involve excavation of 120m³ for phase II efforts and 200m3 for phase III efforts, for a total of 320m³. The estimate allows for permanent curation of archaeological materials recovered during the phase II and phase III programs as 1 archive box per 2m³ of excavated sediment, for a 160 archive boxes. An additional 250 boxes may be required for discovery contingencies, for an estimated project total of 410 boxes. At an average of $500/ft³ (2018 price quote from Oregon Museum of Natural and Cultural History), the curation of 410 archive boxes of cultural materials is estimated at $205,000 excluding escalation. Curation support labor for final artifact and paperwork preparation is estimated at an average of 4 hours per archive box.

Inadvertent Discovery Contingencies

Two types of inadvertent discovery contingencies are anticipated during project implementation, including unanticipated exposure of archaeological resources and human remains. For purposes of this cost estimate, it is assumed that up to 160 discoveries (60 archaeological materials and 100 human remains) may occur in both short-term and long-term contexts. Additional information is provided below:

- Archaeological Resources: It is anticipated that up to 30 new archaeological resources may be discovered during inventory of the former reservoir areas. Stabilization and/or recovery work (excavation) may be required at the anticipated sites to reduce project-related effects, particularly those related to erosion. In addition, ground disturbances associated with the reservoir restoration actions may expose archaeological components when reservoir sediments are removed and the pre-inundation landscape is exposed. The estimate allows for discovery, stabilization, and/or recovery work of up to an additional 30 new archaeological resources associated with restoration actions. The estimate allows a per unit rate of $30,000 per resource for stabilization and/or recovery work for each of the 60 newly identified archaeological resources, to include recordation, archaeological excavation, analysis, and reporting.
- Human Remains: Drawdown, dam removal, and post-dam removal activities have the potential to expose human burials within the former reservoir areas, as well as in downriver contexts where elevated water levels and subsequent bank erosion may occur. The estimate allows a per resource rate of $15,000 for recovery of 100 human remain locations. Discovery, removal, and/or relocation of human remains will require investigation and recovery by a 4-person team, comprised of one field supervisor (archaeologist or physical anthropologist), two archaeological technicians, and one tribal monitor for a period of two days in the field. Archaeological materials recovered from discovery situations will require reporting, analysis and curation.

TCP Reserve Fund

Current agency and tribal consultation efforts have not yet addressed issues related to mitigation of impacts to TCPs. Therefore, a conservative reserve fund of $1,000,000 has been estimated for this possibility.

3.7 Monitoring & Reporting

3.7.1 Aquatic Resource Measures

Measures to benefit aquatic resources (AR) have been developed through coordination with state and federal regulatory agencies, and have been incorporated into the Project. Aquatic resource activities will take place prior to, during, and after dam removal and are based on Appendix I of the Definite Plan. The following provides a summary of cost assumptions associated with AR measures:

- Monitoring of tributary confluence areas for connectivity will occur for 2 years post-dam removal and will include 9 key tributaries within the reservoir and downstream depositional reach (Iron Gate Dam to Cottonwood Creek).
- Tributary confluence connectivity maintenance will occur for 2 years and will require hand crews for 3 weeks per year for downstream tributaries, and 4 weeks of equipment removal per year for reservoir reach tributaries.
- Water quality monitoring and fish rescue/relocation will occur at 13 key tributaries and only during the year of drawdown.
- Juvenile fish rescue and relocation efforts will only take place if temperature and sediment thresholds are exceeded and will take no more than 3 weeks to complete during year of drawdown.
- Cost includes approximately $4 million in gravel augmentation for full mitigation of spawning habitat. The actual amount necessary is likely less and will be based on surveys completed after drawdown.
- Sucker rescue and relocation effort will occur on all three reservoirs and take no more than 2 weeks to complete.
- Freshwater mussels will be relocated to the hydroelectric reach between Keno Dam and the head of J.C. Boyle Reservoir. The relocation effort will take no more than 2 weeks.

3.7.2 Terrestrial Resource Measures

Measures to benefit terrestrial resources (TER) have been developed through coordination with state and federal regulatory agencies, and have been incorporated into the Project. Terrestrial resource activities will take place prior to, during, and after dam removal and are based on Appendix J of the Definite Plan. The following provides a summary of cost assumptions associated with TER measures:

- Habitat Restoration: Includes monitoring and reporting for 3 years following vegetation installation.
- Nesting Bird Surveys: Includes osprey and cliff swallow nest exclusion; monitoring; reporting; pre-clearing nest surveys; work zone monitoring and rescue. Likelihood of northern spotted owl nesting during construction period is low and is excluded from the estimate.

- Bald and Golden Eagles: Likelihood of existence and discovery of nesting bald or golden eagles during construction period is low and is excluded from the estimate.
- Special Status Plants: Likelihood of existence and discovery of special status plants during the construction period is low and is excluded from the estimate.
- Permanent Loss of Wetlands: Includes monitoring and reporting for 5 years, post-construction.
- Roosts for Special Status Bats: Estimate includes a combination of retained/modified structures and new artificial roost structures.

3.7.3 Water Quality Monitoring

Water quality monitoring was estimated to include monitoring at up to ten main stem stations along the Klamath River. Eight of these are existing USGS stations, while two will be new stations. Existing stations will be upgraded with equipment to meet the project objectives.

All sites will be equipped with a multi-parameter sonde to measure temperature, pH, dissolved oxygen, specific conductance and turbidity. In addition, all sites except Keno will be equipped with a high-range turbidity sensor and side-looking acoustic profiler (for acoustic attenuation and backscatter measurements). A TSS and NTU laboratory relationship study will be conducted using sediment samples collected from the reservoirs.

Analysis and reporting of data will be according to United States Geological Survey (USGS) guidelines. The primary final products of the monitoring network will be 15-minute time series of stage, discharge, temperature, pH, dissolved oxygen, specific conductance, turbidity, acoustic attenuation, acoustic backscatter, and suspended-sediment concentration (SSC, potentially discriminating between silt/clay and sand), and suspended-sediment flux.

Rates and prices are based on a USGS proposal submitted in March 2018, and account for monitoring for 3 years following dam removal.

Additional sediment, reservoir and estuary monitoring were assumed during the 5 year period after removal of the dams. The estimate assumes the following:

- High definition aerial photos and LiDAR will be flown together in a single aircraft mobilization each year in the spring of years 2-5. Year 1 includes only high definition aerial photos.
- Volitional fish passage monitoring includes 2 weeks of fieldwork to monitor fish passage through hydroelectric reach, and additional amounts for reporting.
- Monitoring work for all three reservoir areas will be performed at the same time.
- Corrective actions are not included in costs, if they are needed based on monitoring results.
- Estuary and river sampling for toxins before and after dam removal using four separate sampling events.

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Chapter 4: Results

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4. RESULTS

The following sections provide a summary of the results of the cost analyses described above. Detailed construction cost breakdowns for both Full Removal and Partial Removal alternatives are provided in Attachment A. Pay item cost detail worksheets, describing the calculation of individual cost estimate line items rates and prices are provided in Attachment B.

In addition to the estimated project cost results, a full range of results from the Monte Carlo analysis are provided in Section 4.2, and a comparison to the USBR 2012 estimate is provided in Section 4.3.

4.1 Total Cost Summary

Tables 4-1 and 4-2 provide a summary of the estimate of project costs for Full and Partial Removal alternatives, respectively. As described in Section 2.6, a combined design and construction contingency (30% of construction cost) has been included in the estimates. As the detailed design advances toward final construction drawings and specifications, the design contingency will decrease to near zero. While the construction contingency may decrease as more field data and information becomes available, some level of construction contingency will persist throughout the construction phase.

In addition to the estimate of project costs, the summary tables show probabilistic MPL and MPH costs based on the results of Monte Carlo simulations. The right-hand column indicates the estimated project costs, whereas the forecast range from MPL to MPH indicate the range of probabilistic outcomes.

As discussed in more detail in Section 2.7, while it is typical for large water infrastructure projects to select P80 to represent the upper range of project planning contingency (MPH), due to the unique nature of this Project and the KRRC, a more conservative P90 was selected to represent the MPH for the Project. The P90 estimate will cover the most likely final project cost in 90% of all risk scenarios. A P10 was selected to represent the MPL.

Table 4-1 Results Summary - Full Removal

Line Item/Cost Category		Forecast Range		Estimated Project Cost
		MPL (P10)	MPH (P90)	
Project Oversight		$29,466,000	$29,778,000	$29,581,000
10	Project Oversight	$29,466,000	$29,778,000	$29,581,000
Environmental Compliance & Permitting		$8,525,000	$8,829,000	$8,637,000
21	Permitting	$6,607,000	$6,911,000	$6,719,000
22	Environmental Compliance Support	$1,918,000	$1,918,000	$1,918,000
Engineering & Procurement		$15,023,000	$16,925,000	$15,632,000
31	Design Data	$1,938,000	$2,085,000	$1,992,000
32	Engineering - AECOM	$5,949,000	$6,400,000	$6,115,000
33	Engineering - PDB	$6,152,000	$7,381,000	$6,513,000
34	Procurement	$984,000	$1,059,000	$1,012,000
Construction Management		$10,328,000	$11,111,000	$10,617,000
35	Construction Management	$10,328,000	$11,111,000	$10,617,000
Construction		$202,108,000	$268,560,000	$227,980,000
41	Dam Removal	$99,282,000	$117,341,000	$106,827,000
42	Restoration Earthwork	$19,887,000	$24,270,000	$21,051,000
43	Restoration of Vegetation	$46,133,000	$71,103,000	$57,957,000
44	Yreka Water Line Replacement	$2,665,000	$3,305,000	$2,900,000
45	Transportation (Bridges, Culverts, Roads)	$26,980,000	$41,340,000	$30,799,000
46	Recreation Improvements	$3,295,000	$6,486,000	$4,584,000
47	Flood Proofing	$1,340,000	$1,715,000	$1,499,000
48	Public Health And Safety Measures	$2,526,000	$3,000,000	$2,363,000
Anticipated Mitigation Measures		$17,264,000	$19,510,000	$18,407,000
51	Groundwater Improvements	$1,627,000	$2,317,000	$1,982,000
52	Water Supply And Water Rights	$980,000	$1,185,000	$1,091,000
53	Cultural Resources	$14,657,000	$16,008,000	$15,334,000
Monitoring & Reporting		$15,332,000	$22,571,000	$18,405,000
61	Aquatic Resource Measures	$6,326,000	$8,101,000	$6,691,000
62	Terrestrial Resources Measures	$1,387,000	$3,164,000	$2,395,000
63	Water Quality Monitoring	$7,619,000	$11,306,000	$9,319,000
Design & Construction Contingency		-	-	$68,394,000
Risk Contingency		$48,410,000	$129,794,000	-
	TOTAL	**$346,500,000**	**$507,100,000**	**$397,700,000**

Table 4-2 Results Summary - Partial Removal

Line Item/Cost Category		Forecast Range MPL (P10)	Forecast Range MPH (P90)	Estimated Project Cost
Project Oversight		$29,466,000	$29,778,000	$29,581,000
10	Project Oversight	$29,466,000	$29,778,000	$29,581,000
Environmental Compliance & Permitting		$8,525,000	$8,829,000	$8,637,000
21	Permitting	$6,607,000	$6,911,000	$6,719,000
22	Environmental Compliance Support	$1,918,000	$1,918,000	$1,918,000
Engineering & Procurement		$15,023,000	$16,925,000	$15,632,000
31	Design Data	$1,938,000	$2,085,000	$1,992,000
32	Engineering - AECOM	$5,949,000	$6,400,000	$6,115,000
33	Engineering - PDB	$6,152,000	$7,381,000	$6,513,000
34	Procurement	$984,000	$1,059,000	$1,012,000
Construction Management		$10,328,000	$11,111,000	$10,617,000
35	Construction Management	$10,328,000	$11,111,000	$10,617,000
Construction		$169,140,000	$229,250,000	$193,030,000
41	Dam Removal	$66,316,000	$78,042,000	$71,877,000
42	Restoration Earthwork	$19,887,000	$24,270,000	$21,051,000
43	Restoration of Vegetation	$46,131,000	$71,101,000	$57,957,000
44	Yreka Water Line Replacement	$2,665,000	$3,306,000	$2,900,000
45	Transportation (Bridges, Culverts, Roads)	$26,980,000	$41,329,000	$30,799,000
46	Recreation Improvements	$3,295,000	$6,487,000	$4,584,000
47	Flood Proofing	$1,340,000	$1,715,000	$1,499,000
48	Public Health And Safety Measures	$2,526,000	$3,000,000	$2,363,000
Anticipated Mitigation Measures		$17,270,000	$19,505,000	$18,407,000
51	Groundwater Improvements	$1,627,000	$2,317,000	$1,982,000
52	Water Supply And Water Rights	$985,000	$1,180,000	$1,091,000
53	Cultural Resources	$14,657,000	$16,008,000	$15,334,000
Monitoring & Reporting		$15,330,000	$22,576,000	$18,405,000
61	Aquatic Resource Measures	$6,326,000	$8,102,000	$6,691,000
62	Terrestrial Resources Measures	$1,386,000	$3,166,000	$2,395,000
63	Water Quality Monitoring	$7,618,000	$11,308,000	$9,319,000
Design & Construction Contingency		-	-	$57,909,000
Risk Contingency		$48,410,000	$129,794,000	-
	TOTAL	**$313,500,000**	**$467,800,000**	**$352,200,000**

4.2 Monte Carlo Results

The probabilistic range of costs for each estimate line item was determined with the use of '@Risk' Monte Carlo analysis software. The Monte Carlo analysis involves determining the impact and likelihood of occurrence of identified and quantified uncertainties and risks by running simulations to identify the range of possible outcomes for a number of scenarios - 10,000 scenarios in the case of this Project. A random sampling is performed in the simulation by using uncertain risk variable inputs to generate the range of outcomes with a confidence measure for each outcome. For each uncertain variable in a simulation, the possible values are defined using probability distributions. The type of distribution selected depends on the factors surrounding the variable. Selected distributions are included in Attachment C.

Tables 4-3 and 4-4 summarize the results of the Monte Carlo analysis for the Full Removal and Partial Removal alternatives, respectively. Levels of probability are described from P1 to P100, where the number following the 'P' represents the percentage of most probable outcomes. For example, the P1 estimate amount will only cover the lowest 1% of the possible cost outcomes, whereas P100 will cover the maximum estimate amount determined from running the 10,000 scenarios.

Table 4-3 Results Summary – Full Removal Monte Carlo Results

FULL REMOVAL (Year of Construction Dollars)													
		Forecast Range											
Estimate Element		Mean	P01	P10 (MPL)	P20	P30	P40	P50 (Median)	P60	P70	P80	P90 (MPH)	P100
Project Oversight		29,616,000	29,402,000	29,466,000	29,508,000	29,543,000	29,575,000	29,608,000	29,641,000	29,678,000	29,721,000	29,778,000	29,951,000
10	Project Oversight	29,616,000	29,402,000	29,466,000	29,508,000	29,543,000	29,575,000	29,608,000	29,641,000	29,678,000	29,721,000	29,778,000	29,951,000
Environmental Compliance & Permitting		8,671,000	8,462,000	8,525,000	8,565,000	8,600,000	8,631,000	8,663,000	8,696,000	8,731,000	8,773,000	8,829,000	9,006,000
21	Permitting	6,753,000	6,544,000	6,607,000	6,647,000	6,682,000	6,713,000	6,745,000	6,778,000	6,813,000	6,855,000	6,911,000	7,088,000
22	Environmental Compliance Support	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000
Engineering & Procurement		15,925,000	14,675,000	15,023,000	15,261,000	15,465,000	15,659,000	15,855,000	16,059,000	16,288,000	16,557,000	16,925,000	18,099,000
31	Design Data	2,009,000	1,908,000	1,938,000	1,958,000	1,974,000	1,989,000	2,005,000	2,020,000	2,038,000	2,058,000	2,085,000	2,168,000
32	Engineering - AECOM	6,166,000	5,855,000	5,949,000	6,009,000	6,060,000	6,107,000	6,154,000	6,202,000	6,255,000	6,317,000	6,400,000	6,657,000
33	Engineering - PDB	6,730,000	5,943,000	6,152,000	6,300,000	6,429,000	6,553,000	6,678,000	6,811,000	6,960,000	7,137,000	7,381,000	8,173,000
34	Procurement	1,020,000	969,000	984,000	994,000	1,002,000	1,010,000	1,018,000	1,026,000	1,035,000	1,045,000	1,059,000	1,101,000
Construction Management		10,705,000	10,168,000	10,328,000	10,433,000	10,521,000	10,603,000	10,684,000	10,768,000	10,860,000	10,967,000	11,111,000	11,599,000
35	Construction Management	10,705,000	10,168,000	10,328,000	10,433,000	10,521,000	10,603,000	10,684,000	10,768,000	10,860,000	10,967,000	11,111,000	11,599,000
Construction		234,343,000	187,033,000	202,108,000	211,338,000	218,958,000	225,995,000	232,913,000	240,034,000	247,749,000	256,702,000	268,560,000	305,421,000
41	Dam Removal	108,104,000	95,066,000	99,282,000	101,858,000	103,967,000	105,905,000	107,795,000	109,727,000	111,811,000	114,207,000	117,341,000	126,917,000
42	Restoration Earthwork	21,928,000	19,197,000	19,887,000	20,391,000	20,839,000	21,275,000	21,721,000	22,198,000	22,732,000	23,377,000	24,270,000	27,408,000
43	Restoration	58,537,000	39,492,000	46,133,000	49,949,000	52,999,000	55,745,000	58,387,000	61,045,000	63,855,000	67,036,000	71,103,000	82,327,000
44	Yreka Water Line Replacement	2,973,000	2,532,000	2,665,000	2,750,000	2,822,000	2,889,000	2,955,000	3,024,000	3,100,000	3,188,000	3,305,000	3,663,000
45	Transportation	33,673,000	24,519,000	26,980,000	28,661,000	30,135,000	31,555,000	33,008,000	34,559,000	36,302,000	38,405,000	41,340,000	51,748,000
46	Recreation Improvements	4,848,000	2,555,000	3,295,000	3,743,000	4,112,000	4,452,000	4,784,000	5,126,000	5,496,000	5,923,000	6,486,000	8,198,000
47	Flood Proofing	1,524,000	1,251,000	1,340,000	1,394,000	1,438,000	1,478,000	1,517,000	1,558,000	1,601,000	1,651,000	1,715,000	1,898,000
48	Public Health And Safety	2,756,000	2,421,000	2,526,000	2,592,000	2,646,000	2,696,000	2,746,000	2,797,000	2,852,000	2,915,000	3,000,000	3,262,000
Anticipated Mitigation Measures		18,392,000	16,621,000	17,264,000	17,623,000	17,904,000	18,156,000	18,395,000	18,632,000	18,882,000	19,159,000	19,510,000	20,435,000
51	Groundwater Improvements	1,974,000	1,429,000	1,627,000	1,738,000	1,825,000	1,902,000	1,976,000	2,048,000	2,125,000	2,210,000	2,317,000	2,603,000
52	Water Supply And Water Rights	1,084,000	916,000	980,000	1,014,000	1,040,000	1,064,000	1,086,000	1,107,000	1,130,000	1,154,000	1,185,000	1,265,000
53	Cultural Resources	15,334,000	14,276,000	14,657,000	14,871,000	15,039,000	15,190,000	15,333,000	15,477,000	15,627,000	15,795,000	16,008,000	16,567,000
Monitoring & Reporting		18,876,000	13,513,000	15,332,000	16,384,000	17,232,000	18,009,000	18,761,000	19,531,000	20,360,000	21,316,000	22,571,000	26,570,000
61	Aquatic Resource Measures	7,137,000	6,092,000	6,326,000	6,512,000	6,683,000	6,855,000	7,032,000	7,226,000	7,447,000	7,719,000	8,101,000	9,581,000
62	Terrestrial Resources Measures	2,294,000	813,000	1,387,000	1,690,000	1,922,000	2,125,000	2,314,000	2,501,000	2,693,000	2,904,000	3,164,000	3,812,000
63	Water Quality Monitoring	9,445,000	6,608,000	7,619,000	8,182,000	8,627,000	9,029,000	9,415,000	9,804,000	10,220,000	10,693,000	11,306,000	13,177,000
Contingencies		87,387,000	27,366,000	48,410,000	59,454,000	67,928,000	76,144,000	84,215,000	92,833,000	102,114,000	113,550,000	129,794,000	233,371,000
Full Removal Total		423,900,000	307,200,000	346,500,000	368,600,000	386,200,000	402,800,000	419,100,000	436,200,000	454,700,000	476,700,000	507,100,000	654,500,000

Table 4-4 Results Summary – Partial Removal Monte Carlo Results

PARTIAL REMOVAL (Year of Construction Dollars)												
	Forecast Range											
Estimate Element	Mean	P01	P10 (MPL)	P20	P30	P40	P50 (Median)	P60	P70	P80	P90 (MPH)	P100
Project Oversight	29,616,000	29,402,000	29,466,000	29,508,000	29,543,000	29,575,000	29,608,000	29,641,000	29,678,000	29,721,000	29,778,000	29,959,000
10 Project Oversight	29,616,000	29,402,000	29,466,000	29,508,000	29,543,000	29,575,000	29,608,000	29,641,000	29,678,000	29,721,000	29,778,000	29,959,000
Environmental Compliance & Permitting	8,671,000	8,463,000	8,525,000	8,566,000	8,599,000	8,631,000	8,663,000	8,695,000	8,731,000	8,773,000	8,829,000	9,017,000
21 Permitting	6,753,000	6,545,000	6,607,000	6,648,000	6,681,000	6,713,000	6,745,000	6,777,000	6,813,000	6,855,000	6,911,000	7,099,000
22 Environmental Compliance Support	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000	1,918,000
Engineering & Procurement	15,925,000	14,680,000	15,025,000	15,261,000	15,466,000	15,659,000	15,855,000	16,059,000	16,289,000	16,558,000	16,927,000	18,123,000
31 Design Data	2,009,000	1,908,000	1,938,000	1,958,000	1,974,000	1,989,000	2,005,000	2,020,000	2,038,000	2,058,000	2,085,000	2,183,000
32 Engineering - AECOM	6,166,000	5,857,000	5,949,000	6,009,000	6,060,000	6,107,000	6,154,000	6,202,000	6,255,000	6,317,000	6,400,000	6,655,000
33 Engineering - PDB	6,730,000	5,946,000	6,154,000	6,300,000	6,430,000	6,553,000	6,678,000	6,811,000	6,961,000	7,138,000	7,383,000	8,182,000
34 Procurement	1,020,000	969,000	984,000	994,000	1,002,000	1,010,000	1,018,000	1,026,000	1,035,000	1,045,000	1,059,000	1,103,000
Construction Management	10,705,000	10,165,000	10,329,000	10,433,000	10,521,000	10,603,000	10,684,000	10,768,000	10,860,000	10,968,000	11,110,000	11,566,000
35 Construction Management	10,705,000	10,165,000	10,329,000	10,433,000	10,521,000	10,603,000	10,684,000	10,768,000	10,860,000	10,968,000	11,110,000	11,566,000
Construction	198,295,000	155,492,000	169,140,000	177,485,000	184,370,000	190,737,000	196,989,000	203,433,000	210,410,000	218,506,000	229,250,000	262,996,000
41 Dam Removal	72,056,000	63,530,000	66,316,000	68,004,000	69,379,000	70,641,000	71,871,000	73,126,000	74,471,000	76,018,000	78,042,000	84,008,000
42 Restoration Earthwork	21,928,000	19,198,000	19,887,000	20,391,000	20,839,000	21,275,000	21,721,000	22,198,000	22,733,000	23,377,000	24,270,000	27,427,000
43 Restoration of Vegetation	58,537,000	39,481,000	46,131,000	49,949,000	53,001,000	55,752,000	58,388,000	61,045,000	63,857,000	67,032,000	71,101,000	82,340,000
44 Yreka Water Line Replacement	2,973,000	2,532,000	2,665,000	2,750,000	2,822,000	2,889,000	2,955,000	3,024,000	3,100,000	3,188,000	3,306,000	3,683,000
45 Transportation	33,673,000	24,522,000	26,980,000	28,662,000	30,133,000	31,554,000	33,006,000	34,560,000	36,301,000	38,402,000	41,329,000	52,148,000
46 Recreation Improvements	4,848,000	2,556,000	3,295,000	3,743,000	4,112,000	4,452,000	4,784,000	5,126,000	5,496,000	5,923,000	6,487,000	8,226,000
47 Flood Proofing	1,524,000	1,251,000	1,340,000	1,394,000	1,438,000	1,478,000	1,518,000	1,558,000	1,601,000	1,651,000	1,715,000	1,918,000
48 Public Health And Safety	2,756,000	2,422,000	2,526,000	2,592,000	2,646,000	2,696,000	2,746,000	2,796,000	2,851,000	2,915,000	3,000,000	3,246,000
Anticipated Mitigation Measures	18,392,000	16,629,000	17,270,000	17,627,000	17,907,000	18,157,000	18,395,000	18,630,000	18,879,000	19,157,000	19,505,000	20,442,000
51 Groundwater Improvements	1,974,000	1,427,000	1,628,000	1,738,000	1,825,000	1,902,000	1,976,000	2,048,000	2,125,000	2,210,000	2,317,000	2,610,000
52 Water Supply And Water Rights	1,084,000	925,000	985,000	1,018,000	1,043,000	1,065,000	1,086,000	1,106,000	1,127,000	1,151,000	1,180,000	1,255,000
53 Cultural Resources	15,334,000	14,277,000	14,657,000	14,871,000	15,039,000	15,190,000	15,333,000	15,476,000	15,627,000	15,796,000	16,008,000	16,577,000
Monitoring & Reporting	18,876,000	13,507,000	15,330,000	16,383,000	17,233,000	18,008,000	18,762,000	19,532,000	20,360,000	21,314,000	22,576,000	26,522,000
61 Aquatic Resource Measures	7,137,000	6,091,000	6,326,000	6,512,000	6,683,000	6,854,000	7,033,000	7,226,000	7,447,000	7,717,000	8,102,000	9,569,000
62 Terrestrial Resources Measures	2,294,000	811,000	1,386,000	1,690,000	1,922,000	2,125,000	2,315,000	2,501,000	2,693,000	2,905,000	3,166,000	3,823,000
63 Water Quality Monitoring	9,445,000	6,605,000	7,618,000	8,181,000	8,628,000	9,029,000	9,414,000	9,805,000	10,220,000	10,692,000	11,308,000	13,130,000
Contingencies	87,387,000	27,366,000	48,410,000	59,454,000	67,928,000	76,144,000	84,215,000	92,833,000	102,114,000	113,550,000	129,794,000	233,371,000
Partial Removal Total	387,900,000	275,700,000	313,500,000	334,700,000	351,600,000	367,500,000	383,200,000	399,600,000	417,300,000	438,500,000	467,800,000	612,000,000

4.3 Comparison with Previous Estimates

A previous estimate was developed by the USBR in 2012 and is documented in the Detailed Plan for Dam Removal – Klamath River Dams (USBR 2012). Table 4-5 below compares the new estimate of project cost for Full Removal to the 2012 estimate amounts. It is important to note that previous USBR estimate were organized using different cost categories, in addition to separating escalation out as a stand-alone line item. For comparison purposes, the 2012 estimate has been reorganized into the new cost categories, and escalation has been incorporated into applicable line items.

Based on the analyses summarized herein, the projected project cost estimate for Full Removal increased from approximately $292M to $398K. The MPH estimate for Full Removal increased from $493M to $507M. The MPL estimate for Full Removal increased from $238M to $347M.

Based on the analyses summarized herein, the projected project cost estimate for Partial Removal increased from approximately $235M to $352K. The MPH estimate for Partial Removal increased from $404M to $468M. The MPL estimate for Full Removal increased from $185M to $314M.

There are several categories where the new estimate shows notable increases from the previous USBR estimate. A brief discussion of these increases is provided below:

- Escalation: The current project construction schedule includes construction beginning in 2020, which is one year later than what was assumed in the 2012 USBR estimate. This results in an increase in project funds that are reserved to account for escalation.
- Project Oversight: The previous USBR estimate did not account for costs attributable to KRRC project oversight and associated costs currently required for KRRC management, accounting, controls, etc. Accounting for these project oversight costs increases the overall project cost by approximately $30M.
- Transportation Costs: As new field data and associated engineering assessments have been completed, the costs associated with anticipated improvements and maintenance activities to accommodate construction access and traffic have increased significantly. It is anticipated that these costs may decrease through value engineering and future PDB input.
- Restoration Costs: Through close coordination with resource agency representatives and other stakeholders, the approach to reservoir restoration has evolved from the approach and assumptions that were utilized by USBR in 2012. The revised approach is detailed in Appendix H of the Definite Plan and represents both current resource agency expectations, as well as the latest science on restoration techniques to increase the probability of successful plant and habitat establishment. The revised approach includes accommodation of some level of floodplain earthwork, as well as more proactive revegetation efforts within the riparian zone, both of which have increased cost.

Table 4-5 Comparison to Previous Estimate

FULL REMOVAL (Year of Construction Dollars)			
Estimate Element		USBR 2012 Estimate	Estimated Project Cost
Project Oversight		2,361,957	29,581,000
10	Project Oversight	-	29,581,000
Environmental Compliance & Permitting		7,085,871	8,637,000
21	Permitting	7,085,871	6,719,000
22	Environmental Compliance Support	-	1,918,000
Engineering & Procurement		14,171,743	15,632,000
31	Design Data	2,361,957	1,992,000
32	Engineering - AECOM	4,723,914	6,115,000
33	Engineering - PDB	4,723,914	6,513,000
34	Procurement	2,361,957	1,012,000
Construction Management		23,619,571	10,617,000
35	Construction Management	23,619,571	10,617,000
Construction		143,627,356	227,980,000
41	Dam Removal	97,262,754	106,827,000
42	Restoration Earthwork	-	21,051,000
43	Restoration	27,298,194	57,957,000
44	Yreka Water Line Replacement	2,218,619	2,900,000
45	Transportation	2,035,303	30,799,000
46	Recreation Improvements	4,761,605	4,584,000
47	Flood Proofing	5,025,441	1,499,000
48	Public Health And Safety	5,025,441	2,363,000
Anticipated Mitigation Measures		35,540,544	18,407,000
51	Groundwater Improvements	1,158,992	1,982,000
52	Water Supply And Water Rights	459,828	1,091,000
53	Cultural Resources	32,665,364	15,334,000
54	Other Mitigations	1,256,360	-
Monitoring & Reporting		19,272,565	18,405,000
61	Aquatic Resource Measures	5,615,930	6,691,000
62	Terrestrial Resources Measures	590,489	2,395,000
63	Water Quality Monitoring	13,066,146	9,319,000
Contingencies		45,920,393	68,394,000
Design & Contingency		45,920,393	68,394,000
Full Removal Total		291,600,000	397,700,000

Chapter 5: References

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5. REFERENCES

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UCCE 2012. University of California Cooperative Extension – Sample Costs to Establish and Produce Alfalfa Hay, Intermountain – Siskiyou County.

USBR 2012. United States Bureau of Reclamation. Detailed Plan for Dam Removal – Klamath River Dams – Klamath Hydroelectric Project – FERC License No. 2082 – Oregon-California. July 2012.

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Attachment A Cost Estimate

A.1 Cost Estimate - Full Removal

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Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices: Qty	Unit	Rate	Estimate	Low	%	High	%	Escalated to Year of Construction: Estimate	Est Low	Est High
10			**OVERSIGHT**												
10	Project		Compensation & Benefits	7/16-6/17 (year 1)	1	SUM	29,017.00	29,017	29,017	0%	29,017	0%	29,017	29,017	29,017
10	Project		Compensation & Benefits	7/17-12/19 (2.5 years)	1	SUM	1,557,347.00	1,557,347	1,557,347	0%	1,557,347	0%	1,557,347	1,557,347	1,557,347
10	Project		Compensation & Benefits	1/20-6/22 (2.5 years)	1	SUM	3,276,136.00	3,276,136	3,276,136	0%	3,276,136	0%	3,276,136	3,276,136	3,276,136
10	Project		Compensation & Benefits	7/22-6/27 (5 years)	1	SUM	193,967.00	193,967	193,967	0%	193,967	0%	193,967	193,967	193,967
10	Project		Travel and Meetings	7/16-6/17 (year 1)	1	SUM	45,223.00	45,223	45,223	0%	45,223	0%	45,223	45,223	45,223
10	Project		Travel and Meetings	7/17-12/19 (2.5 years)	1	SUM	272,538.00	272,538	272,538	0%	272,538	0%	272,538	272,538	272,538
10	Project		Travel and Meetings	1/20-6/22 (2.5 years)	1	SUM	450,000.00	450,000	450,000	0%	450,000	0%	450,000	450,000	450,000
10	Project		Travel and Meetings	7/22-6/27 (5 years)	1	SUM	45,000.00	45,000	45,000	0%	45,000	0%	45,000	45,000	45,000
10	Project		Dam Removal Contractors	Land Survey Contractor	1	SUM	1,020,000.00	1,020,000	1,020,000	0%	1,020,000	0%	1,020,000	1,020,000	1,020,000
10	Project		Professional Services; CEA Services & Expenses	7/16-6/17 (year 1)	1	SUM	1,054,732.00	1,054,732	1,054,732	0%	1,054,732	0%	1,054,732	1,054,732	1,054,732
10	Project		Professional Services; CEA Services & Expenses	7/17-12/19 (2.5 years)	1	SUM	2,386,949.16	2,386,949	2,386,949	0%	2,386,949	0%	2,386,949	2,386,949	2,386,949
10	Project		Professional Services; CEA Services & Expenses	1/20-6/22 (2.5 years)	1	SUM	2,375,442.96	2,375,443	2,375,443	0%	2,375,443	0%	2,375,443	2,375,443	2,375,443
10	Project		Professional Services; CEA Services & Expenses	7/22-6/27 (5 years)	1	SUM	563,853.35	563,853	563,853	0%	563,853	0%	563,853	563,853	563,853
10	Project		Legal Services; Power + Water, General Counsel	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Legal Services; Power + Water, General Counsel	7/17-12/19 (2.5 years)	1	SUM	500,863.00	500,863	500,863	0%	500,863	0%	500,863	500,863	500,863
10	Project		Legal Services; Power + Water, General Counsel	1/20-6/22 (2.5 years)	1	SUM	694,448.00	694,448	694,448	0%	694,448	0%	694,448	694,448	694,448
10	Project		Legal Services; Power + Water, General Counsel	7/22-6/27 (5 years)	1	SUM	240,843.00	240,843	240,843	0%	240,843	0%	240,843	240,843	240,843
10	Project		Legal Services; Hawkins, General Counsel	7/16-6/17 (year 1)	1	SUM	1,109,894.00	1,109,894	1,109,894	0%	1,109,894	0%	1,109,894	1,109,894	1,109,894
10	Project		Legal Services; Hawkins, General Counsel	7/17-12/19 (2.5 years)	1	SUM	718,211.00	718,211	718,211	0%	718,211	0%	718,211	718,211	718,211
10	Project		Legal Services; Hawkins, General Counsel	1/20-6/22 (2.5 years)	1	SUM	373,112.00	373,112	373,112	0%	373,112	0%	373,112	373,112	373,112
10	Project		Legal Services; Hawkins, General Counsel	7/22-6/27 (5 years)	1	SUM	86,063.00	86,063	86,063	0%	86,063	0%	86,063	86,063	86,063
10	Project		Legal Services; Hawkins, Construction Counsel	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Legal Services; Hawkins, Construction Counsel	7/17-12/19 (2.5 years)	1	SUM	2,551,000.00	2,551,000	2,551,000	0%	2,551,000	0%	2,551,000	2,551,000	2,551,000
10	Project		Legal Services; Hawkins, Construction Counsel	1/20-6/22 (2.5 years)	1	SUM	600,000.00	600,000	600,000	0%	600,000	0%	600,000	600,000	600,000
10	Project		Legal Services; Hawkins, Construction Counsel	7/22-6/27 (5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Board of Consultants	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Board of Consultants	7/17-12/19 (2.5 years)	1	SUM	905,850.00	905,850	905,850	0%	905,850	0%	905,850	905,850	905,850
10	Project		Board of Consultants	1/20-6/22 (2.5 years)	1	SUM	494,100.00	494,100	494,100	0%	494,100	0%	494,100	494,100	494,100
10	Project		Board of Consultants	7/22-6/27 (5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Accounting & Audit Fees	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Accounting & Audit Fees	7/17-12/19 (2.5 years)	1	SUM	246,728.00	246,728	246,728	0%	246,728	0%	246,728	246,728	246,728
10	Project		Accounting & Audit Fees	1/20-6/22 (2.5 years)	1	SUM	612,823.00	612,823	612,823	0%	612,823	0%	612,823	612,823	612,823
10	Project		Accounting & Audit Fees	7/22-6/27 (5 years)	1	SUM	206,252.00	206,252	206,252	0%	206,252	0%	206,252	206,252	206,252
10	Project		Risk Management Services	7/16-6/17 (year 1)	1	SUM	44,519.00	44,519	44,519	0%	44,519	0%	44,519	44,519	44,519
10	Project		Risk Management Services	7/17-12/19 (2.5 years)	1	SUM	91,250.00	91,250	91,250	0%	91,250	0%	91,250	91,250	91,250
10	Project		Risk Management Services	1/20-6/22 (2.5 years)	1	SUM	135,000.00	135,000	135,000	0%	135,000	0%	135,000	135,000	135,000
10	Project		Risk Management Services	7/22-6/27 (5 years)	1	SUM	10,000.00	10,000	10,000	0%	10,000	0%	10,000	10,000	10,000
10	Project		Communications External Services	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Communications External Services	7/17-12/19 (2.5 years)	1	SUM	485,400.00	485,400	485,400	0%	485,400	0%	485,400	485,400	485,400
10	Project		Communications External Services	1/20-6/22 (2.5 years)	1	SUM	950,790.00	950,790	950,790	0%	950,790	0%	950,790	950,790	950,790
10	Project		Communications External Services	7/22-6/27 (5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Insurance & Risk Management	7/16-6/17 (year 1)	1	SUM	25,138.00	25,138	25,138	0%	25,138	0%	25,138	25,138	25,138
10	Project		Insurance & Risk Management	7/17-12/19 (2.5 years)	1	SUM	195,451.00	195,451	195,451	0%	195,451	0%	195,451	195,451	195,451
10	Project		Insurance & Risk Management	1/20-6/22 (2.5 years)	1	SUM	405,475.00	405,475	405,475	0%	405,475	0%	405,475	405,475	405,475
10	Project		Insurance & Risk Management	7/22-6/27 (5 years)	1	SUM	107,895.00	107,895	107,895	0%	107,895	0%	107,895	107,895	107,895
10	Project		Project Specific Insurance	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Project Specific Insurance	7/17-12/19 (2.5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Project Specific Insurance	1/20-6/22 (2.5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Project Specific Insurance	7/22-6/27 (5 years)	1	SUM	100,000.00	100,000	100,000	0%	100,000	0%	100,000	100,000	100,000
10	Project		Admin, IT, Fees	7/16-6/17 (year 1)	1	SUM	38,991.00	38,991	38,991	0%	38,991	0%	38,991	38,991	38,991
10	Project		Admin, IT, Fees	7/17-12/19 (2.5 years)	1	SUM	52,426.00	52,426	52,426	0%	52,426	0%	52,426	52,426	52,426
10	Project		Admin, IT, Fees	1/20-6/22 (2.5 years)	1	SUM	65,973.00	65,973	65,973	0%	65,973	0%	65,973	65,973	65,973
10	Project		Admin, IT, Fees	7/22-6/27 (5 years)	1	SUM	30,732.00	30,732	30,732	0%	30,732	0%	30,732	30,732	30,732

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
10	Project		Project Management, AECOM	Detailed separately	1	sum	2,977,635.66	2,977,636	2,828,754	-5%	3,275,399	10%	2,977,636	2,828,754	3,275,399
10	Project		Outreach, AECOM	Detailed separately	1	sum	1,253,904.32	1,253,904	1,191,209	-5%	1,379,295	10%	1,253,904	1,191,209	1,379,295
20			**ENVIRONMENTAL COMPLIANCE & PERMITTING**												
21			**PERMITTING**												
21	Project		Permitting, AECOM	Detailed separately	1	sum	4,113,000.00	4,113,000	3,907,350	-5%	4,524,300	10%	4,113,000	3,907,350	4,524,300
21	Project		Environmental Legal Serivces; Perkins Coie	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
21	Project		Environmental Legal Serivces; Perkins Coie	7/17-12/19 (2.5 years)	1	SUM	1,537,641.00	1,537,641	1,537,641	0%	1,537,641	0%	1,537,641	1,537,641	1,537,641
21	Project		Environmental Legal Serivces; Perkins Coie	1/20-6/22 (2.5 years)	1	SUM	1,068,125.00	1,068,125	1,068,125	0%	1,068,125	0%	1,068,125	1,068,125	1,068,125
21	Project		Environmental Legal Serivces; Perkins Coie	7/22-6/27 (5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
22			**CEQA & FERC SUPPORT**												
22	Project		Agency Fees and Reimbursements	Oregon Department of Environmental Quality	1	SUM	97,000.00	97,000	97,000	0%	97,000	0%	97,000	97,000	97,000
22	Project		Agency Fees and Reimbursements	CA State Water Resources Control Board	1	SUM	58,950.00	58,950	58,950	0%	58,950	0%	58,950	58,950	58,950
22	Project		Agency Fees and Reimbursements	Still Water Sciences (SWRCB)	1	SUM	1,281,945.00	1,281,945	1,281,945	0%	1,281,945	0%	1,281,945	1,281,945	1,281,945
22	Project		Agency Fees and Reimbursements	Other Environmental Studies	1	SUM	480,000.00	480,000	480,000	0%	480,000	0%	480,000	480,000	480,000
30			**ENGINEERING & CONSTRUCTION MANAGEMENT**												
31			**ENGINEERING - DESIGN DATA**												
31	Project		Engineering - Design Data	Detailed separately	1	sum	1,992,000.00	1,992,000	1,892,400	-5%	2,191,200	10%	1,992,000	1,892,400	2,191,200
32			**ENGINEERING - AECOM**												
32	Project		Construction Cost Estimate	Detailed separately	1	sum	295,000.00	295,000	280,250	-5%	324,500	10%	295,000	280,250	324,500
32	Project		AECOM Preliminary Design & Mitigation	Detailed separately	1	sum	3,585,000.00	3,585,000	3,405,750	-5%	3,943,500	10%	3,585,000	3,405,750	3,943,500
32	Project		AECOM Final Design & Construction Support	Detailed separately	1	sum	1,950,000.00	1,950,000	1,852,500	-5%	2,145,000	10%	1,950,000	1,852,500	2,145,000
32	Project		Review of PDB Final Design	Detailed separately	1	sum	285,000.00	285,000	270,750	-5%	313,500	10%	285,000	270,750	313,500
33			**ENGINEERING - PDB**												
33	Project		Engineering - PDB	Detailed separately	1	sum	6,513,000.00	6,513,000	5,861,700	-10%	8,466,900	30%	6,513,000	5,861,700	8,466,900
34			**PROCUREMENT**												
34	Project		Procurement	Detailed separately	1	sum	1,011,574.86	1,011,575	960,996	-5%	1,112,732	10%	1,011,575	960,996	1,112,732
35			**CONSTRUCTION MANAGEMENT**												
35	Project		Construction Management	Detailed separately	1	sum	10,616,599.33	10,616,599	10,085,769	-5%	11,678,259	10%	10,616,599	10,085,769	11,678,259
40			**CONSTRUCTION**												
41			**DAM REMOVAL**												
41	JC Boyle	1.001	JC Boyle Dam Removal	Removal of Diversion Conduit Bulkheads	14.00	CY	1,323.00	18,522	17,596	-5%	19,448	5%	20,835	19,793	21,876
41	JC Boyle	1.002	JC Boyle Dam Removal	Remove Water from behind Tailrace Cofferdam	500,000	GAL	0.01	5,309	4,778	-10%	6,105	15%	5,972	5,375	6,868
41	JC Boyle	1.003	JC Boyle Dam Removal	Provide Dewatering behind Tailrace Cofferdam	1.00	LS	61,036.38	61,036	54,933	-10%	70,192	15%	68,658	61,792	78,956
41	JC Boyle	1.004	JC Boyle Dam Removal	Construct Embankment Cofferdam in Tailrace around Powerho	2,000	CY	108.78	217,554	195,799	-10%	261,065	20%	244,719	220,247	293,662
41	JC Boyle	1.005	JC Boyle Dam Removal	Remove Spillway Concrete	2,100	CY	330.13	693,263	589,274	-15%	831,916	20%	779,827	662,853	935,793
41	JC Boyle	1.006	JC Boyle Dam Removal	Remove Monorail Structural Steel Components	15,000	LB	0.64	9,570	8,613	-10%	12,919	35%	10,765	9,688	14,533
41	JC Boyle	1.007	JC Boyle Dam Removal	Remove Fish Ladder Concrete	1,820	CY	333.49	606,952	546,257	-10%	667,647	10%	682,738	614,464	751,012
41	JC Boyle	1.008	JC Boyle Dam Removal	Remove Gravity Dam Section Concrete	600	CY	339.60	203,759	173,195	-15%	244,511	20%	229,201	194,821	275,041
41	JC Boyle	1.009	JC Boyle Dam Removal	Remove Timber Equipment Ramp on left side of Dam	10,500	LB	0.66	6,969	5,924	-15%	9,409	35%	7,840	6,664	10,584
41	JC Boyle	1.010	JC Boyle Dam Removal	Remove Pressure-Treated Lumber from Footbridge around Int	3,600	SF	7.19	25,886	23,298	-10%	29,769	15%	29,119	26,207	33,486
41	JC Boyle	1.011	JC Boyle Dam Removal	Remove Storage Shed located on access road	4,480	SF	27.79	124,519	118,293	-5%	136,970	10%	140,066	133,063	154,073
41	JC Boyle	1.012	JC Boyle Dam Removal	Remove Warehouse located on access road	2,580	SF	36.49	94,149	89,441	-5%	103,564	10%	105,905	100,609	116,495
41	JC Boyle	1.013	JC Boyle Dam Removal	Remove Fire System Control Bldg. on left abutment	520	SF	26.00	13,521	12,845	-5%	14,873	10%	15,209	14,448	16,730
41	JC Boyle	1.014	JC Boyle Dam Removal	Remove Dam Communication Bldg. on left abutment	490	SF	27.21	13,332	12,666	-5%	14,666	10%	14,997	14,247	16,497
41	JC Boyle	1.015	JC Boyle Dam Removal	Remove Concrete Slab on left abutment for former Control Ho	6.00	CY	1,778.57	10,671	9,604	-10%	12,272	15%	12,004	10,804	13,804
41	JC Boyle	1.016	JC Boyle Dam Removal	Remove 4'x5' Metal Hatch on top of Concrete Pull Box on left a	1.00	CY	1,769.46	1,769	1,593	-10%	1,946	10%	1,990	1,791	2,189
41	JC Boyle	1.017	JC Boyle Dam Removal	Remove Reservoir Level Gauge House on Dam Crest	24.00	SF	138.69	3,328	3,162	-5%	3,661	10%	3,744	3,557	4,118
41	JC Boyle	1.018	JC Boyle Dam Removal	Upstream Riprap	2,200	CY	93.45	205,581	185,023	-10%	226,139	10%	231,251	208,126	254,376
41	JC Boyle	1.019	JC Boyle Dam Removal	Downstream Riprap	1,300	CY	93.02	120,930	108,837	-10%	133,023	10%	136,030	122,427	149,633
41	JC Boyle	1.020	JC Boyle Dam Removal	Miscellaneous Excavation	132,500	CY	10.42	1,380,126	1,173,107	-15%	1,656,151	20%	1,552,454	1,319,586	1,862,945
41	JC Boyle	1.021	JC Boyle Dam Removal	Cutoff Wall Concrete Demolition	70.00	CY	655.64	45,895	43,600	-5%	52,779	15%	51,626	49,044	59,369
41	JC Boyle	1.022	JC Boyle Dam Removal	Cutoff Wall Anchors	285	EA	12.86	3,664	3,481	-5%	4,030	10%	4,121	3,915	4,533
41	JC Boyle	1.023	JC Boyle Dam Removal	Remove & Dispose Hand Rails and Light Poles	5,000	LB	0.85	4,227	4,016	-5%	4,861	15%	4,755	4,517	5,468
41	JC Boyle	1.024	JC Boyle Dam Removal	Remove & Dispose Spillway Radial Gates and Hoists	124,000	LB	2.14	264,891	238,402	-10%	357,603	35%	297,967	268,170	402,255
41	JC Boyle	1.025	JC Boyle Dam Removal	Remove & Dispose Stop Logs and Slots (steel)	92,000	LB	0.94	86,725	78,053	-10%	104,070	20%	97,554	87,799	117,065
41	JC Boyle	1.026	JC Boyle Dam Removal	Remove & Dispose of 24" Slide Gate at Entrance to Fish Ladd	4,200	LB	0.70	2,919	2,773	-5%	4,233	45%	3,284	3,120	4,761
41	JC Boyle	1.026a	JC Boyle Dam Removal	Remove petroleum products from Red Bam Area	1,600	GAL	13.34	21,338	18,137	-15%	27,739	30%	24,002	20,402	31,203
41	JC Boyle	1.027	JC Boyle Dam Removal	Remove & Dispose of Spillway gate motor & control panel	1.00	EA	1,282.33	1,282	1,154	-10%	1,539	20%	1,442	1,298	1,731
41	JC Boyle	1.028	JC Boyle Dam Removal	Remove & Dispose of Distribution equipment, panelboards	1.00	EA	5,877.55	5,878	5,290	-10%	7,053	20%	6,611	5,950	7,934

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	JC Boyle	1.029	JC Boyle Dam Removal	Remove Powerhouse Concrete down to Elevation 3324.0	1,500	CY	546.51	819,762	737,786	-10%	983,714	20%	922,121	829,909	1,106,545
41	JC Boyle	1.030	JC Boyle Dam Removal	Remove Structural Steel Item associated with Powerhouse	94,000	LB	0.63	59,073	53,166	-10%	67,935	15%	66,450	59,805	76,417
41	JC Boyle	1.031	JC Boyle Dam Removal	Remove Warehouse near Powerhouse	5,060	SF	32.95	166,704	158,369	-5%	183,375	10%	187,520	178,144	206,272
41	JC Boyle	1.032	JC Boyle Dam Removal	Remove & Dispose of 2 - Governor oil systems	52,500	LB	0.80	41,929	39,833	-5%	48,219	15%	47,165	44,807	54,240
41	JC Boyle	1.033	JC Boyle Dam Removal	Remove & Dispose of Cooling water and bearing oil systems	6,500	LB	1.06	6,905	6,215	-10%	7,941	15%	7,768	6,991	8,933
41	JC Boyle	1.034	JC Boyle Dam Removal	Remove & Dispose of 2 - Francis Turbines	560,000	LB	0.75	417,204	354,624	-15%	521,505	25%	469,298	398,903	586,623
41	JC Boyle	1.035	JC Boyle Dam Removal	Remove & Dispose of 150 Ton crane	240,000	LB	0.82	196,396	166,937	-15%	235,675	20%	220,919	187,781	265,103
41	JC Boyle	1.036	JC Boyle Dam Removal	Remove & Dispose of Compressed Air systems	1,100	LB	0.88	973	875	-10%	1,216	25%	1,094	985	1,368
41	JC Boyle	1.037	JC Boyle Dam Removal	Remove & Dispose of 2 - CO2 systems	6,600	LB	0.99	6,504	5,853	-10%	7,805	20%	7,316	6,584	8,779
41	JC Boyle	1.038	JC Boyle Dam Removal	Remove & Dispose of Plant Water and Fire Protection	3,100	LB	0.74	2,298	2,068	-10%	2,757	20%	2,585	2,326	3,101
41	JC Boyle	1.039	JC Boyle Dam Removal	Remove & Dispose of Transformer Oil Fire Protection	6,500	LB	0.80	5,207	4,426	-15%	6,248	20%	5,857	4,979	7,029
41	JC Boyle	1.04	JC Boyle Dam Removal	Remove & Dispose of Unwatering Piping	33,000	LB	0.74	24,351	19,481	-20%	30,439	25%	27,392	21,913	34,240
41	JC Boyle	1.041	JC Boyle Dam Removal	Remove & Dispose of Drainage Piping	10,000	LB	0.84	8,353	7,100	-15%	10,024	20%	9,396	7,987	11,275
41	JC Boyle	1.042	JC Boyle Dam Removal	Remove & Dispose of 2-Oil Sump pumps	2,000	LB	1.27	2,536	2,283	-10%	2,917	15%	2,853	2,568	3,281
41	JC Boyle	1.043	JC Boyle Dam Removal	Remove & Dispose of Draft Tube Bulk Head Gates and Hoists	65,000	LB	0.71	46,356	39,403	-15%	57,946	25%	52,145	44,323	65,181
41	JC Boyle	1.043a	JC Boyle Dam Removal	Remove petroleum products from Mechanical Equipment	2,700	GAL	10.27	27,735	23,575	-15%	36,056	30%	31,198	26,519	40,558
41	JC Boyle	1.044	JC Boyle Dam Removal	Remove & Dispose of Outdoor Vertical AC Generator, Unit 1:	2.00	EA	158,304.56	316,609	269,118	-15%	364,100	15%	356,142	302,721	409,564
41	JC Boyle	1.045	JC Boyle Dam Removal	Remove & Dispose of Excitation equipment for 53/50 MVA Ge	2.00	EA	13,425.63	26,851	24,166	-10%	29,536	10%	30,204	27,184	33,224
41	JC Boyle	1.046	JC Boyle Dam Removal	Remove & Dispose of Surge protection equip. for 53/50 MVA	2.00	EA	8,153.33	16,307	14,676	-10%	17,937	10%	18,343	16,508	20,177
41	JC Boyle	1.047	JC Boyle Dam Removal	Remove & Dispose of Neutral grounding equip. for 53/50 MVA	2.00	EA	3,980.33	7,961	7,165	-10%	8,757	10%	8,955	8,059	9,850
41	JC Boyle	1.048	JC Boyle Dam Removal	Remove & Dispose of Generator Switchgear, 15kV - (6 sectior	1.00	EA	19,730.68	19,731	16,771	-15%	24,663	25%	22,194	18,865	27,743
41	JC Boyle	1.049	JC Boyle Dam Removal	Remove & Dispose of Station Service Switchgear, 600 volt - (	1.00	EA	10,780.56	10,781	9,703	-10%	11,859	10%	12,127	10,914	13,339
41	JC Boyle	1.050	JC Boyle Dam Removal	Remove & Dispose of Unit and plant control switchboard	1.00	EA	5,903.27	5,903	5,313	-10%	6,494	10%	6,640	5,976	7,304
41	JC Boyle	1.051	JC Boyle Dam Removal	Remove & Dispose of Battery system	1.00	EA	7,430.59	7,431	6,688	-10%	8,174	10%	8,358	7,523	9,194
41	JC Boyle	1.052	JC Boyle Dam Removal	Remove & Dispose of Raceways, Conduit and Cable	1.00	EA	13,891.88	13,892	12,503	-10%	15,281	10%	15,626	14,064	17,189
41	JC Boyle	1.053	JC Boyle Dam Removal	Remove & Dispose of Misc. power & control boards	1.00	EA	7,140.08	7,140	6,426	-10%	7,854	10%	8,032	7,228	8,835
41	JC Boyle	1.054	JC Boyle Dam Removal	Remove & Dispose of 5 Gantry Crane motors - hoist (50Hp*),	1.00	EA	1,729.51	1,730	1,557	-10%	2,075	20%	1,945	1,751	2,335
41	JC Boyle	1.055	JC Boyle Dam Removal	Remove & Dispose of Gantry Crane control equipment (3 cubi	1.00	EA	5,869.29	5,869	5,282	-10%	6,456	10%	6,602	5,942	7,262
41	JC Boyle	1.056	JC Boyle Dam Removal	Remove & Dispose of Conduit and Cable	1.00	EA	10,561.93	10,562	9,506	-10%	12,674	20%	11,881	10,693	14,257
41	JC Boyle	1.057	JC Boyle Dam Removal	Remove & Dispose of Exterior Lighting	1.00	EA	10,640.74	10,641	9,577	-10%	12,237	15%	11,969	10,772	13,765
41	JC Boyle	1.058	JC Boyle Dam Removal	Remove & Dispose of Transmission Line No. 59	1.66	MI	31,411.84	52,144	44,322	-15%	65,180	25%	58,655	49,856	73,318
41	JC Boyle	1.059	JC Boyle Dam Removal	Remove & Dispose of Transmission Line No. 98	0.24	MI	27,715.54	6,652	5,654	-15%	8,315	25%	7,482	6,360	9,353
41	JC Boyle	1.060	JC Boyle Dam Removal	Remove & Dispose of Transmission Line No. 58	1.66	MI	31,411.84	52,144	44,322	-15%	65,180	25%	58,655	49,856	73,318
41	JC Boyle	1.061	JC Boyle Dam Removal	Remove Intake Structure Concrete	1,600	CY	294.80	471,675	424,508	-10%	566,010	20%	530,570	477,513	636,685
41	JC Boyle	1.062	JC Boyle Dam Removal	Remove Fish Screen Building	2,010	SF	70.46	141,616	134,535	-5%	155,777	10%	159,298	151,333	175,228
41	JC Boyle	1.063	JC Boyle Dam Removal	Remove 24-inch-dia. Steel Fish Discharge Pipe	37,978	LB	0.31	11,804	10,033	-15%	14,755	25%	13,278	11,286	16,597
41	JC Boyle	1.064	JC Boyle Dam Removal	Remove Concrete Items associated with the 14-ft-diameter St	1,010	CY	313.62	316,752	269,239	-15%	364,265	15%	356,303	302,857	409,748
41	JC Boyle	1.065	JC Boyle Dam Removal	Remove Open Concrete Flume	26,000	CY	266.49	6,928,771	6,235,894	-10%	8,314,525	20%	7,793,925	7,014,533	9,352,710
41	JC Boyle	1.066	JC Boyle Dam Removal	Remove Structural Steel Items associated with the Forebay Tr	11,500	LB	0.49	5,628	4,784	-15%	7,035	25%	6,331	5,381	7,914
41	JC Boyle	1.067	JC Boyle Dam Removal	Remove Fore bay Concrete	2,500	CY	298.78	746,951	672,256	-10%	896,341	20%	840,218	756,197	1,008,262
41	JC Boyle	1.068	JC Boyle Dam Removal	Place Concrete Plugs at Tunnel Portals	30.00	CY	1,616.26	48,488	46,063	-5%	50,912	5%	54,542	51,815	57,269
41	JC Boyle	1.069	JC Boyle Dam Removal	Remove Concrete Items associated with Penstocks D/S from	1,800	CY	495.44	891,799	802,619	-10%	1,070,158	20%	1,003,152	902,837	1,203,783
41	JC Boyle	1.070	JC Boyle Dam Removal	Remove Head gate Control Building at Flume Entrance	500	SF	99.08	49,542	44,588	-10%	56,973	15%	55,728	50,155	64,087
41	JC Boyle	1.071	JC Boyle Dam Removal	Remove Fore bay Spillway Gate House	610	SF	89.23	54,431	48,988	-10%	65,318	20%	61,228	55,105	73,473
41	JC Boyle	1.072	JC Boyle Dam Removal	Remove Fore bay Control Building	560	SF	96.68	54,141	48,727	-10%	64,969	20%	60,901	54,811	73,081
41	JC Boyle	1.074	JC Boyle Dam Removal	Remove Insulated Generator Building next to Fore bay Control	90.00	SF	166.30	14,967	13,470	-10%	17,960	20%	16,835	15,152	20,203
41	JC Boyle	1.075	JC Boyle Dam Removal	Remove Fixed Wheel Gate (gate, Frame, and Hoist)	55,000	LB	0.53	29,090	23,272	-20%	36,363	25%	32,722	26,178	40,903
41	JC Boyle	1.076	JC Boyle Dam Removal	Remove Trash rack and trash rake (steel)	75,000	LB	0.51	38,047	30,438	-20%	47,559	25%	42,798	34,238	53,497
41	JC Boyle	1.077	JC Boyle Dam Removal	Remove stop Logs and slots (steel)	136,000	LB	0.79	107,370	96,633	-10%	134,213	25%	120,777	108,699	150,971
41	JC Boyle	1.078	JC Boyle Dam Removal	Remove Traveling Water Screen	124,000	LB	0.50	62,509	56,258	-10%	78,136	25%	70,314	63,282	87,892
41	JC Boyle	1.079	JC Boyle Dam Removal	Remove Fish By-Pass and Supports (steel)	610,000	LB	0.77	468,978	422,080	-10%	539,325	15%	527,537	474,783	606,667
41	JC Boyle	1.080	JC Boyle Dam Removal	Remove Gates and Hoists	18,500	LB	0.48	8,848	7,521	-15%	11,503	30%	9,953	8,460	12,939
41	JC Boyle	1.081	JC Boyle Dam Removal	Remove Trash rack and trash rake (steel)	47,249	LB	0.60	28,236	24,001	-15%	36,707	30%	31,762	26,998	41,291
41	JC Boyle	1.082	JC Boyle Dam Removal	Remove stop Logs and slots (steel)	37,069	LB	0.62	23,167	19,692	-15%	30,117	30%	26,060	22,151	33,878
41	JC Boyle	1.083	JC Boyle Dam Removal	Remove & Dispose Penstocks and bifurcation (steel)	1,600,000	LB	0.70	1,112,218	945,385	-15%	1,334,661	20%	1,251,094	1,063,429	1,501,312
41	JC Boyle	1.084	JC Boyle Dam Removal	Remove & Dispose Surge Tank (steel)	79,000	LB	0.82	64,445	58,000	-10%	83,778	30%	72,492	65,242	94,239
41	JC Boyle	1.085	JC Boyle Dam Removal	Remove & Dispose 2 - 108" Butterfly valves	148,000	LB	0.74	109,839	98,855	-10%	142,790	30%	123,554	111,198	160,620
41	JC Boyle	1.086	JC Boyle Dam Removal	Remove & Dispose Gate, Stem and Frame	28,000	LB	0.71	19,883	17,895	-10%	23,860	20%	22,366	20,129	26,839
41	JC Boyle	1.087	JC Boyle Dam Removal	Remove & Dispose of Steel Transition Manifolds on Upstream	250,000	LB	0.64	160,863	136,734	-15%	209,122	30%	180,949	153,807	235,234
41	JC Boyle	1.087a	JC Boyle Dam Removal	Remove petroleum products from Mechanical Equipment	380	GAL	16.54	6,284	5,342	-15%	8,169	30%	7,069	6,008	9,189
41	JC Boyle	1.097	JC Boyle Dam Removal	Clear and Grub Disposal Area (Embankment)	10.00	AC	12,954.90	129,549	116,594	-10%	142,504	10%	145,725	131,152	160,297
41	JC Boyle	1.098	JC Boyle Dam Removal	Clear and Grub, 40' width	2.40	AC	12,954.90	31,092	27,983	-10%	34,201	10%	34,974	31,477	38,471
41	JC Boyle	1.099	JC Boyle Dam Removal	4" thick gravel surfacing	2,150	T	29.66	63,762	57,386	-10%	70,139	10%	71,724	64,552	78,896
41	JC Boyle	1.103	JC Boyle Dam Removal	Soil Cover over Concrete Rubble	13,000	CY	8.64	112,348	101,113	-10%	134,818	20%	126,376	113,739	151,651
41	JC Boyle	1.107	JC Boyle Dam Removal	Embankment Fill in Waste way (Fore bay) Scour Hole	55,900	CY	77.16	4,313,417	3,882,075	-10%	4,744,759	10%	4,852,008	4,366,807	5,337,209
41	JC Boyle	1.108	JC Boyle Dam Removal	Topsy Recreational Area - Concrete total	68.00	CY	454.68	30,918	29,372	-5%	34,010	10%	34,779	33,040	38,256
41	JC Boyle	1.109	JC Boyle Dam Removal	Topsy Recreational Area - 6'x80' Floating dock made of lumbe	1.00	EA	8,816.20	8,816	8,375	-5%	9,257	5%	9,917	9,421	10,413
41	JC Boyle	1.110	JC Boyle Dam Removal	Topsy Recreational Area - 5'x20' Walkway leading to hex fishir	200	SF	10.02	2,005	1,904	-5%	2,105	5%	2,255	2,142	2,368

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	JC Boyle	1.111	JC Boyle Dam Removal	Topsy Recreational Area - Regrade to natural contour	300	SF	14.63	4,390	4,171	-5%	4,829	10%	4,938	4,691	5,432
41	JC Boyle	1.112	JC Boyle Dam Removal	Pioneer Park - Picnic tables to be removed and hauled away	12.00	EA	156.62	1,879	1,785	-5%	1,973	5%	2,114	2,008	2,220
41	JC Boyle	1.113	JC Boyle Dam Removal	Pioneer Park - 12 Concrete fire rings	5.00	CY	353.89	1,769	1,681	-5%	1,858	5%	1,990	1,891	2,090
41	JC Boyle	1.114	JC Boyle Dam Removal	Pioneer Park - Portable toilets to be removed and hauled away	2.00	EA	1,002.35	2,005	1,904	-5%	2,105	5%	2,255	2,142	2,368
41	JC Boyle	1.115	JC Boyle Dam Removal	Pioneer Park - Signs to be removed and hauled away	6.00	EA	141.12	847	804	-5%	889	5%	952	905	1,000
41	JC Boyle	1.116	JC Boyle Dam Removal	Pioneer Park - Dumpster to be removed and hauled away	1.00	EA	2,971.02	2,971	2,674	-10%	3,417	15%	3,342	3,008	3,843
41	JC Boyle	1.118	JC Boyle Dam Removal	Pioneer Park - Regrade to natural contour	0.50	AC	17,560.36	8,780	7,902	-10%	9,658	10%	9,877	8,889	10,864
41	JC Boyle	5.000	JC Boyle Dam Removal	Remove Frame dead end structures 60-80 ft high	2.00	EA	7,101.59	14,203	12,783	-10%	17,044	20%	15,977	14,379	19,172
41	JC Boyle	5.001	JC Boyle Dam Removal	Remove (incl foundation) and Save Transformers 230KV	2.00	EA	2,688.70	5,377	4,840	-10%	6,184	15%	6,049	5,444	6,956
41	JC Boyle	5.002	JC Boyle Dam Removal	Remove (incl foundation) and Save Power Circuit Breakers 2	2.00	EA	3,640.83	7,282	6,918	-5%	8,010	10%	8,191	7,781	9,010
41	JC Boyle	5.003	JC Boyle Dam Removal	Substation Tie Structure 230KV	1.00	EA	41,482.05	41,482	37,334	-10%	47,704	15%	46,662	41,995	53,661
41	JC Boyle	5.004	JC Boyle Dam Removal	Remove Chain Link Fence	601	LF	17.70	10,639	9,575	-10%	11,703	10%	11,967	10,770	13,164
41	JC Boyle	5.005	JC Boyle Dam Removal	Demolish overhead distribution 2.5 miles (30-45 poles)	45.00	EA	1,160.01	52,200	46,980	-10%	62,640	20%	58,718	52,846	70,462
41	JC Boyle	5.032	JC Boyle Dam Removal	Install 230kV strain transmission structures outside JC Boyle S	2.00	EA	132,241.37	264,483	238,034	-10%	317,379	20%	297,507	267,756	357,009
41	Copco 1	2.001	Copco 1 Dam Removal	Furnish, Install, and Remove Barge-Mounted Crane in Reservo	1.00	LS	191,823.14	191,823	172,641	-10%	239,779	25%	215,775	194,197	269,719
41	Copco 1	2.002	Copco 1 Dam Removal	Remove Sediment from Diversion Tunnel Intake to provide acc	30.00	CY	3,434.68	103,040	92,736	-10%	123,649	20%	115,907	104,316	139,088
41	Copco 1	2.003	Copco 1 Dam Removal	Furnish, Install, and Remove Large Crane on Right Abutment	1.00	LS	566,865.71	566,866	481,836	-15%	651,896	15%	637,647	542,000	733,294
41	Copco 1	2.004	Copco 1 Dam Removal	Remove Water from behind Tailrace Cofferdam	200,000	GAL	0.01	2,091	1,882	-10%	2,405	15%	2,353	2,117	2,706
41	Copco 1	2.005	Copco 1 Dam Removal	Riprap Protection on Cofferdam	260	CY	148.31	38,561	32,777	-15%	46,273	20%	43,376	36,869	52,051
41	Copco 1	2.006	Copco 1 Dam Removal	Provide Dewatering behind Tailrace Cofferdam	1.00	LS	89,882.80	89,883	80,895	-10%	107,859	20%	101,106	90,995	121,327
41	Copco 1	2.007	Copco 1 Dam Removal	Remove Current Diversion Tunnel Plug	195	CY	1,390.41	271,129	244,016	-10%	325,355	20%	304,983	274,485	365,980
41	Copco 1	2.008	Copco 1 Dam Removal	Construct Embankment Cofferdam in Tailrace	1,700	CY	165.62	281,551	239,319	-15%	337,862	20%	316,707	269,201	380,049
41	Copco 1	2.009	Copco 1 Dam Removal	Installation of 3 each 72" Blind Flanges	38,000	LB	34.66	1,317,134	1,119,564	-15%	1,712,274	30%	1,481,597	1,259,357	1,926,076
41	Copco 1	2.009.2	Copco 1 Dam Removal	Installation of 16.5 X 18.5 Roller Gate and Gate Structure	1.00	LS	4,098,153.55	4,098,154	3,483,431	-15%	5,327,600	30%	4,609,865	3,918,386	5,992,825
41	Copco 1	2.009.3	Copco 1 Dam Removal	Removal of 16.5 X 18.5 Roller Gate and Gate Structure	1.00	LS	271,584.86	271,585	230,847	-15%	353,060	30%	305,496	259,672	397,145
41	Copco 1	2.010	Copco 1 Dam Removal	Remove Concrete Dam down to Elev. 2476	36,000	CY	227.38	8,185,528	7,366,975	-10%	9,822,633	20%	9,207,605	8,286,845	11,049,126
41	Copco 1	2.011	Copco 1 Dam Removal	Remove Concrete Intake Structure on Right Abutment	21,000	CY	346.51	7,276,705	6,185,199	-15%	8,732,046	20%	8,185,303	6,957,508	9,822,364
41	Copco 1	2.012	Copco 1 Dam Removal	Remove Structural Steel from Spillway	55,000	LB	1.27	69,659	59,210	-15%	87,074	25%	78,357	66,604	97,946
41	Copco 1	2.013	Copco 1 Dam Removal	Install Diversion Tunnel Plugs	30.00	CY	1,330.24	39,907	35,916	-10%	45,893	15%	44,890	40,401	51,624
41	Copco 1	2.014	Copco 1 Dam Removal	Remove Diversion Tunnel Control Structure Concrete	350	CY	231.13	80,895	72,805	-10%	97,074	20%	90,995	81,896	109,195
41	Copco 1	2.015	Copco 1 Dam Removal	Remove & Dispose of Hand Rails	11,000	LB	1.36	14,919	12,681	-15%	17,903	20%	16,782	14,265	20,139
41	Copco 1	2.016	Copco 1 Dam Removal	Remove & Dispose of Radial Gates	140,500	LB	1.11	156,117	140,505	-10%	195,146	25%	175,610	158,049	219,513
41	Copco 1	2.017	Copco 1 Dam Removal	Remove & Dispose Radial Gate Stop logs	18,000	LB	1.06	19,126	17,214	-10%	23,908	25%	21,515	19,363	26,893
41	Copco 1	2.018	Copco 1 Dam Removal	Remove & Dispose Stop log hoist, track and supports	26,000	LB	1.03	26,842	24,158	-10%	33,552	25%	30,193	27,174	37,742
41	Copco 1	2.019	Copco 1 Dam Removal	Remove & Dispose of 3 sections of 23' of 72" Dia. steel lining (	54,000	LB	1.04	56,361	47,906	-15%	67,633	20%	63,398	53,888	76,078
41	Copco 1	2.020	Copco 1 Dam Removal	Remove & Dispose of 3 - 72" butterfly valves (embedded)	55,000	LB	1.10	60,293	54,264	-10%	69,337	15%	67,822	61,040	77,995
41	Copco 1	2.021	Copco 1 Dam Removal	Remove & Dispose of 3 - 72" flapper valves with remote mech	78,000	LB	5.54	432,104	388,894	-10%	496,920	15%	486,058	437,453	558,967
41	Copco 1	2.022	Copco 1 Dam Removal	Remove & Dispose of Spillway gate motor & control panel	1.00	EA	1,318.63	1,319	1,187	-10%	1,516	15%	1,483	1,335	1,706
41	Copco 1	2.023	Copco 1 Dam Removal	Remove & Dispose Distribution equipment, panelboards	1.00	EA	5,877.55	5,878	5,290	-10%	7,053	20%	6,611	5,950	7,934
41	Copco 1	2.024	Copco 1 Dam Removal	Remove Powerhouse Concrete down to top of rock under the	3,100	CY	387.53	1,201,333	1,021,133	-15%	1,501,667	25%	1,351,337	1,148,636	1,689,171
41	Copco 1	2.025	Copco 1 Dam Removal	Remove Powerhouse Structural Steel	110,000	LB	1.02	112,188	95,360	-15%	134,625	20%	126,196	107,267	151,435
41	Copco 1	2.026	Copco 1 Dam Removal	Remove & Dispose of 2 - Governor Oil Systems	38,000	LB	1.07	40,521	36,469	-10%	50,651	25%	45,580	41,022	56,975
41	Copco 1	2.027	Copco 1 Dam Removal	Remove & Dispose of Cooling water and bearing oil systems	11,000	LB	3.16	34,710	31,239	-10%	41,652	20%	39,044	35,140	46,853
41	Copco 1	2.028	Copco 1 Dam Removal	Remove & Dispose of 4 - Horizontal Tandem Francis Turbines	452,000	LB	0.80	362,135	325,922	-10%	434,562	20%	407,353	366,618	488,824
41	Copco 1	2.029	Copco 1 Dam Removal	Remove & Dispose of 2 - 40 Ton indoor cranes	140,000	LB	0.74	103,941	88,350	-15%	124,729	20%	116,920	99,382	140,304
41	Copco 1	2.030	Copco 1 Dam Removal	Remove & Dispose of Compressed Air System	1,000	LB	1.00	997	897	-10%	1,147	15%	1,122	1,009	1,290
41	Copco 1	2.031	Copco 1 Dam Removal	Remove & Dispose of 2 - CO2 Systems	3,100	LB	1.05	3,252	2,927	-10%	3,739	15%	3,658	3,292	4,206
41	Copco 1	2.032	Copco 1 Dam Removal	Remove & Dispose of Plant Water and Fire Protection	2,600	LB	1.35	3,511	3,160	-10%	4,214	20%	3,950	3,555	4,740
41	Copco 1	2.033	Copco 1 Dam Removal	Remove & Dispose of Transformer Oil Fire Protection	5,400	LB	1.22	6,586	5,927	-10%	7,903	20%	7,408	6,667	8,890
41	Copco 1	2.034	Copco 1 Dam Removal	Remove & Dispose of Unwatering Piping	27,000	LB	0.73	19,738	16,777	-15%	24,672	25%	22,202	18,872	27,753
41	Copco 1	2.035	Copco 1 Dam Removal	Remove & Dispose of Drainage Piping	5,000	LB	1.04	5,202	4,422	-15%	6,503	25%	5,852	4,974	7,314
41	Copco 1	2.035a	Copco 1 Dam Removal	Remove petroleum products from mechanical equipment	1,250	GAL	4.39	5,490	4,941	-10%	6,313	15%	6,175	5,558	7,101
41	Copco 1	2.036	Copco 1 Dam Removal	Remove & Dispose of Horizontal AC Generator, Indoor Open F	2.00	EA	38,691.77	77,384	65,776	-15%	92,860	20%	87,046	73,989	104,455
41	Copco 1	2.037	Copco 1 Dam Removal	Remove & Dispose of Excitation equipment for 12.5 MVA Gen	1.50	EA	8,472.47	12,709	10,802	-15%	15,886	25%	14,296	12,151	17,869
41	Copco 1	2.038	Copco 1 Dam Removal	Remove & Dispose of Surge protection equip. for 12.5 MVA G	2.00	EA	2,504.46	5,009	4,258	-15%	6,512	30%	5,634	4,789	7,325
41	Copco 1	2.039	Copco 1 Dam Removal	Remove & Dispose of Neutral grounding equip. for 12.5 MVA G	2.00	EA	2,332.24	4,664	4,198	-10%	5,364	15%	5,247	4,722	6,034
41	Copco 1	2.040	Copco 1 Dam Removal	Remove & Dispose of Generator Switchgear, 5kV-includes uni	1.00	EA	20,666.10	20,666	18,599	-10%	23,766	15%	23,247	20,922	26,734
41	Copco 1	2.041	Copco 1 Dam Removal	Remove & Dispose of Station Service Switchgear, 600 volt - (5	1.00	EA	11,311.14	11,311	10,180	-10%	13,008	15%	12,723	11,451	14,632
41	Copco 1	2.042	Copco 1 Dam Removal	Remove & Dispose of Unit and plant control switchboard	1.00	EA	6,110.32	6,110	5,499	-10%	7,027	15%	6,873	6,186	7,904
41	Copco 1	2.043	Copco 1 Dam Removal	Remove & Dispose of Battery System	1.00	EA	20,638.63	20,639	18,575	-10%	23,734	15%	23,216	20,894	26,698
41	Copco 1	2.044	Copco 1 Dam Removal	Remove & Dispose of Raceways, Conduit and Cable	1.00	EA	17,082.48	17,082	15,374	-10%	19,645	15%	19,215	17,294	22,098
41	Copco 1	2.045	Copco 1 Dam Removal	Remove & Dispose of Misc. power & control boards	1.00	EA	6,945.94	6,946	6,251	-10%	7,988	15%	7,813	7,032	8,985
41	Copco 1	2.046	Copco 1 Dam Removal	Remove & Dispose of Step-up Transformers, indoor, oil-filled,	3.00	EA	64,338.39	193,015	173,714	-10%	221,967	15%	217,116	195,404	249,683
41	Copco 1	2.047	Copco 1 Dam Removal	Remove & Dispose of Step-up Transformers, indoor, oil-filled, (	3.00	EA	57,252.76	171,758	154,582	-10%	197,522	15%	193,205	173,884	222,185
41	Copco 1	2.048	Copco 1 Dam Removal	Remove & Dispose of Seven 40-Ton Travelling Crane motors	1.00	EA	3,306.69	3,307	2,976	-10%	3,803	15%	3,720	3,348	4,278
41	Copco 1	2.049	Copco 1 Dam Removal	Remove & Dispose of 40-Ton Travelling Crane control equipm	1.00	EA	4,364.61	4,365	3,928	-10%	5,019	15%	4,910	4,419	5,646
41	Copco 1	2.050	Copco 1 Dam Removal	Remove & Dispose of 40-Ton Travelling Crane Festoon Cable	1.00	EA	1,534.84	1,535	1,381	-10%	1,842	20%	1,726	1,554	2,072

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					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Copco 1	2.051	Copco 1 Dam Removal	Remove & Dispose of Four 15-Ton Overhead Crane Motors -	1.00	EA	959.54	960	864	-10%	1,151	20%	1,079	971	1,295
41	Copco 1	2.052	Copco 1 Dam Removal	Remove & Dispose of 15-Ton Overhead Crane control equipm	1.00	EA	434.20	434	391	-10%	499	15%	488	440	562
41	Copco 1	2.053	Copco 1 Dam Removal	Remove & Dispose of 15-Ton Overhead Crane Festoon Cable	1.00	EA	637.49	637	574	-10%	733	15%	717	645	825
41	Copco 1	2.053a	Copco 1 Dam Removal	Remove petroleum products from mechanical equipment	10,500	GAL	10.39	109,116	98,204	-10%	125,483	15%	122,740	110,466	141,151
41	Copco 1	2.054	Copco 1 Dam Removal	Remove & Dispose of 69kV circuit breakers, oil0 filled, PCB	2.00	EA	861.46	1,723	1,551	-10%	1,895	10%	1,938	1,744	2,132
41	Copco 1	2.055	Copco 1 Dam Removal	Remove & Dispose of 69kV disconnect switches, group-opera	2.00	EA	861.46	1,723	1,551	-10%	1,895	10%	1,938	1,744	2,132
41	Copco 1	2.056	Copco 1 Dam Removal	Remove & Dispose of 60-foot wood poles	12.00	EA	1,296.96	15,563	13,229	-15%	18,676	20%	17,507	14,881	21,008
41	Copco 1	2.057	Copco 1 Dam Removal	Remove & Dispose of 30-foot wood cross arms	24.00	EA	484.41	11,626	9,882	-15%	13,951	20%	13,078	11,116	15,693
41	Copco 1	2.058	Copco 1 Dam Removal	Remove & Dispose of 69-kV insulator strings	12.00	EA	372.92	4,475	3,804	-15%	5,370	20%	5,034	4,279	6,041
41	Copco 1	2.059	Copco 1 Dam Removal	Remove & Dispose of Transmission Line No. 3	1.66	MI	31,411.84	52,144	44,322	-15%	65,180	25%	58,655	49,856	73,318
41	Copco 1	2.060	Copco 1 Dam Removal	Remove & Dispose of Transmission Line No. 15	1.23	MI	33,971.31	41,785	35,517	-15%	52,231	25%	47,002	39,952	58,753
41	Copco 1	2.061	Copco 1 Dam Removal	Remove & Dispose of Transmission Line No. 26-1	0.07	MI	33,525.16	2,347	1,995	-15%	2,933	25%	2,640	2,244	3,300
41	Copco 1	2.062	Copco 1 Dam Removal	Remove & Dispose of Transmission Line No. 26-2	0.07	MI	33,525.16	2,347	1,995	-15%	2,933	25%	2,640	2,244	3,300
41	Copco 1	2.063	Copco 1 Dam Removal	Remove gate house #1 from top of dam	720	SF	72.06	51,880	44,098	-15%	64,850	25%	58,358	49,604	72,947
41	Copco 1	2.064	Copco 1 Dam Removal	Remove gate house #2 from top of dam	690	SF	74.35	51,302	43,607	-15%	64,128	25%	57,708	49,052	72,135
41	Copco 1	2.065	Copco 1 Dam Removal	Remove Concrete Items associated with 10 ft. diam. Penstock	1,050	CY	300.38	315,398	268,089	-15%	394,248	25%	354,780	301,563	443,476
41	Copco 1	2.066	Copco 1 Dam Removal	Plug 14-foot diameter penstock with concrete	23.00	CY	3,373.31	77,586	69,828	-10%	89,224	15%	87,274	78,547	100,365
41	Copco 1	2.067	Copco 1 Dam Removal	Remove & Dispose of 8 screens	18,000	LB	1.17	21,014	18,913	-10%	25,217	20%	23,638	21,275	28,366
41	Copco 1	2.068	Copco 1 Dam Removal	Remove & Dispose of 8 Water Gates	18,000	LB	1.10	19,802	17,822	-10%	23,762	20%	22,274	20,047	26,729
41	Copco 1	2.069	Copco 1 Dam Removal	Remove & Dispose of 3 - 30" Dia. x 25' stand pipes	6,000	LB	0.91	5,458	4,912	-10%	6,550	20%	6,140	5,526	7,368
41	Copco 1	2.070	Copco 1 Dam Removal	Remove & Dispose of 14' Dia. penstock pipe	256,000	LB	1.31	335,207	284,926	-15%	419,009	25%	377,063	320,503	471,328
41	Copco 1	2.071	Copco 1 Dam Removal	Remove & Dispose of 10' Dia. penstock pipe	270,000	LB	1.37	370,853	315,225	-15%	463,566	25%	417,159	354,585	521,449
41	Copco 1	2.081	Copco 1 Dam Removal	Site work - Clear and Grub Disposal Area	4.00	AC	13,732.22	54,929	46,690	-15%	65,915	20%	61,788	52,519	74,145
41	Copco 1	2.082	Copco 1 Dam Removal	Site work - Soil Cover for Disposal Area	12,000	CY	6.84	82,107	69,791	-15%	98,529	20%	92,359	78,505	110,831
41	Copco 1	2.089	Copco 1 Dam Removal	Mallard Cove - Concrete total	106	CY	338.09	35,838	30,462	-15%	41,214	15%	40,313	34,266	46,360
41	Copco 1	2.09	Copco 1 Dam Removal	Mallard Cove - 25'x5' Dock made of composite decking and po	1.00	EA	3,009.15	3,009	2,558	-15%	3,461	15%	3,385	2,877	3,893
41	Copco 1	2.091	Copco 1 Dam Removal	Mallard Cove - 20'x5' Gangway w/ aluminum grate and railings	1.00	EA	2,758.50	2,758	2,345	-15%	3,172	15%	3,103	2,637	3,568
41	Copco 1	2.092	Copco 1 Dam Removal	Mallard Cove - Signs to be removed and hauled away	6.00	EA	152.39	914	823	-10%	1,006	10%	1,029	926	1,131
41	Copco 1	2.093	Copco 1 Dam Removal	Mallard Cove - Wood plank tables to be removed and hauled a	8.00	EA	114.29	914	823	-10%	1,006	10%	1,029	926	1,131
41	Copco 1	2.094	Copco 1 Dam Removal	Mallard Cove - Parking area to be regraded	2.50	AC	7,451.08	18,628	16,765	-10%	21,422	15%	20,954	18,858	24,097
41	Copco 1	2.095	Copco 1 Dam Removal	Copco Cove - Concrete Total	84.00	CY	331.83	27,874	23,693	-15%	32,055	15%	31,354	26,651	36,058
41	Copco 1	2.096	Copco 1 Dam Removal	Copco Cove - Dock abutment railing made of 2.5" dia. steel pi	1.00	EA	1,446.70	1,447	1,302	-10%	1,591	10%	1,627	1,465	1,790
41	Copco 1	2.097	Copco 1 Dam Removal	Copco Cove - Signs to be removed and hauled away	6.00	EA	407.82	2,447	2,202	-10%	2,692	10%	2,752	2,477	3,028
41	Copco 1	2.098	Copco 1 Dam Removal	Copco Cove - Wood plank tables to be removed and hauled a	2.00	EA	152.39	305	274	-10%	335	10%	343	309	377
41	Copco 1	2.099	Copco 1 Dam Removal	Copco Cove - Regrade	2.30	AC	6,531.70	15,023	13,521	-10%	17,276	15%	16,899	15,209	19,434
41	Copco 1	2.100	Copco 1 Dam Removal	Diversion Tunnel Lining	1.00	LS	244,844.33	244,844	220,360	-10%	281,571	15%	275,417	247,875	316,729
41	Copco 1	5.006	Copco 1 Dam Removal	Remove Frame Dead End Structures 60-80ft High @ Switch Y	4.00	EA	6,436.15	25,745	21,883	-15%	33,468	30%	28,959	24,615	37,647
41	Copco 1	5.007	Copco 1 Dam Removal	Remove Power Circuit Breakers 69KV @ Switch Yard	2.00	EA	5,681.20	11,362	10,226	-10%	14,203	25%	12,781	11,503	15,976
41	Copco 1	5.008	Copco 1 Dam Removal	Remove Disconnect Switches @ Switch Yard	4.00	EA	9,731.40	38,926	35,033	-10%	48,657	25%	43,786	39,407	54,733
41	Copco 1	5.009	Copco 1 Dam Removal	Remove All Associated AUX Equipment @ Switch Yard (allow	1.00	LS	48,501.71	48,502	43,652	-10%	60,627	25%	54,558	49,102	68,197
41	Copco 1	5.010	Copco 1 Dam Removal	Remove Distribution Lines 69 KV Copco 1 Switch Yard and HE	6.00	EA	1,402.44	8,415	7,573	-10%	10,518	25%	9,465	8,519	11,832
41	Copco 1	5.011	Copco 1 Dam Removal	Remove Distribution Poles 2.4 KV Btw Copco 1/ HE Plant/ Co	8.00	EA	1,950.45	15,604	14,043	-10%	19,505	25%	17,552	15,797	21,940
41	Copco 1	5.012	Copco 1 Dam Removal	Remove Production Poles in General Area of Copco 1	7.00	EA	1,956.86	13,698	11,643	-15%	17,807	30%	15,408	13,097	20,031
41	Copco 1	5.013	Copco 1 Dam Removal	Remove Village House Distribution Poles Near Dam (Est 10 ea	10.00	EA	1,293.71	12,937	10,997	-15%	16,818	30%	14,552	12,370	18,918
41	Copco 1	5.014	Copco 1 Dam Removal	Remove 69 KV Distribution Line 1.6 Miles (30 Poles)	30.00	EA	2,096.19	62,886	53,453	-15%	81,751	30%	70,738	60,127	91,959
41	Copco 1	5.015	Copco 1 Dam Removal	Remove Transmission Conductors on Poles 1X/001 and 2X/00	2.00	EA	2,686.44	5,373	4,567	-15%	6,985	30%	6,044	5,137	7,857
41	Copco 1	5.016	Copco 1 Dam Removal	Remove Transmission Conductors 1.3 Miles Copco 1 to Copco	6,864	LF	7.16	49,138	41,767	-15%	63,880	30%	55,274	46,983	71,856
41	Copco 2	3.001	Copco 2 Dam Removal	Construct and Remove Embankment Cofferdam-Right Side of	3,100	CY	59.70	185,071	148,057	-20%	259,100	40%	208,180	166,544	291,452
41	Copco 2	3.002	Copco 2 Dam Removal	Furnish, Install, and Remove RipRap	465	CY	129.88	60,392	48,314	-20%	84,549	40%	67,933	54,347	95,106
41	Copco 2	3.003	Copco 2 Dam Removal	Provide Dewatering behind Cofferdams	1.00	LS	143,210.99	143,211	128,890	-10%	186,174	30%	161,093	144,984	209,421
41	Copco 2	3.004	Copco 2 Dam Removal	Remove Water from behind Cofferdams	241,000	GAL	0.02	5,834	5,251	-10%	7,584	30%	6,563	5,906	8,531
41	Copco 2	3.005	Copco 2 Dam Removal	Construct and Remove Embankment Cofferdam-Left Side of D	1,100	CY	172.54	189,793	147,837	-22%	258,715	36%	213,491	166,297	291,019
41	Copco 2	3.006	Copco 2 Dam Removal	Furnish, Install, and Remove RipRap	250	CY	185.94	46,486	37,189	-20%	65,080	40%	52,290	41,832	73,207
41	Copco 2	3.007	Copco 2 Dam Removal	Provide Dewatering behind left Side Cofferdam	1.00	LS	79,612.67	79,613	71,651	-10%	103,496	30%	89,553	80,598	116,419
41	Copco 2	3.008	Copco 2 Dam Removal	Remove Water from behind Cofferdams	36,000	GAL	0.15	5,352	4,817	-10%	6,958	30%	6,021	5,418	7,827
41	Copco 2	3.009	Copco 2 Dam Removal	Remove Water from behind Tailrace Cofferdam	400,000	GAL	0.03	10,287	9,258	-10%	13,373	30%	11,571	10,414	15,043
41	Copco 2	3.010	Copco 2 Dam Removal	Provide Dewatering behind Tailrace Cofferdam	1.00	LS	49,938.86	49,939	44,945	-10%	64,921	30%	56,174	50,557	73,027
41	Copco 2	3.011	Copco 2 Dam Removal	Construct Embankment Cofferdam across Tailrace	1,700	CY	115.34	196,077	156,862	-20%	274,508	40%	220,560	176,448	308,784
41	Copco 2	3.014	Copco 2 Dam Removal	Remove Concrete in Dam	4,430	CY	253.02	1,120,868	952,738	-15%	1,625,258	45%	1,260,824	1,071,700	1,828,195
41	Copco 2	3.015	Copco 2 Dam Removal	Remove concrete equipment slab from top of embankment wi	5.00	CY	353.89	1,769	1,504	-15%	2,300	30%	1,990	1,692	2,588
41	Copco 2	3.016	Copco 2 Dam Removal	Remove Concrete Wing wall	240	CY	217.45	52,187	44,359	-15%	67,843	30%	58,703	49,898	76,314
41	Copco 2	3.017	Copco 2 Dam Removal	Right Abutment Removal - Random Fill	1,510	CY	52.34	79,041	67,185	-15%	98,801	25%	88,910	75,574	111,138
41	Copco 2	3.018	Copco 2 Dam Removal	Right Abutment Removal - Remove Hand Placed Riprap	5,400	SF	2.26	12,211	10,379	-15%	15,264	25%	13,736	11,675	17,170
41	Copco 2	3.019	Copco 2 Dam Removal	Right Abutment Removal - Gunite Curtain Wall	180	CY	333.73	60,071	51,060	-15%	75,089	25%	67,572	57,436	84,465
41	Copco 2	3.020	Copco 2 Dam Removal	Remove & Dispose - Hand rails and Light Poles	5,000	LB	0.84	4,183	3,556	-15%	5,020	20%	4,706	4,000	5,647
41	Copco 2	3.021	Copco 2 Dam Removal	Remove & Dispose - Radial Gates and Hoists	66,000	LB	0.81	53,452	45,434	-15%	72,160	35%	60,126	51,107	81,170
41	Copco 2	3.022	Copco 2 Dam Removal	Remove & Dispose - 5-Radial Gate Stop logs & Slots (steel)	95,800	LB	0.93	89,381	75,974	-15%	120,665	35%	100,542	85,461	135,732

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Copco 2	3.023	Copco 2 Dam Removal	Remove & Dispose - Spillway intake gate motor & control pane	1.00	EA	1,297.31	1,297	1,168	-10%	1,492	15%	1,459	1,313	1,678
41	Copco 2	3.024	Copco 2 Dam Removal	Remove & Dispose - Spillway radial gate motor & control pane	1.00	EA	1,297.31	1,297	1,168	-10%	1,492	15%	1,459	1,313	1,678
41	Copco 2	3.025	Copco 2 Dam Removal	Remove & Dispose - Spillway trash rake motor, festoon cable	1.00	EA	551.31	551	496	-10%	634	15%	620	558	713
41	Copco 2	3.026	Copco 2 Dam Removal	Remove & Dispose - Distribution equipment, panelboards	1.00	EA	5,877.55	5,878	5,290	-10%	6,759	15%	6,611	5,950	7,603
41	Copco 2	3.027	Copco 2 Dam Removal	Remove Copper Shingles from Roof of Powerhouse	7,000	SF	2.07	14,473	12,302	-15%	16,644	15%	16,280	13,838	18,722
41	Copco 2	3.028	Copco 2 Dam Removal	Remove Powerhouse Concrete down to spring-line of turbine	1,110	CY	514.15	570,702	485,097	-15%	827,518	45%	641,962	545,668	930,845
41	Copco 2	3.029	Copco 2 Dam Removal	Remove Structural Steel items associated with Powerhouse	220,000	LB	0.96	211,759	169,407	-20%	296,463	40%	238,200	190,560	333,480
41	Copco 2	3.030	Copco 2 Dam Removal	Remove Control House Concrete	30.00	CY	317.78	9,533	7,627	-20%	12,870	35%	10,724	8,579	14,477
41	Copco 2	3.031	Copco 2 Dam Removal	Remove Control House Structural Steel Items	3,500	LB	0.88	3,088	2,471	-20%	4,324	40%	3,474	2,779	4,864
41	Copco 2	3.032	Copco 2 Dam Removal	Remove Shop Building	4,300	SF	69.45	298,623	238,898	-20%	388,210	30%	335,910	268,728	436,683
41	Copco 2	3.033	Copco 2 Dam Removal	Remove & Dispose - 2 - Governor oil systems	38,000	LB	1.06	40,406	34,345	-15%	50,507	25%	45,451	38,633	56,814
41	Copco 2	3.034	Copco 2 Dam Removal	Remove & Dispose - Cooling water and bearing oil systems	13,300	LB	0.93	12,414	10,552	-15%	15,518	25%	13,965	11,870	17,456
41	Copco 2	3.035	Copco 2 Dam Removal	Remove & Dispose - Oil / Water separator tank and piping	2,700	LB	0.93	2,520	2,142	-15%	3,149	25%	2,834	2,409	3,543
41	Copco 2	3.036	Copco 2 Dam Removal	Remove & Dispose - 12 - Cast Iron Columns	54,000	LB	0.83	44,692	35,754	-20%	53,631	20%	50,273	40,218	60,327
41	Copco 2	3.037	Copco 2 Dam Removal	Remove & Dispose - 2 - Francis Turbines	660,000	LB	0.83	547,502	438,002	-20%	711,753	30%	615,866	492,692	800,625
41	Copco 2	3.038	Copco 2 Dam Removal	Remove & Dispose - 2 - 40 Ton indoor cranes	140,000	LB	1.17	163,271	130,617	-20%	212,253	30%	183,658	146,926	238,755
41	Copco 2	3.039	Copco 2 Dam Removal	Remove & Dispose - Compressed Air Systems	1,000	LB	1.13	1,129	960	-15%	1,411	25%	1,270	1,080	1,588
41	Copco 2	3.040	Copco 2 Dam Removal	Remove & Dispose - 2 - CO2 Systems	2,100	LB	1.23	2,573	2,187	-15%	3,216	25%	2,894	2,460	3,618
41	Copco 2	3.041	Copco 2 Dam Removal	Remove & Dispose - Plant Water and Fire Protection	3,100	LB	1.41	4,373	3,717	-15%	5,466	25%	4,919	4,181	6,149
41	Copco 2	3.042	Copco 2 Dam Removal	Remove & Dispose - Transformer Oil Fire Protection	6,500	LB	0.87	5,633	4,788	-15%	7,042	25%	6,337	5,386	7,921
41	Copco 2	3.043	Copco 2 Dam Removal	Remove & Dispose - Unwatering Piping	32,000	LB	0.75	24,116	20,499	-15%	30,145	25%	27,127	23,058	33,909
41	Copco 2	3.044	Copco 2 Dam Removal	Remove & Dispose - Drainage Piping	10,000	LB	1.39	13,877	11,795	-15%	17,346	25%	15,609	13,268	19,512
41	Copco 2	3.044a	Copco 2 Dam Removal	Remove & Dispose - Petroleum Products from Mechanical Equ	3,300	GAL	4.54	14,972	13,475	-10%	17,217	15%	16,841	15,157	19,367
41	Copco 2	3.044b	Copco 2 Dam Removal	Remove & Dispose - Remove Petroleum Products at or near t	3,300	GAL	4.54	14,972	13,475	-10%	17,217	15%	16,841	15,157	19,367
41	Copco 2	3.045	Copco 2 Dam Removal	Remove & Dispose - AC Generator, Indoor Vertical	2.00	EA	82,295.42	164,591	148,132	-10%	189,279	15%	185,142	166,628	212,914
41	Copco 2	3.046	Copco 2 Dam Removal	Remove & Dispose - Excitation equipment for 15 MVA Genera	2.00	EA	8,173.98	16,348	14,713	-10%	18,800	15%	18,389	16,550	21,148
41	Copco 2	3.047	Copco 2 Dam Removal	Remove & Dispose - Surge protection equip. for 15 MVA Gene	2.00	EA	2,582.65	5,165	4,649	-10%	5,940	15%	5,810	5,229	6,682
41	Copco 2	3.048	Copco 2 Dam Removal	Remove & Dispose - Neutral grounding equip. for 15 MVA Ger	2.00	EA	2,514.72	5,029	4,526	-10%	5,784	15%	5,657	5,092	6,506
41	Copco 2	3.049	Copco 2 Dam Removal	Remove & Dispose - Generator Switchgear, 7.2kV-includes ur	1.00	EA	27,340.22	27,340	24,606	-10%	31,441	15%	30,754	27,679	35,367
41	Copco 2	3.050	Copco 2 Dam Removal	Remove & Dispose - Station Service Switchgear, 600-volt (5 s	1.00	EA	24,083.60	24,084	21,675	-10%	27,696	15%	27,091	24,382	31,154
41	Copco 2	3.051	Copco 2 Dam Removal	Remove & Dispose - Unit and plant control switchboard	1.00	EA	7,551.93	7,552	6,797	-10%	8,685	15%	8,495	7,645	9,769
41	Copco 2	3.052	Copco 2 Dam Removal	Remove & Dispose - Battery system	1.00	EA	10,473.21	10,473	9,426	-10%	12,044	15%	11,781	10,603	13,548
41	Copco 2	3.053	Copco 2 Dam Removal	Remove & Dispose - Raceways, Conduit and Cable	1.00	EA	15,384.27	15,384	13,846	-10%	17,692	15%	17,305	15,575	19,901
41	Copco 2	3.054	Copco 2 Dam Removal	Remove & Dispose - Misc. Power & Control Boards	1.00	EA	5,724.44	5,724	5,152	-10%	6,583	15%	6,439	5,795	7,405
41	Copco 2	3.055	Copco 2 Dam Removal	Remove & Dispose - 7 - 40-Ton Travelling Crane motors-hoist	1.00	EA	3,548.91	3,549	3,194	-10%	4,259	20%	3,992	3,593	4,790
41	Copco 2	3.056	Copco 2 Dam Removal	Remove & Dispose - 40-Ton Travelling Crane control equipme	1.00	EA	11,203.08	11,203	10,083	-10%	13,444	20%	12,602	11,342	15,122
41	Copco 2	3.057	Copco 2 Dam Removal	Remove & Dispose - 40-Ton Travelling Crane Festoon Cable	1.00	EA	2,557.66	2,558	2,302	-10%	3,069	20%	2,877	2,589	3,452
41	Copco 2	3.058a	Copco 2 Dam Removal	Remove Oil from Oil-Filled Step-up Transformers	23,000	GAL	10.59	243,653	207,105	-15%	280,201	15%	274,077	232,965	315,188
41	Copco 2	3.061	Copco 2 Dam Removal	Remove Intake Structure Concrete	1,650	CY	299.68	494,479	420,307	-15%	741,718	50%	556,221	472,788	834,332
41	Copco 2	3.062	Copco 2 Dam Removal	Remove Concrete Items associated with 16-foot I.D. Wood Sta	1,310	CY	299.39	392,197	333,367	-15%	568,685	45%	441,168	374,993	639,693
41	Copco 2	3.063	Copco 2 Dam Removal	Place Concrete Plugs for Tunnels	100	CY	1,827.07	182,707	155,301	-15%	237,519	30%	205,521	174,692	267,177
41	Copco 2	3.064	Copco 2 Dam Removal	Remove Concrete Items associated with Penstocks D/S from	3,500	CY	298.85	1,045,973	836,779	-20%	1,359,765	30%	1,176,578	941,262	1,529,551
41	Copco 2	3.065	Copco 2 Dam Removal	Remove & Dispose of Caterpillar Gate (steel)	50,000	LB	0.92	45,874	38,993	-15%	52,755	15%	51,602	43,862	59,342
41	Copco 2	3.066	Copco 2 Dam Removal	Remove & Dispose of Trash rack and trash rake (steel)	86,000	LB	0.63	54,375	46,219	-15%	70,687	30%	61,164	51,990	79,513
41	Copco 2	3.067	Copco 2 Dam Removal	Remove & Dispose of Stop Logs and slots for intake (steel)	220,000	LB	0.78	170,795	145,176	-15%	222,034	30%	192,121	163,303	249,758
41	Copco 2	3.068	Copco 2 Dam Removal	Remove & Dispose of Wood Staves Soaked in Creosote	1,100,000	LB	0.93	1,021,716	715,201	-30%	1,328,231	30%	1,149,292	804,504	1,494,079
41	Copco 2	3.069	Copco 2 Dam Removal	Remove & Dispose of Cradles (steel)	290,000	LB	0.94	273,748	191,623	-30%	355,872	30%	307,929	215,550	400,308
41	Copco 2	3.070	Copco 2 Dam Removal	Remove & Dispose of Bands (steel)	463,000	LB	0.92	426,777	298,744	-30%	554,811	30%	480,067	336,047	624,086
41	Copco 2	3.071	Copco 2 Dam Removal	Remove & Dispose of Penstock after bifurcation to butterfly va	860,000	LB	1.08	925,612	647,928	-30%	1,203,295	30%	1,041,188	728,831	1,353,544
41	Copco 2	3.072	Copco 2 Dam Removal	Remove & Dispose of Bifurcated vent pipes and support struct	19,500	LB	1.13	22,033	15,423	-30%	28,643	30%	24,784	17,349	32,220
41	Copco 2	3.073	Copco 2 Dam Removal	Remove & Dispose of 2 - 138" Butterfly Valves	148,000	LB	0.88	129,906	90,934	-30%	168,878	30%	146,127	102,289	189,965
41	Copco 2	5.017	Copco 2 Dam Removal	Disconnect and Remove Medium Voltage Circuit Breakers 115	2.00	EA	678.35	1,357	1,153	-15%	1,899	40%	1,526	1,297	2,137
41	Copco 2	5.018	Copco 2 Dam Removal	Disconnect and Remove Medium Voltage Circuit Breakers 69K	5.00	LB	590.84	2,954	2,511	-15%	4,136	40%	3,323	2,825	4,652
41	Copco 2	5.019	Copco 2 Dam Removal	Disconnect and Remove Transformers 12KV @ substation	1.00	EA	816.83	817	694	-15%	1,144	40%	919	781	1,286
41	Copco 2	5.020	Copco 2 Dam Removal	Disconnect and Remove cable connection between Copco 2 a	0.10	MI	94,661.96	9,466	8,046	-15%	13,253	40%	10,648	9,051	14,907
41	Copco 2	5.021	Copco 2 Dam Removal	Remove All associated Aux Equipment @ substation (allowan	1.00	LS	24,184.84	24,185	20,557	-15%	33,859	40%	27,205	23,124	38,087
41	Copco 2	5.022	Copco 2 Dam Removal	Demolish overhead transmission line and structure 69KV Cop	5.00	MI	118,983.58	594,918	505,680	-15%	832,885	40%	669,202	568,821	936,882
41	Copco 2	5.023	Copco 2 Dam Removal	Demolish transmission conductor from existing structure pole.	1.50	MI	7,073.23	10,610	9,018	-15%	14,854	40%	11,935	10,144	16,708
41	Copco 2	5.024	Copco 2 Dam Removal	Remove structures between pole 2/007 and Iron Gate	6.00	EA	3,754.31	22,526	20,273	-10%	31,536	40%	25,339	22,805	35,474
41	Iron Gate	4.001	Iron Gate Dam Removal	Furnish, Install, and Remove Barge-Mounted Crane in Reservo	1.00	LS	191,823.14	191,823	172,641	-10%	220,597	15%	215,775	194,197	248,141
41	Iron Gate	4.002	Iron Gate Dam Removal	Furnish, Install, and Remove Temporary Air Vent Hose from B	50.00	EA	315.45	15,773	13,407	-15%	18,927	20%	17,742	15,081	21,290
41	Iron Gate	4.003	Iron Gate Dam Removal	Remove Reinforced Concrete Ring Located D/S of Closure Ga	46.00	CY	1,012.49	46,575	39,589	-15%	58,218	25%	52,390	44,532	65,488
41	Iron Gate	4.004	Iron Gate Dam Removal	Remove Reinforced Concrete Stoplog Structure	6.00	CY	1,738.55	10,431	9,388	-10%	11,996	15%	11,734	10,560	13,494
41	Iron Gate	4.005	Iron Gate Dam Removal	Remove Water from behind Tailrace Cofferdam	300,000	GAL	0.01	3,132	2,662	-15%	3,602	15%	3,523	2,995	4,051
41	Iron Gate	4.006	Iron Gate Dam Removal	Provide Dewatering behind Tailrace Cofferdam for removal of	1.00	LS	29,462.94	29,463	25,044	-15%	33,882	15%	33,142	28,171	38,113
41	Iron Gate	4.007	Iron Gate Dam Removal	Construct Embankment Cofferdam across Tailrace to remove	1,650	CY	112.09	184,946	166,451	-10%	212,687	15%	208,039	187,235	239,244
41	Iron Gate	4.010	Iron Gate Dam Removal	Upstream Cofferdam to be Removed in the Wet	20,000	CY	14.70	294,012	249,910	-15%	338,114	15%	330,723	281,115	380,332

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Iron Gate	4.011	Iron Gate Dam Removal	Remove 9' dia. hinged blind flange	19,000	LB	6.49	123,371	104,866	-15%	148,046	20%	138,776	117,960	166,531
41	Iron Gate	4.012	Iron Gate Dam Removal	Remove 18" plug valve and 7' of 18" drainage pipe	2,620	LB	2.70	7,061	6,002	-15%	8,473	20%	7,943	6,751	9,531
41	Iron Gate	4.013.1	Iron Gate Dam Removal	Furnish and Install 1-16.5'x18' roller gate, stem, and operator	110,000	LB	34.16	3,757,547	3,381,793	-10%	4,133,302	10%	4,226,730	3,804,057	4,649,403
41	Iron Gate	4.013.2	Iron Gate Dam Removal	Remove Existing sluice and diversion gates from shaft by dive	110,000	LB	4.38	482,328	434,095	-10%	530,561	10%	542,554	488,298	596,809
41	Iron Gate	4.013.3	Iron Gate Dam Removal	Remove 16.5'X 18' sluice and diversion gates from shaft in Dr	110,000	LB	0.58	64,216	57,794	-10%	70,637	10%	72,234	65,011	79,457
41	Iron Gate	4.014	Iron Gate Dam Removal	Remove Concrete in Observation Platform, Crest Wall and Wa	780	CY	298.81	233,072	209,765	-10%	256,379	10%	262,174	235,957	288,392
41	Iron Gate	4.015	Iron Gate Dam Removal	Remove Concrete in Diversion Tunnel Intake Structure	715	CY	300.06	214,542	193,088	-10%	246,723	15%	241,330	217,197	277,530
41	Iron Gate	4.016	Iron Gate Dam Removal	Remove Concrete in Diversion Tunnel Gate Tower	650	CY	196.63	127,809	108,637	-15%	146,980	15%	143,767	122,202	165,333
41	Iron Gate	4.017	Iron Gate Dam Removal	Remove Steel Footbridge to Gate Tower	13,000	LB	1.10	14,259	12,120	-15%	16,398	15%	16,039	13,633	18,445
41	Iron Gate	4.018	Iron Gate Dam Removal	Remove Concrete in Diversion Tunnel Footbridge Abutment	39.00	CY	197.94	7,720	6,562	-15%	8,878	15%	8,684	7,381	9,986
41	Iron Gate	4.019	Iron Gate Dam Removal	Place Concrete Plugs for Diversion Tunnel	43.00	CY	1,672.11	71,901	64,711	-10%	79,091	10%	80,879	72,791	88,966
41	Iron Gate	4.020	Iron Gate Dam Removal	Remove Concrete Closure Gates in Gate Tower	85.00	CY	894.09	75,998	64,598	-15%	87,397	15%	85,487	72,664	98,310
41	Iron Gate	4.021	Iron Gate Dam Removal	Remove Upstream Riprap	92,400	CY	21.05	1,944,680	1,652,978	-15%	2,333,616	20%	2,187,500	1,859,375	2,625,000
41	Iron Gate	4.022	Iron Gate Dam Removal	Remove Downstream Riprap	23,400	CY	15.64	365,879	310,997	-15%	439,054	20%	411,564	349,829	493,876
41	Iron Gate	4.023	Iron Gate Dam Removal	Miscellaneous Excavation	270,000	CY	6.72	1,815,450	1,543,132	-15%	2,178,539	20%	2,042,134	1,735,814	2,450,561
41	Iron Gate	4.023.1	Iron Gate Dam Removal	Miscellaneous Excavation	761,159	CY	15.55	11,836,796	10,061,276	-15%	14,204,155	20%	13,314,785	11,317,568	15,977,742
41	Iron Gate	4.024	Iron Gate Dam Removal	Cutoff Wall Concrete Demolition	2,440	CY	112.84	275,336	247,803	-10%	316,637	15%	309,716	278,744	356,173
41	Iron Gate	4.025	Iron Gate Dam Removal	Earth Fill Crest Raise	13,000	CY	15.68	203,841	173,265	-15%	234,417	15%	229,293	194,899	263,687
41	Iron Gate	4.026	Iron Gate Dam Removal	Sheet pile Crest Raise	800	LF	281.18	224,946	191,204	-15%	258,688	15%	253,034	215,079	290,989
41	Iron Gate	4.027	Iron Gate Dam Removal	Remove 5 Monitoring Wells	5.00	EA	2,332.81	11,664	10,498	-10%	13,414	15%	13,120	11,808	15,089
41	Iron Gate	4.028	Iron Gate Dam Removal	Remove and Dispose of Trash Sluice Gate - 10 ft x 9 ft H	4,500	LB	1.01	4,544	3,408	-25%	5,680	25%	5,112	3,834	6,390
41	Iron Gate	4.029	Iron Gate Dam Removal	Remove and Dispose of Intake Structure	72,000	LB	0.90	64,663	54,964	-15%	77,596	20%	72,738	61,827	87,285
41	Iron Gate	4.030	Iron Gate Dam Removal	Remove and Dispose of Sluice and Diversion Tunnel Gate	28,000	LB	1.09	30,649	26,052	-15%	36,779	20%	34,476	29,304	41,371
41	Iron Gate	4.031	Iron Gate Dam Removal	Remove and Dispose of Hoist Stem - 6" Dia. Sch 160x150'	7,500	LB	1.01	7,578	6,441	-15%	9,093	20%	8,524	7,245	10,229
41	Iron Gate	4.032	Iron Gate Dam Removal	Remove and Dispose of Air Vent Pipe - 8" Dia. Sch 40 x160'	4,650	LB	2.12	9,855	8,377	-15%	11,826	20%	11,085	9,423	13,303
41	Iron Gate	4.034	Iron Gate Dam Removal	Remove and Dispose of Air Vent Pipe - 12" Dia. Sch 40 x560'	30,250	LB	2.26	68,353	58,100	-15%	82,024	20%	76,888	65,355	92,266
41	Iron Gate	4.035	Iron Gate Dam Removal	Remove and Dispose of Outlet Works Stop Logs	2,670	LB	1.01	2,696	2,022	-25%	3,370	25%	3,033	2,275	3,791
41	Iron Gate	4.036	Iron Gate Dam Removal	Remove and Dispose of Hydraulic Pump Motor (10 HP est) &	1.00	EA	415.82	416	312	-25%	520	25%	468	351	585
41	Iron Gate	4.037	Iron Gate Dam Removal	Remove and Dispose of Distribution Equipment, Junction Box	1.00	EA	2,019.67	2,020	1,515	-25%	2,525	25%	2,272	1,704	2,840
41	Iron Gate	4.038	Iron Gate Dam Removal	Remove and Dispose of Power Cable and 4" Conduit from Pe	800	FT	49.86	39,887	33,904	-15%	45,870	15%	44,867	38,137	51,598
41	Iron Gate	4.039	Iron Gate Dam Removal	Remove Powerhouse Concrete	5,200	CY	402.36	2,092,267	1,883,040	-10%	2,406,107	15%	2,353,516	2,118,164	2,706,543
41	Iron Gate	4.040	Iron Gate Dam Removal	Remove and Dispose of Turbine Unit	344,058	LB	0.95	327,583	278,446	-15%	376,721	15%	368,487	313,214	423,760
41	Iron Gate	4.041	Iron Gate Dam Removal	Remove and Dispose of Draft Tube Bulkheads	16,500	LB	0.98	16,235	13,800	-15%	19,482	20%	18,263	15,523	21,915
41	Iron Gate	4.042	Iron Gate Dam Removal	Remove and Dispose of Crane	24,000	LB	1.07	25,619	21,776	-15%	32,023	25%	28,818	24,495	36,022
41	Iron Gate	4.043	Iron Gate Dam Removal	Remove and Dispose of Governor	20,310	LB	1.04	21,033	17,878	-15%	25,240	20%	23,660	20,111	28,392
41	Iron Gate	4.044	Iron Gate Dam Removal	Remove and Dispose of Bearing Oil System and Cooling Wate	9,182	LB	1.06	9,761	8,297	-15%	11,713	20%	10,980	9,333	13,176
41	Iron Gate	4.045	Iron Gate Dam Removal	Remove and Dispose of CO2 Systems	2,568	LB	1.01	2,604	2,343	-10%	3,124	20%	2,929	2,636	3,514
41	Iron Gate	4.046	Iron Gate Dam Removal	Remove and Dispose of Plant Water and Fire Protection Syste	9,182	LB	1.05	9,596	8,636	-10%	11,515	20%	10,794	9,714	12,953
41	Iron Gate	4.047	Iron Gate Dam Removal	Remove and Dispose of Sump Pumps	2,000	LB	1.05	2,092	1,883	-10%	2,510	20%	2,353	2,118	2,824
41	Iron Gate	4.048	Iron Gate Dam Removal	Remove and Dispose of Pumps	22,000	LB	1.09	24,084	21,676	-10%	28,901	20%	27,092	24,382	32,510
41	Iron Gate	4.049	Iron Gate Dam Removal	Remove and Dispose of Exposed Piping Around the Plant	19,291	LB	1.05	20,285	18,257	-10%	24,342	20%	22,818	20,536	27,382
41	Iron Gate	4.050	Iron Gate Dam Removal	Remove and Dispose of Unwatering Piping	19,291	LB	0.88	16,967	15,270	-10%	19,512	15%	19,085	17,177	21,948
41	Iron Gate	4.051	Iron Gate Dam Removal	Remove and Dispose of Drainage Piping	9,518	LB	1.12	10,657	9,591	-10%	12,256	15%	11,988	10,789	13,786
41	Iron Gate	4.052	Iron Gate Dam Removal	Remove and Dispose of Transformer Oil and Fire Protection	9,182	LB	1.00	9,199	8,739	-5%	10,119	10%	10,347	9,830	11,382
41	Iron Gate	4.053	Iron Gate Dam Removal	Remove and Dispose of Compressed Air System	1,450	LB	0.91	1,313	1,182	-10%	1,510	15%	1,477	1,329	1,698
41	Iron Gate	4.053a	Iron Gate Dam Removal	Remove & Dispose - Petroleum Products from Mechanical Eq	1,100	GAL	10.05	11,057	10,504	-5%	12,163	10%	12,438	11,816	13,681
41	Iron Gate	4.054	Iron Gate Dam Removal	Remove and Dispose of AC Generator, Outdoor Horizontal	1.00	EA	91,158.88	91,159	82,043	-10%	104,833	15%	102,541	92,287	117,923
41	Iron Gate	4.055	Iron Gate Dam Removal	Remove and Dispose of Excitation equipment for 18.975 MVA	1.00	EA	2,384.74	2,385	2,146	-10%	2,742	15%	2,683	2,414	3,085
41	Iron Gate	4.056	Iron Gate Dam Removal	Remove and Dispose of Surge protection equip. for 18.975 M	1.00	EA	1,891.05	1,891	1,702	-10%	2,175	15%	2,127	1,914	2,446
41	Iron Gate	4.057	Iron Gate Dam Removal	Remove and Dispose of Neutral grounding equip. for 18.975 M	1.00	EA	3,980.33	3,980	3,582	-10%	4,577	15%	4,477	4,030	5,149
41	Iron Gate	4.058	Iron Gate Dam Removal	Remove and Dispose of Station Service Switchgear, 600 volt -	1.00	EA	7,378.96	7,379	6,641	-10%	8,486	15%	8,300	7,470	9,545
41	Iron Gate	4.059	Iron Gate Dam Removal	Remove and Dispose of Unit and plant control switchboard	1.00	EA	23,948.92	23,949	21,554	-10%	27,541	15%	26,939	24,245	30,980
41	Iron Gate	4.060	Iron Gate Dam Removal	Remove and Dispose of Battery System - assume 60 batteries	1.00	EA	15,350.22	15,350	13,815	-10%	17,653	15%	17,267	15,540	19,857
41	Iron Gate	4.061	Iron Gate Dam Removal	Remove and Dispose of Raceways, Bus, Conduit and Cable	1.00	EA	18,352.70	18,353	16,517	-10%	21,106	15%	20,644	18,580	23,741
41	Iron Gate	4.062	Iron Gate Dam Removal	Remove and Dispose of Misc. power & control boards	1.00	EA	5,642.84	5,643	5,079	-10%	6,489	15%	6,347	5,713	7,300
41	Iron Gate	4.063	Iron Gate Dam Removal	Remove and Dispose of Transformer (3 phase, 275 kVA, 6600	1.00	EA	9,142.79	9,143	8,229	-10%	10,514	15%	10,284	9,256	11,827
41	Iron Gate	4.064	Iron Gate Dam Removal	Remove and Dispose of Governor Oil Pump Motors (10 hp an	2.00	EA	244.50	489	440	-10%	562	15%	550	495	633
41	Iron Gate	4.065	Iron Gate Dam Removal	Remove and Dispose of Vertical Motors, outdoor, (480V, 100	4.00	EA	712.83	2,851	2,138	-25%	3,564	25%	3,207	2,405	4,009
41	Iron Gate	4.066	Iron Gate Dam Removal	Remove and Dispose of Transformer (3 phase, 300 kVA, 6600	1.00	EA	10,482.18	10,482	9,434	-10%	12,055	15%	11,791	10,612	13,560
41	Iron Gate	4.067	Iron Gate Dam Removal	Remove and Dispose of Step-up Transformer, outdoor, oil-fille	1.00	EA	85,541.22	85,541	76,987	-10%	98,372	15%	96,222	86,600	110,656
41	Iron Gate	4.068	Iron Gate Dam Removal	Remove and Dispose of Lattice steel structure, with 69-kV dis	1.00	EA	6,973.83	6,974	6,276	-10%	8,020	15%	7,845	7,060	9,021
41	Iron Gate	4.069	Iron Gate Dam Removal	Remove and Dispose of Generator Switchgear, outdoor, 7.2kV	1.00	EA	24,487.62	24,488	22,039	-10%	28,161	15%	27,545	24,791	31,677
41	Iron Gate	4.070	Iron Gate Dam Removal	Remove and Dispose of Single Phase Pole Transformers (25	3.00	EA	2,514.24	7,543	6,788	-10%	8,674	15%	8,485	7,636	9,757
41	Iron Gate	4.071	Iron Gate Dam Removal	Remove Concrete in Penstock Intake Structure	460	CY	302.54	139,169	118,294	-15%	160,044	15%	156,546	133,064	180,028
41	Iron Gate	4.072	Iron Gate Dam Removal	Remove Concrete in Penstock Encasement	710	CY	300.16	213,116	191,805	-10%	245,084	15%	239,727	215,754	275,686
41	Iron Gate	4.073	Iron Gate Dam Removal	Remove Concrete in 3 Penstock Anchors and 7 Penstock Sup	3,110	CY	298.85	929,437	790,022	-15%	1,068,853	15%	1,045,491	888,667	1,202,314
41	Iron Gate	4.074	Iron Gate Dam Removal	Remove Steel Footbridge to Intake Structure	11,000	LB	1.11	12,161	10,337	-15%	13,986	15%	13,680	11,628	15,732
41	Iron Gate	4.075	Iron Gate Dam Removal	Remove Concrete in Intake Structure Footbridge Abutment	5.00	CY	820.58	4,103	3,487	-15%	4,718	15%	4,615	3,923	5,307

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Iron Gate	4.076	Iron Gate Dam Removal	Remove and Dispose of Intake Structure	131,630	LB	1.04	136,401	115,941	-15%	156,862	15%	153,433	130,418	176,448
41	Iron Gate	4.077	Iron Gate Dam Removal	Remove and Dispose of Gate Hoist Stem - 6" Sch160x40'	1,800	LB	1.01	1,818	1,363	-25%	2,272	25%	2,045	1,534	2,556
41	Iron Gate	4.078	Iron Gate Dam Removal	Remove and Dispose of Water Fill line- 12" Dia STD x 27'	1,350	LB	1.01	1,363	1,022	-25%	1,704	25%	1,534	1,150	1,917
41	Iron Gate	4.079	Iron Gate Dam Removal	Remove and Dispose of Air Vent - 12" Dia STD x 32'	1,600	LB	1.01	1,616	1,212	-25%	2,020	25%	1,817	1,363	2,272
41	Iron Gate	4.080	Iron Gate Dam Removal	Remove and Dispose of Gage Wells	2,612	LB	1.01	2,638	1,978	-25%	3,297	25%	2,967	2,225	3,709
41	Iron Gate	4.081	Iron Gate Dam Removal	Remove and Dispose of Penstock Vent - 46" Dia, 0.25" Thick	7,440	LB	2.08	15,466	13,146	-15%	17,786	15%	17,398	14,788	20,007
41	Iron Gate	4.082	Iron Gate Dam Removal	Remove and Dispose of Penstock - 12" Dia, 0.25" Thick x 698	294,428	LB	1.47	433,061	368,102	-15%	498,020	15%	487,135	414,065	560,205
41	Iron Gate	4.083	Iron Gate Dam Removal	Remove and Dispose of Bypass Outlet - 96" Dia, 0.25" Thick x	12,850	LB	0.90	11,547	9,815	-15%	13,279	15%	12,989	11,041	14,937
41	Iron Gate	4.084	Iron Gate Dam Removal	Remove and Dispose of Outlet Valve on bypass outlet - 66" Di	18,000	LB	1.62	29,193	24,814	-15%	33,572	15%	32,838	27,912	37,764
41	Iron Gate	4.085	Iron Gate Dam Removal	Remove and Dispose Overhead trolley Crane Motor (4hp est)	1.00	EA	1,188.04	1,188	891	-25%	1,485	25%	1,336	1,002	1,670
41	Iron Gate	4.086	Iron Gate Dam Removal	Remove and Dispose Distribution equipment, Junction Boxes	1.00	EA	2,970.11	2,970	2,228	-25%	3,713	25%	3,341	2,506	4,176
41	Iron Gate	4.087	Iron Gate Dam Removal	Remove and Dispose Power Cable and Conduit	1.00	EA	91,734.75	91,735	77,975	-15%	105,495	15%	103,189	87,711	118,667
41	Iron Gate	4.097	Iron Gate Dam Removal	Clear and Grub Disposal Area	29.00	AC	6,292.60	182,485	155,113	-15%	209,858	15%	205,271	174,481	236,062
41	Iron Gate	4.101	Iron Gate Dam Removal	Remove Building No. 2	800	SF	73.00	58,404	52,563	-10%	67,164	15%	65,696	59,127	75,551
41	Iron Gate	4.102	Iron Gate Dam Removal	Remove Building No. 3	1,088	SF	75.55	82,199	73,979	-10%	94,529	15%	92,463	83,217	106,332
41	Iron Gate	4.103	Iron Gate Dam Removal	Remove Concrete in Fish Ladder	1,240	CY	300.19	372,241	316,405	-15%	428,077	15%	418,721	355,913	481,529
41	Iron Gate	4.104	Iron Gate Dam Removal	Remove Concrete in Holding Ponds #1 thru #6	1,380	CY	196.04	270,529	243,476	-10%	311,109	15%	304,309	273,878	349,955
41	Iron Gate	4.105	Iron Gate Dam Removal	Remove Concrete in Fish Facility Items	1,200	CY	194.03	232,832	197,908	-15%	267,757	15%	261,905	222,619	301,191
41	Iron Gate	4.106	Iron Gate Dam Removal	Remove Miscellaneous Metalwork in Fish Facilities	12,000	LB	0.95	11,351	9,648	-15%	13,621	20%	12,768	10,853	15,322
41	Iron Gate	4.107	Iron Gate Dam Removal	Remove Concrete Associated with 30" Dia. water supply line	80.00	CY	194.03	15,522	13,194	-15%	17,850	15%	17,460	14,841	20,079
41	Iron Gate	4.108	Iron Gate Dam Removal	Remove Concrete in Aerator Structure	65.00	CY	191.23	12,430	10,565	-15%	14,294	15%	13,982	11,884	16,079
41	Iron Gate	4.109	Iron Gate Dam Removal	Remove Wood in Aerator Structure	6,000	LB	0.83	4,990	3,742	-25%	6,237	25%	5,613	4,210	7,016
41	Iron Gate	4.110	Iron Gate Dam Removal	Remove Structural Steel in Aerator Structure	2,500	LB	1.01	2,525	1,893	-25%	3,156	25%	2,840	2,130	3,550
41	Iron Gate	4.111	Iron Gate Dam Removal	Remove Asphalt Pavement	3,900	SF	6.54	25,489	21,665	-15%	29,312	15%	28,671	24,370	32,972
41	Iron Gate	4.112	Iron Gate Dam Removal	Remove Restroom Building near Aerator Structure	340	SF	60.38	20,528	18,475	-10%	23,607	15%	23,091	20,782	26,555
41	Iron Gate	4.113	Iron Gate Dam Removal	Remove Storage Shed near Aerator Structure	90.00	SF	70.22	6,320	5,688	-10%	7,268	15%	7,109	6,398	8,175
41	Iron Gate	4.114	Iron Gate Dam Removal	Remove Toe Drain Pipe	260	LF	27.00	7,021	5,968	-15%	8,074	15%	7,897	6,713	9,082
41	Iron Gate	4.115	Iron Gate Dam Removal	Remove Toe Drain Manhole	25.00	LF	59.40	1,485	1,114	-25%	1,856	25%	1,670	1,253	2,088
41	Iron Gate	4.116	Iron Gate Dam Removal	Berm Removal	53,000	CY	13.82	732,558	659,302	-10%	842,442	15%	824,028	741,625	947,633
41	Iron Gate	4.117	Iron Gate Dam Removal	Remove and Dispose of Intake Structures Trashracks	5,000	LB	0.89	4,455	3,341	-25%	5,569	25%	5,011	3,759	6,264
41	Iron Gate	4.118	Iron Gate Dam Removal	Remove and Dispose of Pipe Conduit, 30" Dia. x 0.25" Thick x	76,640	LB	1.03	78,948	67,106	-15%	94,738	20%	88,806	75,485	106,567
41	Iron Gate	4.119	Iron Gate Dam Removal	Remove and Dispose of Sluice Gate Valve, 30" Dia.	3,000	LB	1.01	3,030	2,272	-25%	3,787	25%	3,408	2,556	4,260
41	Iron Gate	4.120	Iron Gate Dam Removal	Remove and Dispose of Sluice Gate Stem, 2" Dia. Sch160x45	360	LB	1.01	364	273	-25%	454	25%	409	307	511
41	Iron Gate	4.121	Iron Gate Dam Removal	Remove and Dispose of Butterfly Valve, 30" Dia.	2,435	LB	1.01	2,459	1,844	-25%	3,074	25%	2,766	2,074	3,457
41	Iron Gate	4.122	Iron Gate Dam Removal	Remove and Dispose of Piping- 30-in. Dia. x 0.25 Thickness x	7,200	LB	0.60	4,332	3,682	-15%	5,198	20%	4,872	4,142	5,847
41	Iron Gate	4.123	Iron Gate Dam Removal	Remove and Dispose of Piping- 24-in. Dia. x 0.25 Thickness x	15,872	LB	0.50	8,005	6,804	-15%	9,606	20%	9,004	7,654	10,805
41	Iron Gate	4.124	Iron Gate Dam Removal	Remove and Dispose of Piping- 20-in. Dia. x 0.25 Thickness x	4,505	LB	0.58	2,599	2,209	-15%	3,119	20%	2,923	2,485	3,508
41	Iron Gate	4.125	Iron Gate Dam Removal	Remove and Dispose of Piping- 18-in. Dia. x 0.25 Thickness x	29,088	LB	0.38	11,115	9,448	-15%	13,338	20%	12,503	10,627	15,003
41	Iron Gate	4.126	Iron Gate Dam Removal	Remove and Dispose of Piping- 16-in. Dia. x 0.25 Thickness x	6,972	LB	0.56	3,898	3,314	-15%	4,678	20%	4,385	3,727	5,262
41	Iron Gate	4.127	Iron Gate Dam Removal	Remove and Dispose of Piping- 12-in. Dia. x 0.25 Thickness x	2,176	LB	0.46	992	843	-15%	1,190	20%	1,116	948	1,339
41	Iron Gate	4.128	Iron Gate Dam Removal	Remove and Dispose of Piping- 10-in. Dia. x 0.25 Thickness x	1,932	LB	0.45	864	734	-15%	1,036	20%	972	826	1,166
41	Iron Gate	4.129	Iron Gate Dam Removal	Remove and Dispose of Piping- 8-in. Dia. x 0.25 Thickness x	3,588	LB	0.23	818	695	-15%	982	20%	920	782	1,104
41	Iron Gate	4.130	Iron Gate Dam Removal	Remove and Dispose of Piping- 3-in. Dia. x STD x 30'	1,088	LB	0.38	412	350	-15%	494	20%	463	394	556
41	Iron Gate	4.131	Iron Gate Dam Removal	Remove and Dispose of Gate Valves	21,792	LB	0.98	21,312	18,116	-15%	25,575	20%	23,974	20,378	28,768
41	Iron Gate	4.132	Iron Gate Dam Removal	Remove and Dispose of Basin #1	2,880	LB	2.89	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.133	Iron Gate Dam Removal	Remove and Dispose of Basin #2	3,860	LB	2.16	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.134	Iron Gate Dam Removal	Remove and Dispose of Basin #3	2,880	LB	2.89	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.135	Iron Gate Dam Removal	Remove and Dispose of Basin #4	3,580	LB	2.33	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.136	Iron Gate Dam Removal	Remove and Dispose of Basin #5	1,440	LB	5.79	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.137	Iron Gate Dam Removal	Remove and Dispose of Basin #6	1,440	LB	5.79	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.138	Iron Gate Dam Removal	Remove and Dispose of Holding Tank	7,400	LB	1.53	11,355	9,652	-15%	13,627	20%	12,773	10,857	15,328
41	Iron Gate	4.139	Iron Gate Dam Removal	Remove and Dispose of Misc.: Motors, control panels, cables,	1.00	EA	1,782.06	1,782	1,337	-25%	2,228	25%	2,005	1,503	2,506
41	Iron Gate	4.140	Iron Gate Dam Removal	Wanaka Springs - Concrete Total	28.00	CY	306.28	8,576	7,290	-15%	9,862	15%	9,647	8,200	11,094
41	Iron Gate	4.141	Iron Gate Dam Removal	Wanaka Springs - Double Pipe Railings	60.00	LF	47.52	2,851	2,138	-25%	3,564	25%	3,207	2,405	4,009
41	Iron Gate	4.142	Iron Gate Dam Removal	Wanaka Springs - Wood picnic tables to be removed and haul	5.00	EA	118.80	594	446	-25%	743	25%	668	501	835
41	Iron Gate	4.143	Iron Gate Dam Removal	Wanaka Springs - 25'x5' Wooden floating dock	125	SF	23.76	2,970	2,228	-25%	3,713	25%	3,341	2,506	4,176
41	Iron Gate	4.144	Iron Gate Dam Removal	Wanaka Springs - Rip and reseed site and access road	2.50	AC	6,798.10	16,995	14,446	-15%	19,545	15%	19,117	16,250	21,985
41	Iron Gate	4.145	Iron Gate Dam Removal	Wanaka Springs - Signs to be removed and hauled away	3.00	EA	356.41	1,069	802	-25%	1,337	25%	1,203	902	1,503
41	Iron Gate	4.146	Iron Gate Dam Removal	Wanaka Springs - 15'x5' Gangplank with Railings	75.00	SF	23.76	1,782	1,337	-25%	2,228	25%	2,005	1,503	2,506
41	Iron Gate	4.147	Iron Gate Dam Removal	Juniper Point - Concrete Total	19.00	CY	359.74	6,835	5,810	-15%	7,860	15%	7,688	6,535	8,842
41	Iron Gate	4.148	Iron Gate Dam Removal	Juniper Point - 2, 4x4 Toilet Vaults	32.00	SF	118.80	3,802	2,851	-25%	4,752	25%	4,276	3,207	5,346
41	Iron Gate	4.149	Iron Gate Dam Removal	Juniper Point - Wood picnic tables to be removed and hauled	8.00	EA	118.80	950	713	-25%	1,188	25%	1,069	802	1,336
41	Iron Gate	4.150	Iron Gate Dam Removal	Juniper Point - Signs to be removed and hauled away	4.00	EA	356.41	1,426	1,069	-25%	1,782	25%	1,604	1,203	2,005
41	Iron Gate	4.151	Iron Gate Dam Removal	Juniper Point - Dock pile railing	50.00	LF	47.52	2,376	1,782	-25%	2,970	25%	2,673	2,005	3,341
41	Iron Gate	4.152	Iron Gate Dam Removal	Juniper Point - 50'x5' Composite dock with poly floats	250	SF	31.34	7,834	7,051	-10%	8,618	10%	8,812	7,931	9,694
41	Iron Gate	4.153	Iron Gate Dam Removal	Juniper Point - 20'x5' Composite gangplank with railings	100	SF	23.76	2,376	1,782	-25%	2,970	25%	2,673	2,005	3,341
41	Iron Gate	4.155	Iron Gate Dam Removal	Juniper Point - Regrade to Natural Contour, rip, and reseed	2.00	AC	10,546.17	21,092	17,928	-15%	24,256	15%	23,726	20,167	27,285
41	Iron Gate	4.156	Iron Gate Dam Removal	Camp Creek - Concrete Total	110	CY	306.56	33,722	28,664	-15%	38,780	15%	37,932	32,243	43,622

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Iron Gate	4.157	Iron Gate Dam Removal	Camp Creek - 180'Lx16'Wx8'D Earth jetty to remove and/or re	855	CY	73.54	62,876	53,445	-15%	72,307	15%	70,727	60,118	81,336
41	Iron Gate	4.158	Iron Gate Dam Removal	Camp Creek - Well house 10'x16' concrete block building	160	SF	72.74	11,638	10,475	-10%	12,802	10%	13,092	11,783	14,401
41	Iron Gate	4.159	Iron Gate Dam Removal	Camp Creek - 2, 20'x5' Composite decking gangplanks	200	SF	23.76	4,752	3,564	-25%	5,940	25%	5,346	4,009	6,682
41	Iron Gate	4.160	Iron Gate Dam Removal	Camp Creek - 2, 20'x5' Floating composite w/ aluminum frame	200	SF	23.76	4,752	3,564	-25%	5,940	25%	5,346	4,009	6,682
41	Iron Gate	4.161	Iron Gate Dam Removal	Camp Creek - Concrete block double toilet bldg 10'x16'	160	SF	72.74	11,638	10,475	-10%	12,802	10%	13,092	11,783	14,401
41	Iron Gate	4.162	Iron Gate Dam Removal	Camp Creek - Dump stations and approx. 2000 gal buried	1.00	EA	6,596.62	6,597	5,607	-15%	7,916	20%	7,420	6,307	8,904
41	Iron Gate	4.163	Iron Gate Dam Removal	Camp Creek - Power poles and lines	3.00	EA	1,818.16	5,454	4,636	-15%	6,545	20%	6,136	5,215	7,363
41	Iron Gate	4.164	Iron Gate Dam Removal	Camp Creek - Remove waterlines and 3 faucets and regrade	600	LF	5.94	3,564	2,673	-25%	4,455	25%	4,009	3,007	5,011
41	Iron Gate	4.166	Iron Gate Dam Removal	Camp Creek - Steel pipe/plank picnic tables to be removed an	5.00	EA	118.80	594	446	-25%	743	25%	668	501	835
41	Iron Gate	4.167	Iron Gate Dam Removal	Camp Creek - Relocate concrete tables	12.00	EA	118.80	1,426	1,069	-25%	1,782	25%	1,604	1,203	2,005
41	Iron Gate	4.168	Iron Gate Dam Removal	Camp Creek - Regrade, rip, and reseed	4.00	AC	8,861.29	35,445	30,128	-15%	40,762	15%	39,871	33,890	45,852
41	Iron Gate	4.169	Iron Gate Dam Removal	Camp Creek - Signs to be removed and hauled away	7.00	EA	356.41	2,495	1,871	-25%	3,119	25%	2,806	2,105	3,508
41	Iron Gate	4.170	Iron Gate Dam Removal	Dutch Creek - 50'4'3' Dock Concrete Abutment	22.00	CY	333.37	7,334	6,601	-10%	8,068	10%	8,250	7,425	9,075
41	Iron Gate	4.171	Iron Gate Dam Removal	Dutch Creek - Double Pipe Railing	100	LF	47.52	4,752	3,564	-25%	5,940	25%	5,346	4,009	6,682
41	Iron Gate	4.172	Iron Gate Dam Removal	Mirror Cove - Concrete Total	89.00	CY	235.88	20,994	18,894	-10%	23,093	10%	23,615	21,254	25,977
41	Iron Gate	4.173	Iron Gate Dam Removal	Mirror Cove - 10'x16' Toilet Vault	160	SF	96.23	15,397	13,857	-10%	16,937	10%	17,320	15,588	19,052
41	Iron Gate	4.174	Iron Gate Dam Removal	Mirror Cove - 2, 30'x5' Composite Gangplanks w/ aluminum	300	SF	21.43	6,430	5,787	-10%	7,073	10%	7,233	6,510	7,957
41	Iron Gate	4.175	Iron Gate Dam Removal	Mirror Cove - Double pipe railings on dock	80.00	LF	47.52	3,802	2,851	-25%	4,752	25%	4,276	3,207	5,346
41	Iron Gate	4.177	Iron Gate Dam Removal	Mirror Cove - Regrade site	3.00	AC	12,512.61	37,538	31,907	-15%	43,169	15%	42,225	35,891	48,559
41	Iron Gate	4.178	Iron Gate Dam Removal	Mirror Cove - Signs to be removed and hauled away	7.00	EA	356.41	2,495	1,871	-25%	3,119	25%	2,806	2,105	3,508
41	Iron Gate	4.179	Iron Gate Dam Removal	Overlook Point - 1 concrete picnic table base	1.00	CY	356.41	356	267	-25%	446	25%	401	301	501
41	Iron Gate	4.180	Iron Gate Dam Removal	Overlook Point - Steel frame table to be removed and hauled a	1.00	EA	118.80	119	89	-25%	149	25%	134	100	167
41	Iron Gate	4.181	Iron Gate Dam Removal	Overlook Point - Regrade steep access road and site to natura	0.50	AC	30,630.71	15,315	13,018	-15%	17,613	15%	17,228	14,644	19,812
41	Iron Gate	4.182	Iron Gate Dam Removal	Long Gulch - 80'x25x4" Concrete boat ramp to be removed	25.00	CY	310.44	7,761	6,985	-10%	8,537	10%	8,730	7,857	9,603
41	Iron Gate	4.183	Iron Gate Dam Removal	Long Gulch - Remove picnic tables (steel frames with planks)	2.00	EA	118.80	238	178	-25%	297	25%	267	200	334
41	Iron Gate	4.184	Iron Gate Dam Removal	Long Gulch - Regrade ramp area to natural contours, rip, rese	0.05	AC	29,701.07	1,485	1,114	-25%	1,856	25%	1,670	1,253	2,088
41	Iron Gate	4.185	Iron Gate Dam Removal	Concrete Lining Installation for Diversion Tunnel	1.00	LS	1,196,251.74	1,196,252	1,076,627	-10%	1,315,877	10%	1,345,621	1,211,058	1,480,183
41	Iron Gate	5.025	Iron Gate Dam Removal	Remove Distribution Poles near Iron Gate Hydro Plant	5.00	EA	1,190.24	5,951	5,059	-15%	7,141	20%	6,694	5,690	8,033
41	Iron Gate	5.026	Iron Gate Dam Removal	Remove 69kV/6.6kV Transformer @Substation	1.00	EA	2,273.46	2,273	1,932	-15%	2,842	25%	2,557	2,174	3,197
41	Iron Gate	5.027	Iron Gate Dam Removal	Remove 6.6kV Power Circuit Breaker @Substation	1.00	EA	1,524.31	1,524	1,296	-15%	1,905	25%	1,715	1,457	2,143
41	Iron Gate	5.028	Iron Gate Dam Removal	Remove Generator @Substation	1.00	EA	4,767.78	4,768	4,053	-15%	5,960	25%	5,363	4,559	6,704
41	Iron Gate	5.029	Iron Gate Dam Removal	Remove all auxiliary equipment @Substation (Allowance)	1.00	LS	26,865.48	26,865	22,836	-15%	33,582	25%	30,220	25,687	37,775
41	Iron Gate	5.030	Iron Gate Dam Removal	New Connection @Iron Gate Hatchery from PacifiCorp's Horn	1.00	LS	298,809.00	298,809	268,928	-10%	328,690	10%	336,119	302,508	369,731
42			**RESTORATION EARTHWORKS & HABITAT**												
42	Copco 1 & 2		Tributary Connectivity	Removal of sediment and similar obstructions to ensure volitio	7.00	EA	119,000.00	833,000	749,700	-10%	1,124,550	35%	955,752	860,177	1,290,265
42	Copco 1 & 2		Wetlands, Floodplain and Off-channel Habitat Features Site 1	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Wetlands, Floodplain and Off-channel Habitat Features Site 1	Grading and shaping of floodplain sediments (no export)	81,367	CY	8.00	650,936	585,842	-10%	878,764	35%	732,214	658,993	988,490
42	Copco 1 & 2		Wetlands, Floodplain and Off-channel Habitat Features Site 1	Floodplain roughness for 50% of area	5.60	AC	30,000.00	168,000	151,200	-10%	226,800	35%	188,977	170,079	255,119
42	Copco 1 & 2		Site 2 (25.5 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 2 (25.5 acres)	Grading and shaping of floodplain sediments (no export)	164,252	CY	8.00	1,314,016	1,182,614	-10%	1,773,922	35%	1,478,089	1,330,280	1,995,421
42	Copco 1 & 2		Site 2 (25.5 acres)	Floodplain roughness for 50% of area	12.75	AC	30,000.00	382,500	344,250	-10%	516,375	35%	430,260	387,234	580,852
42	Copco 1 & 2		Site 3 (13.9 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 3 (13.9 acres)	Grading and shaping of floodplain sediments (no export)	78,556	CY	8.00	628,448	565,603	-10%	848,405	35%	706,919	636,227	954,340
42	Copco 1 & 2		Site 3 (13.9 acres)	Floodplain roughness for 50% of area	6.95	AC	30,000.00	208,500	187,650	-10%	281,475	35%	234,534	211,081	316,621
42	Copco 1 & 2		Site 4 (10.5 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 4 (10.5 acres)	Grading and shaping of floodplain sediments (no export)	50,600	CY	8.00	404,800	364,320	-10%	546,480	35%	455,345	409,810	614,716
42	Copco 1 & 2		Site 4 (10.5 acres)	Floodplain roughness for 50% of area	5.25	AC	30,000.00	157,500	141,750	-10%	212,625	35%	177,166	159,449	239,174
42	Copco 1 & 2		Site 5 (4.2 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 5 (4.2 acres)	Grading and shaping of floodplain sediments (no export)	20,267	CY	8.00	162,136	145,922	-10%	218,884	35%	182,381	164,143	246,214
42	Copco 1 & 2		Site 5 (4.2 acres)	Floodplain roughness for 50% of area	2.10	AC	30,000.00	63,000	56,700	-10%	85,050	35%	70,866	63,780	95,670
42	Copco 1 & 2		Site 6 (5.3 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 6 (5.3 acres)	Grading and shaping of floodplain sediments (no export)	17,148	CY	8.00	137,184	123,466	-10%	185,198	35%	154,313	138,882	208,323
42	Copco 1 & 2		Site 6 (5.3 acres)	Floodplain roughness for 50% of area	2.65	AC	30,000.00	79,500	71,550	-10%	107,325	35%	89,427	80,484	120,726
42	Copco 1 & 2		Site 6 (5.3 acres)	Bank Stability and Channel Fringe ComplexityDevelop process	2,500	LF	253.00	632,500	569,250	-10%	853,875	35%	725,706	653,135	979,703
42	Copco 1 & 2		Large Wood Habitat Features	Ground-Based Placement	20.00	EA	27,990.00	559,800	503,820	-10%	755,730	35%	642,293	578,064	867,095
42	Copco 1 & 2		Large Wood Habitat Features	Helicopter Placement (@ 50 members staged and placed per	8.00	EA	57,000.00	456,000	410,400	-10%	615,600	35%	523,197	470,877	706,316
42	Copco 1 & 2		General Conditions	Contractor overhead	15%	%	7,287,820.00	1,093,173	983,856	-10%	1,475,784	35%	1,234,142	1,110,728	1,666,092
42	Copco 1 & 2		General Conditions	Insurance	1%	%	8,380,993.00	83,810	75,429	-10%	113,143	35%	94,618	85,156	127,734
42	Copco 1 & 2		General Conditions	Bond	1%	%	8,380,993.00	83,810	75,429	-10%	113,143	35%	94,618	85,156	127,734
42	Iron Gate		Tributary Connectivity	Removal of sediment and similar obstructions to ensure volitio	5.00	EA	119,000.00	595,000	535,500	-10%	803,250	35%	682,680	614,412	921,618
42	Iron Gate		Site 1 (14.2 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Iron Gate		Site 1 (14.2 acres)	Grading and shaping of floodplain sediments (no export)	60,000	CY	8.00	480,000	432,000	-10%	648,000	35%	539,935	485,941	728,912
42	Iron Gate		Site 1 (14.2 acres)	Floodplain roughness for 50% of area	7.10	AC	30,000.00	213,000	191,700	-10%	287,550	35%	239,596	215,636	323,455
42	Iron Gate		Site 2 (5.8 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Iron Gate		Site 2 (5.8 acres)	Grading and shaping of floodplain sediments (no export)	19,000	CY	8.00	152,000	136,800	-10%	205,200	35%	170,979	153,881	230,822
42	Iron Gate		Site 2 (5.8 acres)	Floodplain roughness for 50% of area	2.90	AC	30,000.00	87,000	78,300	-10%	117,450	35%	97,863	88,077	132,115

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
42	Iron Gate		Site 3 (23.1 acres)	Equipment & road access into site	2,000	LF	25.00	50,000	45,000	-10%	67,500	35%	56,243	50,619	75,928
42	Iron Gate		Site 3 (23.1 acres)	Grading and shaping of floodplain sediments (no export)	95,000	CY	8.00	760,000	684,000	-10%	1,026,000	35%	854,897	769,407	1,154,110
42	Iron Gate		Site 3 (23.1 acres)	Floodplain roughness for 75% of area	17.30	AC	30,000.00	519,000	467,100	-10%	700,650	35%	583,804	525,424	788,136
42	Iron Gate		Bank Stability and Channel Fringe Complexity	Develop process-based restoration and velocity variations alor	1,000	LF	253.00	253,000	227,700	-10%	341,550	35%	290,282	261,254	391,881
42	Iron Gate		Large Wood Habitat Features	Ground-Based Placement	20.00	EA	27,990.00	559,800	503,820	-10%	755,730	35%	642,293	578,064	867,095
42	Iron Gate		Large Wood Habitat Features	Helicopter Placement (@ 50 members staged and placed per	4.00	EA	57,000.00	228,000	205,200	-10%	307,800	35%	261,598	235,439	353,158
42	Iron Gate		General Conditions	Contractor overhead	15%	%	4,046,800.00	607,020	546,318	-10%	819,477	35%	687,017	618,315	927,473
42	Iron Gate		General Conditions	Contractor profit (included in rates & prices)	0%	%	4,046,800.00	-	-	0%	-	0%	-	-	-
42	Iron Gate		General Conditions	Insurance	1%	%	4,653,820.00	46,538	41,884	-10%	62,827	35%	52,671	47,404	71,106
42	Iron Gate		General Conditions	Bond	1%	%	4,653,820.00	46,538	41,884	-10%	62,827	35%	52,671	47,404	71,106
42	JC Boyle		Tributary Connectivity	Removal of sediment and similar obstructions to ensure volitio	2.00	EA	119,000.00	238,000	214,200	-10%	321,300	35%	273,072	245,765	368,647
42	JC Boyle		Site 1 (3.3 acres)	Equipment & road access into site	500	LF	25.00	12,500	11,250	-10%	16,875	35%	14,061	12,655	18,982
42	JC Boyle		Site 1 (3.3 acres)	Grading and shaping of floodplain sediments (no export)	37,000	CY	8.00	296,000	266,400	-10%	399,600	35%	332,960	299,664	449,496
42	JC Boyle		Site 1 (3.3 acres)	Floodplain roughness for 50% of area	1.65	AC	30,000.00	49,500	44,550	-10%	66,825	35%	55,681	50,113	75,169
42	JC Boyle		Site 2 (43.8 acres)	Equipment & road access into site	500	LF	25.00	12,500	11,250	-10%	16,875	35%	14,061	12,655	18,982
42	JC Boyle		Site 2 (43.8 acres)	Grading and shaping of floodplain sediments (no export)	35,000	CY	8.00	280,000	252,000	-10%	378,000	35%	314,962	283,466	425,199
42	JC Boyle		Site 2 (43.8 acres)	Floodplain roughness for 50% of area	21.90	AC	30,000.00	657,000	591,300	-10%	886,950	35%	739,036	665,132	997,698
42	JC Boyle		Site 3 (65.8 acres)	Equipment & road access into site	500	LF	25.00	12,500	11,250	-10%	16,875	35%	14,061	12,655	18,982
42	JC Boyle		Site 3 (65.8 acres)	Grading and shaping of floodplain sediments (no export)	53,000	CY	8.00	424,000	381,600	-10%	572,400	35%	476,942	429,248	643,872
42	JC Boyle		Site 3 (65.8 acres)	Floodplain roughness for 30% of area	20.00	AC	30,000.00	600,000	540,000	-10%	810,000	35%	674,918	607,427	911,140
42	JC Boyle		Site 4 (21.3 acres)	Equipment & road access into site	500	LF	25.00	12,500	11,250	-10%	16,875	35%	14,061	12,655	18,982
42	JC Boyle		Site 4 (21.3 acres)	Grading and shaping of floodplain sediments (no export)	17,000	CY	8.00	136,000	122,400	-10%	183,600	35%	152,982	137,683	206,525
42	JC Boyle		Site 4 (21.3 acres)	Floodplain roughness for 50% of area	10.65	AC	30,000.00	319,500	287,550	-10%	431,325	35%	359,394	323,455	485,182
42	JC Boyle		Bank Stability and Channel Fringe Complexity	Develop process-based restoration and velocity variations alor	2,000	LF	253.00	506,000	455,400	-10%	683,100	35%	580,565	522,508	783,762
42	JC Boyle		Large Wood Habitat Features	Ground-Based Placement	30.00	EA	27,990.00	839,700	755,730	-10%	1,133,595	35%	963,439	867,095	1,300,643
42	JC Boyle		Large Wood Habitat Features	Helicopter Placement (50 members staged and placed per site	2.00	EA	57,000.00	114,000	102,600	-10%	153,900	35%	130,799	117,719	176,579
42	JC Boyle		General Conditions	Contractor overhead	15%	%	4,509,700.00	676,455	608,810	-10%	913,214	35%	764,724	688,252	1,032,378
42	JC Boyle		General Conditions	Contractor profit (included in rates & prices)	0%	%	4,509,700.00	-	-	0%	-	0%	-	-	-
42	JC Boyle		General Conditions	Insurance	1%	%	5,186,155.00	51,862	46,675	-10%	70,013	35%	58,629	52,766	79,149
42	JC Boyle		General Conditions	Bond	1%	%	5,186,155.00	51,862	46,675	-10%	70,013	35%	58,629	52,766	79,149
43			**RESTORATION OF VEGETATION**												
43	JC Boyle		Restoration of Vegetation	On-Site Pilot Growing Experiment	0.18	%	636,843.00	114,632	100,667	-12%	132,873	16%	115,847	101,734	134,282
43	JC Boyle		Restoration of Vegetation	Seed Collection	0.18	%	1,167,800.00	210,204	159,426	-24%	261,486	24%	221,213	167,775	275,181
43	JC Boyle		Restoration of Vegetation	Seed Propagation	0.18	%	2,803,989.00	504,718	189,718	-62%	648,718	29%	555,301	208,732	713,733
43	JC Boyle		Restoration of Vegetation	Weed Eradication	0.18	%	3,049,095.15	548,837	433,359	-21%	664,315	21%	606,617	478,982	734,252
43	JC Boyle		Restoration of Vegetation	Pioneer Seeding	0.18	%	2,150,000.00	387,000	252,000	-35%	594,000	53%	435,322	283,466	668,169
43	JC Boyle		Restoration of Vegetation	Container Plant Growing	0.18	%	1,057,742.00	190,394	69,627	-63%	311,160	63%	217,088	79,389	354,787
43	JC Boyle		Restoration of Vegetation	Establ. Prd. Maint. & Monitor'g	0.18	%	8,043,339.82	1,447,801	776,357	-46%	2,198,979	52%	1,761,471	944,557	2,675,394
43	JC Boyle		Restoration of Vegetation	Long-Term Maint. & Monitor'g	0.18	%	8,189,100.00	1,474,038	668,469	-55%	2,493,180	69%	1,923,473	872,286	3,253,352
43	JC Boyle		Restoration of Vegetation	Emergent Wetland	0.85	AC	35,203.00	29,775	20,555	-31%	41,297	39%	34,260	23,651	47,519
43	JC Boyle		Restoration of Vegetation	Bank Wetland	4.21	AC	21,453.20	90,220	54,232	-40%	116,796	29%	103,198	62,034	133,597
43	JC Boyle		Restoration of Vegetation	Bank Riparian	32.92	AC	30,175.20	993,384	643,821	-35%	1,362,911	37%	1,144,047	741,466	1,569,618
43	JC Boyle		Restoration of Vegetation	Floodplain Riparian	55.08	AC	13,817.40	761,037	507,182	-33%	1,043,992	37%	876,122	583,879	1,201,866
43	JC Boyle		Restoration of Vegetation	Uplands below RW	24.20	AC	9,714.00	235,062	175,776	-25%	318,207	35%	273,032	204,169	369,607
43	JC Boyle		Restoration of Vegetation	Rocky Wake Zone	16.37	AC	9,719.00	159,096	118,909	-25%	221,113	39%	184,792	138,114	256,825
43	JC Boyle		Restoration of Vegetation	Disturbed Uplands above RWZ	42.29	AC	9,502.00	401,819	302,294	-25%	559,998	39%	466,536	350,982	650,192
43	JC Boyle		Restoration of Vegetation	Uplands Stockpiles	6.73	AC	8,856.67	59,595	44,882	-25%	83,046	39%	64,832	48,826	90,344
43	JC Boyle		Restoration of Vegetation	Undisturbed Uplands	10.07	AC	4,850.00	48,829	37,251	-24%	59,904	23%	56,385	43,015	69,173
43	JC Boyle		Restoration of Vegetation	Contractor overhead	1.00	LS	1,391,623.54	1,391,624	879,961	-37%	2,005,720	44%	1,643,136	1,030,506	2,379,157
43	Iron Gate		Restoration of Vegetation	On-Site Pilot Growing Experiment	0.42	%	636,843.00	267,601	235,001	-12%	310,185	16%	270,438	237,492	313,474
43	Iron Gate		Restoration of Vegetation	Seed Collection	0.42	%	1,167,800.00	490,710	372,171	-24%	610,425	24%	516,409	391,662	642,394
43	Iron Gate		Restoration of Vegetation	Seed Propagation	0.42	%	2,803,989.00	1,178,236	442,886	-62%	1,514,396	29%	1,296,320	487,273	1,666,170
43	Iron Gate		Restoration of Vegetation	Weed Eradication	0.42	%	3,049,095.15	1,281,230	1,011,653	-21%	1,550,806	21%	1,416,113	1,118,156	1,714,070
43	Iron Gate		Restoration of Vegetation	Pioneer Seeding	0.42	%	2,150,000.00	903,430	588,280	-35%	1,386,660	53%	1,016,236	661,735	1,559,804
43	Iron Gate		Restoration of Vegetation	Container Plant Growing	0.42	%	1,057,742.00	444,463	162,540	-63%	726,386	63%	506,780	185,329	828,231
43	Iron Gate		Restoration of Vegetation	Establ. Prd. Maint. & Monitor'g	0.42	%	8,043,339.82	3,379,811	1,812,363	-46%	5,133,395	52%	4,112,057	2,205,016	6,245,560
43	Iron Gate		Restoration of Vegetation	Long-Term Maint. & Monitor'g	0.42	%	8,189,100.00	3,441,060	1,560,504	-55%	5,820,190	69%	4,490,241	2,036,303	7,594,770
43	Iron Gate		Restoration of Vegetation	Emergent Wetland	1.78	AC	35,203.00	62,658	43,255	-31%	86,907	39%	72,099	49,772	100,000
43	Iron Gate		Restoration of Vegetation	Bank Wetland	7.59	AC	21,453.20	162,728	97,818	-40%	210,662	29%	186,135	111,888	240,965
43	Iron Gate		Restoration of Vegetation	Bank Riparian	23.87	AC	30,175.20	720,169	466,748	-35%	988,064	37%	829,395	537,538	1,137,919
43	Iron Gate		Restoration of Vegetation	Floodplain Riparian	34.82	AC	13,817.40	481,147	320,653	-33%	660,039	37%	553,907	369,143	759,851
43	Iron Gate		Restoration of Vegetation	Uplands below RW	333	AC	9,714.00	3,230,647	2,415,835	-25%	4,373,379	35%	3,752,497	2,806,068	5,079,817
43	Iron Gate		Restoration of Vegetation	Rocky Wake Zone	11.20	AC	9,719.00	108,851	81,355	-25%	151,281	39%	126,431	94,495	175,715
43	Iron Gate		Restoration of Vegetation	Disturbed Uplands above RWZ	70.53	AC	9,502.00	670,217	504,215	-25%	934,054	39%	778,163	585,424	1,084,494
43	Iron Gate		Restoration of Vegetation	Uplands Stockpiles	38.76	AC	8,856.67	343,285	258,534	-25%	478,368	39%	373,450	281,252	520,404

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
43	Iron Gate		Restoration of Vegetation	Undisturbed Uplands	20.99	AC	4,850.00	101,810	77,669	-24%	124,901	23%	117,563	89,688	144,227
43	Iron Gate		Restoration of Vegetation	Contractor overhead	1.00	LS	3,094,512.21	3,094,512	2,008,187	-35%	4,458,145	44%	3,660,630	2,354,359	5,298,930
43	Copco 1		Restoration of Vegetation	On-Site Pilot Growing Experiment	0.40	%	636,843.00	253,909	222,977	-12%	294,314	16%	256,601	225,340	297,434
43	Copco 1		Restoration of Vegetation	Seed Collection	0.40	%	1,167,800.00	465,602	353,129	-24%	579,191	24%	489,986	371,623	609,525
43	Copco 1		Restoration of Vegetation	Seed Propagation	0.40	%	2,803,989.00	1,117,950	420,225	-62%	1,436,910	29%	1,229,992	462,341	1,580,919
43	Copco 1		Restoration of Vegetation	Weed Eradication	0.40	%	3,049,095.15	1,215,674	959,891	-21%	1,471,458	21%	1,343,656	1,060,945	1,626,368
43	Copco 1		Restoration of Vegetation	Pioneer Seeding	0.40	%	2,150,000.00	857,205	558,180	-35%	1,315,710	53%	964,239	627,877	1,479,995
43	Copco 1		Restoration of Vegetation	Container Plant Growing	0.40	%	1,057,742.00	421,722	154,224	-63%	689,220	63%	480,850	175,847	785,853
43	Copco 1		Restoration of Vegetation	Establ. Prd. Maint. & Monitor'g	0.40	%	8,043,339.82	3,206,880	1,719,631	-46%	4,870,739	52%	3,901,659	2,092,194	5,925,999
43	Copco 1		Restoration of Vegetation	Long-Term Maint. & Monitor'g	0.40	%	8,189,100.00	3,264,994	1,480,659	-55%	5,522,394	69%	4,260,493	1,932,113	7,206,175
43	Copco 1		Restoration of Vegetation	Emergent Wetland	1.79	AC	35,203.00	63,017	43,503	-31%	87,405	39%	72,512	50,058	100,574
43	Copco 1		Restoration of Vegetation	Bank Wetland	7.65	AC	21,453.20	164,188	98,696	-40%	212,553	29%	187,806	112,893	243,127
43	Copco 1		Restoration of Vegetation	Bank Riparian	48.01	AC	30,175.20	1,448,583	938,839	-35%	1,987,438	37%	1,668,284	1,081,229	2,288,865
43	Copco 1		Restoration of Vegetation	Floodplain Riparian	58.23	AC	13,817.40	804,552	536,182	-33%	1,103,686	37%	926,218	617,264	1,270,588
43	Copco 1		Restoration of Vegetation	Uplands below RW	306	AC	9,714.00	2,968,059	2,219,475	-25%	4,017,909	35%	3,447,493	2,577,989	4,666,927
43	Copco 1		Restoration of Vegetation	Rocky Wake Zone	15.06	AC	9,719.00	146,354	109,386	-25%	203,405	39%	169,993	127,053	236,257
43	Copco 1		Restoration of Vegetation	Disturbed Uplands above RWZ	8.02	AC	9,502.00	76,226	57,346	-25%	106,233	39%	88,503	66,582	123,343
43	Copco 1		Restoration of Vegetation	Uplands Stockpiles	3.37	AC	8,856.67	29,844	22,476	-25%	41,587	39%	32,466	24,451	45,242
43	Copco 1		Restoration of Vegetation	Undisturbed Uplands	13.39	AC	4,850.00	64,957	49,554	-24%	79,689	23%	75,008	57,222	92,020
43	Copco 1		Restoration of Vegetation	Contractor overhead	1.00	LS	2,983,330.50	2,983,330	1,912,476	-36%	4,291,645	44%	3,530,879	2,244,456	5,103,293
43	Copco 2		Restoration of Vegetation	On-Site Pilot Growing Experiment	0.00	%	636,843.00	701	615	-12%	812	16%	708	622	821
43	Copco 2		Restoration of Vegetation	Seed Collection	0.00	%	1,167,800.00	1,285	974	-24%	1,598	24%	1,352	1,025	1,682
43	Copco 2		Restoration of Vegetation	Seed Propagation	0.00	%	2,803,989.00	3,084	1,159	-62%	3,964	29%	3,394	1,276	4,362
43	Copco 2		Restoration of Vegetation	Weed Eradication	0.00	%	3,049,095.15	3,354	2,648	-21%	4,060	21%	3,707	2,927	4,487
43	Copco 2		Restoration of Vegetation	Pioneer Seeding	0.00	%	2,150,000.00	2,365	1,540	-35%	3,630	53%	2,660	1,732	4,083
43	Copco 2		Restoration of Vegetation	Container Plant Growing	0.00	%	1,057,742.00	1,164	426	-63%	1,902	63%	1,327	485	2,168
43	Copco 2		Restoration of Vegetation	Establ. Prd. Maint. & Monitor'g	0.00	%	8,043,339.82	8,848	4,744	-46%	13,438	52%	10,765	5,772	16,350
43	Copco 2		Restoration of Vegetation	Long-Term Maint. & Monitor'g	0.00	%	8,189,100.00	9,008	4,085	-55%	15,236	69%	11,755	5,331	19,882
43	Copco 2		Restoration of Vegetation	Floodplain Riparian	0.81	AC	13,817.40	11,157	7,435	-33%	15,305	37%	12,844	8,560	17,619
43	Copco 2		Restoration of Vegetation	Disturbed Uplands above RWZ	1.19	AC	9,502.00	11,280	8,486	-25%	15,721	39%	13,097	9,853	18,253
43	Copco 2		Restoration of Vegetation	Contractor overhead	1.00	LS	9,894.21	9,894	6,468	-35%	14,234	44%	11,663	7,569	16,845
44			**YREKA WATER LINE REPLACEMENT**												
44	Project	6.001	Yreka Water Line Replacement	Microtunneling	612	LH	1,558.34	953,701	810,646	-20%	1,239,812	40%	1,052,154	894,331	1,367,800
44	Project	6.002	Yreka Water Line Replacement	Pile and Lagging Pre Drilling	458	LF	150.68	69,010	58,658	-20%	89,712	40%	76,134	64,714	98,974
44	Project	6.003	Yreka Water Line Replacement	Pile and Lagging Wall InstallatioN	13,715	SF	73.01	1,001,297	851,102	-20%	1,301,686	40%	1,104,663	938,963	1,436,062
44	Project	6.004	Yreka Water Line Replacement	Pipe Installation	2,106	LF	133.76	281,698	239,443	-20%	366,207	40%	310,778	264,161	404,012
44	Project	6.005	Yreka Water Line Replacement	Excavation and Backfill	3,653	CY	88.45	323,097	274,632	-20%	420,026	40%	356,451	302,983	463,386
45			**TRANSPORTATION (BRIDGES, CULVERTS, ROADS)**												
45	Project		Lakeview Bridge	Sheet Pile Coffer Dam For Center Footer	2,400	SF	38.40	92,161	73,729	-20%	119,809	30%	100,878	80,702	131,141
45	Project		Lakeview Bridge	Backfill, structural, common earth, 105 H.P. dozer, 50' haul, fro	89.00	CY	39.77	3,540	2,832	-20%	4,602	30%	3,875	3,100	5,037
45	Project		Lakeview Bridge	Earth Work Coffer Dam Construction for side footers	1,186	CY	15.26	18,097	14,478	-20%	23,526	30%	19,809	15,847	25,752
45	Project		Lakeview Bridge	Structure Excavation (Rock) Drilling and blasting rock, boulder	107	CY	186.20	19,924	15,939	-20%	25,901	30%	21,808	17,447	28,351
45	Project		Lakeview Bridge	Structure Excavation (Type D)	1,122	CY	20.27	22,741	18,193	-20%	29,563	30%	24,892	19,913	32,359
45	Project		Lakeview Bridge	Structure Excavation (Bridge)	159	CY	58.08	9,234	7,387	-20%	12,004	30%	10,107	8,086	13,140
45	Project		Lakeview Bridge	Prestressed concrete piles, square, 40' long, 24" square, price	480	LF	165.17	79,283	63,426	-20%	103,068	30%	86,781	69,425	112,816
45	Project		Lakeview Bridge	18" Diameter 40' Long Tie Down Anchor Installation	480	LF	101.95	48,937	39,149	-20%	63,618	30%	53,565	42,852	69,634
45	Project		Lakeview Bridge	Piling special costs, pre-augering for Pile and Tie Down Ancho	960	LF	311.56	299,101	239,281	-20%	388,831	30%	327,390	261,912	425,606
45	Project		Lakeview Bridge	Mobilization, 150 ton, set up and remove crane, with pile leads	2.00	EA	22,228.11	44,456	35,565	-20%	57,793	30%	48,661	38,929	63,259
45	Project		Lakeview Bridge	A736 Barrier Wall	536	LF	388.00	207,966	166,373	-20%	270,356	30%	227,635	182,108	295,926
45	Project		Lakeview Bridge	Expansion joint, neoprene, liquid, 1" x 2", cold applied	46.00	LF	44.09	2,028	1,623	-20%	2,637	30%	2,220	1,776	2,886
45	Project		Lakeview Bridge	Columns Structural Concrete includes forms, Grade 60 rebar,	172	CY	1,953.07	335,929	268,743	-20%	436,707	30%	367,701	294,161	478,011
45	Project		Lakeview Bridge	Deck Structural concrete, in place, includes forms, Grade 60 r	168	CY	1,143.38	192,088	153,670	-20%	249,714	30%	210,255	168,204	273,332
45	Project		Lakeview Bridge	Footer Structural concrete,footing, reinforced, includes forms(4	448	CY	421.72	188,929	151,143	-20%	245,608	30%	206,798	165,438	268,837
45	Project		Lakeview Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	17.00	CY	293.49	4,989	3,992	-20%	6,486	30%	5,461	4,369	7,100
45	Project		Lakeview Bridge	Precast 36" I-Girder 65'	8.00	EA	29,970.09	239,761	191,809	-20%	311,689	30%	262,437	209,950	341,168
45	Project		Lakeview Bridge	Precast 36" I-Girder 48'	8.00	EA	35,810.59	286,485	229,188	-20%	372,430	30%	313,580	250,864	407,654
45	Project		Lakeview Bridge	Bridge Demolition	3,917	SF	60.00	235,020	188,016	-20%	305,526	30%	257,248	205,798	334,422
45	Project		Lakeview Bridge - Paving	Roadway Excavation	510	CY	40.00	20,400	16,320	-20%	25,500	25%	22,329	17,864	27,912
45	Project		Lakeview Bridge - Paving	Imported Borrow	2,510	CY	45.00	112,950	90,360	-20%	141,188	25%	123,633	98,906	154,541
45	Project		Lakeview Bridge - Paving	Hot Mix Asphalt (Type A)	450	T	130.00	58,500	46,800	-20%	73,125	25%	64,033	51,226	80,041
45	Project		Lakeview Bridge - Paving	Class 2 Aggregate Base	330	CY	65.00	21,450	17,160	-20%	26,813	25%	23,479	18,783	29,348
45	Project		Lakeview Bridge - Paving	Midwest Guardrail System	200	LF	40.61	8,122	6,498	-20%	10,153	25%	8,890	7,112	11,113
45	Project		Lakeview Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Lakeview Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Lakeview Bridge - Paving	Temporary Reinforced Silt Fence	600	LF	7.58	4,548	3,638	-20%	5,685	25%	4,978	3,983	6,223
45	Project		Lakeview Bridge - Paving	Temporary Fence (Type ESA)	300	LF	5.03	1,509	1,207	-20%	1,886	25%	1,652	1,321	2,065
45	Project		Lakeview Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Lakeview Bridge - Paving	Water Pollution Control	0.10	%	213,300.00	21,330	17,064	-20%	26,663	25%	23,347	18,678	29,184
45	Project		Lakeview Bridge - Paving	Roadside Sign - One Post	2.00	EA	270.00	540	432	-20%	675	25%	591	473	739
45	Project		Lakeview Bridge - Paving	Reset Roadside Sign	4.00	EA	300.00	1,200	960	-20%	1,500	25%	1,313	1,051	1,642
45	Project		Lakeview Bridge - Paving	Relocate Roadside Sign	2.00	EA	100.00	200	160	-20%	250	25%	219	175	274
45	Project		Lakeview Bridge - Paving	Thermoplastic Traffic Stripe	660	LF	0.86	568	454	-20%	710	25%	621	497	777
45	Project		Lakeview Bridge - Paving	Type III Barricade	4.00	EA	274.29	1,097	878	-20%	1,371	25%	1,201	961	1,501
45	Project		Lakeview Bridge - Paving	Traffic Control System	20.00	DA	1,000.00	20,000	16,000	-20%	25,000	25%	21,892	17,513	27,364
45	Project		Lakeview Bridge - Paving	Temporary Railing (Type K)	300	LF	47.00	14,100	11,280	-20%	17,625	25%	15,434	12,347	19,292
45	Project		Fall Creek Bridge	Structure Excavation (Bridge)	499	CY	58.08	28,980	23,184	-20%	37,674	30%	31,721	25,377	41,237
45	Project		Fall Creek Bridge	A736 Barrier Wall	100	LF	388.00	38,800	31,040	-20%	50,440	30%	42,469	33,975	55,210
45	Project		Fall Creek Bridge	Columns/Walls Structural Concrete includes forms, Grade 60 r	111	CY	1,953.07	216,791	173,433	-20%	281,829	30%	237,295	189,836	308,484
45	Project		Fall Creek Bridge	Deck Structural concrete, in place, includes forms, Grade 60 r	31.00	CY	1,143.38	35,445	28,356	-20%	46,078	30%	38,797	31,038	50,436
45	Project		Fall Creek Bridge	Footer Structural concrete,footing, reinforced, includes forms(4	86.00	CY	421.72	36,268	29,014	-20%	47,148	30%	39,698	31,758	51,607
45	Project		Fall Creek Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	22.00	CY	293.49	6,457	5,166	-20%	8,394	30%	7,068	5,654	9,188
45	Project		Fall Creek Bridge	Bridge Demolition	720	SF	60.00	43,200	34,560	-20%	56,160	30%	47,286	37,829	61,472
45	Project		Fall Creek Bridge - Paving	Roadway Excavation	720	CY	40.00	28,800	23,040	-20%	36,000	25%	31,524	25,219	39,405
45	Project		Fall Creek Bridge - Paving	Imported Borrow	2,380	CY	45.00	107,100	85,680	-20%	133,875	25%	117,229	93,784	146,537
45	Project		Fall Creek Bridge - Paving	Hot Mix Asphalt (Type A)	230	T	130.00	29,900	23,920	-20%	37,375	25%	32,728	26,182	40,910
45	Project		Fall Creek Bridge - Paving	Class 2 Aggregate Base	170	CY	65.00	11,050	8,840	-20%	13,813	25%	12,095	9,676	15,119
45	Project		Fall Creek Bridge - Paving	Midwest Guardrail System	100	LF	40.61	4,061	3,249	-20%	5,076	25%	4,445	3,556	5,556
45	Project		Fall Creek Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Fall Creek Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Fall Creek Bridge - Paving	Relocate Gate	1.00	EA	100.00	100	80	-20%	125	25%	109	88	137
45	Project		Fall Creek Bridge - Paving	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Fall Creek Bridge - Paving	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Fall Creek Bridge - Paving	Temporary Hydroseed	280	SY	9.22	2,582	2,065	-20%	3,227	25%	2,826	2,261	3,532
45	Project		Fall Creek Bridge - Paving	Rolled Erosion Control / Jute Mesh	280	SY	16.62	4,654	3,723	-20%	5,817	25%	5,094	4,075	6,367
45	Project		Fall Creek Bridge - Paving	Temporary Fiber Roll	375	LF	8.10	3,038	2,430	-20%	3,797	25%	3,325	2,660	4,156
45	Project		Fall Creek Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Fall Creek Bridge - Paving	Water Pollution Control	0.10	%	176,850.00	17,685	14,148	-20%	22,106	25%	19,358	15,486	24,197
45	Project		Fall Creek Bridge - Paving	Temporary Traffic Stripe	500	LF	1.20	600	480	-20%	750	25%	657	525	821
45	Project		Fall Creek Bridge - Paving	Thermoplastic Traffic Stripe	275	LF	0.86	237	189	-20%	296	25%	259	207	324
45	Project		Fall Creek Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Fall Creek Bridge - Paving	Traffic Control System	50.00	DA	1,000.00	50,000	40,000	-20%	62,500	25%	54,729	43,783	68,411
45	Project		Fall Creek Bridge - Paving	Temporary Railing (Type K)	200	LF	47.00	9,400	7,520	-20%	11,750	25%	10,289	8,231	12,861
45	Project		Daggett Road Bridge	Sheet Pile Coffer Dam For Footers	7,200	SF	38.40	276,483	221,186	-20%	359,428	30%	302,633	242,106	393,422
45	Project		Daggett Road Bridge	Backfill, structural, common earth, 105 H.P. dozer, 50' haul, fro	91.00	CY	39.77	3,619	2,896	-20%	4,705	30%	3,962	3,169	5,150
45	Project		Daggett Road Bridge	Structure Excavation (Rock) Drilling and blasting rock, boulder	107	CY	186.20	19,924	15,939	-20%	25,901	30%	21,808	17,447	28,351
45	Project		Daggett Road Bridge	Structure Excavation (Type D)	1,535	CY	20.27	31,112	24,889	-20%	40,445	30%	34,054	27,243	44,271
45	Project		Daggett Road Bridge	Structure Excavation (Bridge)	171	CY	58.08	9,931	7,945	-20%	12,910	30%	10,870	8,696	14,131
45	Project		Daggett Road Bridge	Prestressed concrete piles, square, 40' long, 24" square, price	480	LF	165.17	79,283	63,426	-20%	103,068	30%	86,781	69,425	112,816
45	Project		Daggett Road Bridge	18" Diameter 40' Long Tie Down Anchor Installation	480	LF	101.95	48,937	39,149	-20%	63,618	30%	53,565	42,852	69,634
45	Project		Daggett Road Bridge	Piling special costs, pre-augering for Pile and Tie Down Ancho	960	LF	311.56	299,101	239,281	-20%	388,831	30%	327,390	261,912	425,606
45	Project		Daggett Road Bridge	Mobilization, 150 ton, set up and remove crane, with pile leads	2.00	EA	22,228.11	44,456	35,565	-20%	57,793	30%	48,661	38,929	63,259
45	Project		Daggett Road Bridge	A736 Barrier Wall	530	LF	388.00	205,638	164,510	-20%	267,330	30%	225,087	180,070	292,613
45	Project		Daggett Road Bridge	Expansion joint, neoprene, liquid, 1" x 2", cold applied	46.00	LF	44.09	2,028	1,623	-20%	2,637	30%	2,220	1,776	2,886
45	Project		Daggett Road Bridge	Columns Structural Concrete includes forms, Grade 60 rebar,	157	CY	1,953.07	306,633	245,306	-20%	398,622	30%	335,634	268,507	436,324
45	Project		Daggett Road Bridge	Deck Structural concrete, in place, includes forms, Grade 60 r	167	CY	1,143.38	190,944	152,755	-20%	248,228	30%	209,004	167,203	271,705
45	Project		Daggett Road Bridge	Footer Structural concrete,footing, reinforced, includes forms(4	448	CY	421.72	188,929	151,143	-20%	245,608	30%	206,798	165,438	268,837
45	Project		Daggett Road Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	17.00	CY	293.49	4,989	3,992	-20%	6,486	30%	5,461	4,369	7,100
45	Project		Daggett Road Bridge	Precast 36" I-Girder 65'	8.00	EA	29,970.09	239,761	191,809	-20%	311,689	30%	262,437	209,950	341,168
45	Project		Daggett Road Bridge	Precast 36" I-Girder 48'	8.00	EA	35,810.59	286,485	229,188	-20%	372,430	30%	313,580	250,864	407,654
45	Project		Daggett Road Bridge	Bridge Demolition	3,262	SF	60.00	195,720	156,576	-20%	254,436	30%	214,231	171,385	278,500
45	Project		Daggett Road Bridge - Paving	Roadway Excavation	1,500	CY	40.00	60,000	48,000	-20%	75,000	25%	65,675	52,540	82,093
45	Project		Daggett Road Bridge - Paving	Imported Borrow	5,500	CY	45.00	247,500	198,000	-20%	309,375	25%	270,908	216,727	338,635
45	Project		Daggett Road Bridge - Paving	Hot Mix Asphalt (Type A)	1,240	T	130.00	161,200	128,960	-20%	201,500	25%	176,446	141,157	220,558
45	Project		Daggett Road Bridge - Paving	Class 2 Aggregate Base	920	CY	65.00	59,800	47,840	-20%	74,750	25%	65,456	52,365	81,820
45	Project		Daggett Road Bridge - Paving	Remove Base and Surfacing	9,485	SF	6.00	56,910	45,528	-20%	71,138	25%	62,293	49,834	77,866
45	Project		Daggett Road Bridge - Paving	Midwest Guardrail System	200	LF	40.61	8,122	6,498	-20%	10,153	25%	8,890	7,112	11,113
45	Project		Daggett Road Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Daggett Road Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Daggett Road Bridge - Paving	Temporary Reinforced Silt Fence	1,000	LF	7.58	7,580	6,064	-20%	9,475	25%	8,297	6,638	10,371
45	Project		Daggett Road Bridge - Paving	Temporary Fence (Type ESA)	1,000	LF	5.03	5,030	4,024	-20%	6,288	25%	5,506	4,405	6,882
45	Project		Daggett Road Bridge - Paving	Temporary Hydroseed	1,200	SY	9.22	11,064	8,851	-20%	13,830	25%	12,110	9,688	15,138
45	Project		Daggett Road Bridge - Paving	Rolled Erosion Control / Jute Mesh	1,200	SY	16.62	19,944	15,955	-20%	24,930	25%	21,830	17,464	27,288
45	Project		Daggett Road Bridge - Paving	Temporary Fiber Roll	1,100	LF	8.10	8,910	7,128	-20%	11,138	25%	9,753	7,802	12,191
45	Project		Daggett Road Bridge - Paving	Temporary Construction Entrance	1.00	EA	4,303.25	4,303	3,443	-20%	5,379	25%	4,710	3,768	5,888
45	Project		Daggett Road Bridge - Paving	Water Pollution Control	0.10	%	585,410.00	58,541	46,833	-20%	73,176	25%	64,078	51,262	80,097
45	Project		Daggett Road Bridge - Paving	Roadside Sign - One Post	1.00	EA	270.00	270	216	-20%	338	25%	296	236	369
45	Project		Daggett Road Bridge - Paving	Remove Roadside Sign	2.00	EA	100.00	200	160	-20%	250	25%	219	175	274
45	Project		Daggett Road Bridge - Paving	Reset Roadside Sign	2.00	EA	300.00	600	480	-20%	750	25%	657	525	821
45	Project		Daggett Road Bridge - Paving	Thermoplastic Traffic Stripe	2,020	LF	0.86	1,737	1,390	-20%	2,172	25%	1,902	1,521	2,377
45	Project		Daggett Road Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Daggett Road Bridge - Paving	Traffic Control System	15.00	DA	1,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Daggett Road Bridge - Paving	Temporary Railing (Type K)	120	LF	47.00	5,640	4,512	-20%	7,050	25%	6,173	4,939	7,717
45	Project		Dry Creek Bridge	Temporary Bridge	1,015	SF	210.00	213,150	170,520	-20%	277,095	30%	233,310	186,648	303,302
45	Project		Dry Creek Bridge - Paving	Roadway Excavation	700	CY	40.00	28,000	22,400	-20%	35,000	25%	30,648	24,519	38,310
45	Project		Dry Creek Bridge - Paving	Imported Borrow	1,000	CY	45.00	45,000	36,000	-20%	56,250	25%	49,256	39,405	61,570
45	Project		Dry Creek Bridge - Paving	Hot Mix Asphalt (Type A)	600	T	130.00	78,000	62,400	-20%	97,500	25%	85,377	68,302	106,721
45	Project		Dry Creek Bridge - Paving	Class 2 Aggregate Base	380	CY	65.00	24,700	19,760	-20%	30,875	25%	27,036	21,629	33,795
45	Project		Dry Creek Bridge - Paving	Midwest Guardrail System	100	LF	40.61	4,061	3,249	-20%	5,076	25%	4,445	3,556	5,556
45	Project		Dry Creek Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Dry Creek Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Dry Creek Bridge - Paving	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Dry Creek Bridge - Paving	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Dry Creek Bridge - Paving	Temporary Hydroseed	550	SY	9.22	5,071	4,057	-20%	6,339	25%	5,551	4,440	6,938
45	Project		Dry Creek Bridge - Paving	Rolled Erosion Control / Jute Mesh	550	SY	16.62	9,141	7,313	-20%	11,426	25%	10,006	8,004	12,507
45	Project		Dry Creek Bridge - Paving	Temporary Fiber Roll	1,000	LF	8.10	8,100	6,480	-20%	10,125	25%	8,866	7,093	11,083
45	Project		Dry Creek Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Dry Creek Bridge - Paving	Water Pollution Control	0.10	%	175,700.00	17,570	14,056	-20%	21,963	25%	19,232	15,385	24,040
45	Project		Dry Creek Bridge - Paving	Thermoplastic Traffic Stripe	650	LF	0.86	559	447	-20%	699	25%	612	489	765
45	Project		Dry Creek Bridge - Paving	Portable Changeable Message Signs	2.00	EA	3,000.00	6,000	4,800	-20%	7,500	25%	6,567	5,254	8,209
45	Project		Dry Creek Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Dry Creek Bridge - Paving	Traffic Control System	20.00	DA	1,000.00	20,000	16,000	-20%	25,000	25%	21,892	17,513	27,364
45	Project		Dry Creek Bridge - Paving	Temporary Railing (Type K)	200	LF	47.00	9,400	7,520	-20%	11,750	25%	10,289	8,231	12,861
45	Project		Dry Creek Bridge - Temp Detour	Roadway Excavation	1,200	CY	40.00	48,000	38,400	-20%	60,000	25%	52,540	42,032	65,675
45	Project		Dry Creek Bridge - Temp Detour	Ditch Excavation	40.00	CY	35.00	1,400	1,120	-20%	1,750	25%	1,532	1,226	1,916
45	Project		Dry Creek Bridge - Temp Detour	Imported Borrow	1,620	CY	45.00	72,900	58,320	-20%	91,125	25%	79,795	63,836	99,744
45	Project		Dry Creek Bridge - Temp Detour	Hot Mix Asphalt (Type A)	530	T	130.00	68,900	55,120	-20%	86,125	25%	75,417	60,333	94,271
45	Project		Dry Creek Bridge - Temp Detour	Class 2 Aggregate Base	400	CY	65.00	26,000	20,800	-20%	32,500	25%	28,459	22,767	35,574
45	Project		Dry Creek Bridge - Temp Detour	Midwest Guardrail System	100	LF	40.61	4,061	3,249	-20%	5,076	25%	4,445	3,556	5,556
45	Project		Dry Creek Bridge - Temp Detour	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Dry Creek Bridge - Temp Detour	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Dry Creek Bridge - Temp Detour	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Dry Creek Bridge - Temp Detour	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Dry Creek Bridge - Temp Detour	Temporary Hydroseed	320	SY	9.22	2,950	2,360	-20%	3,688	25%	3,229	2,584	4,037
45	Project		Dry Creek Bridge - Temp Detour	Rolled Erosion Control / Jute Mesh	320	SY	16.62	5,318	4,255	-20%	6,648	25%	5,821	4,657	7,277
45	Project		Dry Creek Bridge - Temp Detour	Temporary Fiber Roll	400	LF	8.10	3,240	2,592	-20%	4,050	25%	3,546	2,837	4,433
45	Project		Dry Creek Bridge - Temp Detour	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Dry Creek Bridge - Temp Detour	Water Pollution Control	0.10	%	217,200.00	21,720	17,376	-20%	27,150	25%	23,774	19,019	29,718
45	Project		Dry Creek Bridge - Temp Detour	Construction Area Signs	1.00	LS	2,000.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Dry Creek Bridge - Temp Detour	Temporary Traffic Stripe	620	LF	0.78	486	389	-20%	608	25%	532	426	665
45	Project		Dry Creek Bridge - Temp Detour	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Dry Creek Bridge - Temp Detour	Traffic Control System	5.00	DA	1,000.00	5,000	4,000	-20%	6,250	25%	5,473	4,378	6,841
45	Project		Dry Creek Bridge - Temp Detour	Temporary Railing (Type K)	160	LF	47.00	7,520	6,016	-20%	9,400	25%	8,231	6,585	10,289
45	Project		Camp Creek Bridge	Backfill, structural, common earth, 105 H.P. dozer, 50' haul, fr	420	CY	39.77	16,705	13,364	-20%	21,717	30%	18,285	14,628	23,771
45	Project		Camp Creek Bridge	Earth Work Coffer Dam Construction for side footers	1,186	CY	15.26	18,097	14,478	-20%	23,526	30%	19,809	15,847	25,752
45	Project		Camp Creek Bridge	Structure Excavation (Bridge)	585	CY	58.08	33,975	27,180	-20%	44,167	30%	37,188	29,750	48,344
45	Project		Camp Creek Bridge	Steel piles, "H" Sections, 50' long, HP14 X 89, excludes mobili	1,400	LF	86.12	120,571	96,457	-20%	156,742	30%	131,974	105,580	171,567
45	Project		Camp Creek Bridge	Piling special costs, pre-augering for Pile	1,400	LF	311.56	436,189	348,951	-20%	567,045	30%	477,443	381,955	620,676
45	Project		Camp Creek Bridge	Mobilization, 150 ton, set up and remove crane, with pile leads	2.00	EA	22,228.11	44,456	35,565	-20%	57,793	30%	48,661	38,929	63,259
45	Project		Camp Creek Bridge	A736 Barrier Wall	444	LF	388.00	172,270	137,816	-20%	223,952	30%	188,564	150,851	245,133
45	Project		Camp Creek Bridge	Expansion joint, neoprene, liquid, 1" x 2", cold applied	50.00	LF	44.09	2,205	1,764	-20%	2,866	30%	2,413	1,931	3,137
45	Project		Camp Creek Bridge	Columns Structural Concrete includes forms, Grade 60 rebar,	132	CY	1,953.07	257,806	206,245	-20%	335,148	30%	282,189	225,751	366,846

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Camp Creek Bridge	Deck Structural concrete, in place, includes forms, Grade 60 r	139	CY	1,143.38	158,930	127,144	-20%	206,609	30%	173,961	139,169	226,149
45	Project		Camp Creek Bridge	Footer Structural concrete,footing, reinforced, includes forms(4	162	CY	421.72	68,318	54,655	-20%	88,814	30%	74,780	59,824	97,214
45	Project		Camp Creek Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	19.00	CY	293.49	5,576	4,461	-20%	7,249	30%	6,104	4,883	7,935
45	Project		Camp Creek Bridge	Precast 36" I-Girder 67'	4.00	EA	29,970.09	119,880	95,904	-20%	155,844	30%	131,219	104,975	170,584
45	Project		Camp Creek Bridge	Precast 36" I-Girder 53'	8.00	EA	35,810.59	286,485	229,188	-20%	372,430	30%	313,580	250,864	407,654
45	Project		Camp Creek Bridge - Paving	Roadway Excavation	12,270	CY	40.00	490,800	392,640	-20%	613,500	25%	537,219	429,776	671,524
45	Project		Camp Creek Bridge - Paving	Ditch Excavation	200	CY	35.00	7,000	5,600	-20%	8,750	25%	7,662	6,130	9,578
45	Project		Camp Creek Bridge - Paving	Imported Borrow	12,550	CY	45.00	564,750	451,800	-20%	705,938	25%	618,164	494,531	772,705
45	Project		Camp Creek Bridge - Paving	Hot Mix Asphalt (Type A)	710	T	130.00	92,300	73,840	-20%	115,375	25%	101,030	80,824	126,287
45	Project		Camp Creek Bridge - Paving	Class 2 Aggregate Base	520	CY	65.00	33,800	27,040	-20%	42,250	25%	36,997	29,597	46,246
45	Project		Camp Creek Bridge - Paving	Midwest Guardrail System	400	LF	40.61	16,244	12,995	-20%	20,305	25%	17,780	14,224	22,225
45	Project		Camp Creek Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Camp Creek Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Camp Creek Bridge - Paving	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Camp Creek Bridge - Paving	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Camp Creek Bridge - Paving	Temporary Hydroseed	160	SY	9.22	1,475	1,180	-20%	1,844	25%	1,615	1,292	2,018
45	Project		Camp Creek Bridge - Paving	Rolled Erosion Control / Jute Mesh	160	SY	16.62	2,659	2,127	-20%	3,324	25%	2,911	2,329	3,638
45	Project		Camp Creek Bridge - Paving	Temporary Fiber Roll	225	LF	8.10	1,823	1,458	-20%	2,278	25%	1,995	1,596	2,494
45	Project		Camp Creek Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Camp Creek Bridge - Paving	Water Pollution Control	0.10	%	497,800.00	49,780	39,824	-20%	62,225	25%	54,488	43,591	68,110
45	Project		Camp Creek Bridge - Paving	Roadside Sign - One Post	8.00	EA	270.00	2,160	1,728	-20%	2,700	25%	2,364	1,891	2,955
45	Project		Camp Creek Bridge - Paving	Thermoplastic Traffic Stripe	810	LF	0.86	697	557	-20%	871	25%	762	610	953
45	Project		Camp Creek Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Camp Creek Bridge - Paving	Traffic Control System	20.00	DA	1,000.00	20,000	16,000	-20%	25,000	25%	21,892	17,513	27,364
45	Project		Camp Creek Bridge - Paving	Temporary Railing (Type K)	300	LF	47.00	14,100	11,280	-20%	17,625	25%	15,434	12,347	19,292
45	Project		Camp Creek Bridge - Temporary Culvert	Roadway Excavation	100	CY	40.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Camp Creek Bridge - Temporary Culvert	Ditch Excavation	150	CY	35.00	5,250	4,200	-20%	6,563	25%	5,747	4,597	7,183
45	Project		Camp Creek Bridge - Temporary Culvert	Imported Borrow	3,500	CY	45.00	157,500	126,000	-20%	196,875	25%	172,396	137,917	215,495
45	Project		Camp Creek Bridge - Temporary Culvert	Clearing & Grubbing	5,000	LS	1.00	5,000	4,000	-20%	6,250	25%	5,473	4,378	6,841
45	Project		Camp Creek Bridge - Temporary Culvert	Hot Mix Asphalt (Type A)	470	T	130.00	61,100	48,880	-20%	76,375	25%	66,879	53,503	83,598
45	Project		Camp Creek Bridge - Temporary Culvert	Class 2 Aggregate Base	235	CY	65.00	15,275	12,220	-20%	19,094	25%	16,720	13,376	20,900
45	Project		Camp Creek Bridge - Temporary Culvert	Rock Slope Protection (Class?) Method B	15.00	CY	100.00	1,500	1,200	-20%	1,875	25%	1,642	1,313	2,052
45	Project		Camp Creek Bridge - Temporary Culvert	Rock Slope Protection Fabric Class 8	45.00	SY	10.13	456	365	-20%	570	25%	499	399	624
45	Project		Camp Creek Bridge - Temporary Culvert	36" Alternative Pipe Culvert	300	LF	261.42	78,426	62,741	-20%	98,033	25%	85,843	68,675	107,304
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Reinforced Silt Fence	600	LF	7.58	4,548	3,638	-20%	5,685	25%	4,978	3,983	6,223
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Fence (Type ESA)	600	LF	5.03	3,018	2,414	-20%	3,773	25%	3,303	2,643	4,129
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Hydroseed	630	SY	9.22	5,809	4,647	-20%	7,261	25%	6,358	5,086	7,947
45	Project		Camp Creek Bridge - Temporary Culvert	Rolled Erosion Control / Jute Mesh	630	SY	16.62	10,471	8,376	-20%	13,088	25%	11,461	9,169	14,326
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Fiber Roll	1,190	LF	8.10	9,639	7,711	-20%	12,049	25%	10,551	8,441	13,188
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Concrete Washout	2,000	LS	1.50	2,999	2,399	-20%	3,749	25%	3,283	2,626	4,104
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Camp Creek Bridge - Temporary Culvert	Water Pollution Control	0.10	%	328,506.85	32,851	26,281	-20%	41,063	25%	35,958	28,766	44,947
45	Project		Camp Creek Bridge - Temporary Culvert	Construction Area Signs	1.00	LS	2,000.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Traffic Stripe	650	LF	0.78	510	408	-20%	637	25%	558	446	698
45	Project		Camp Creek Bridge - Temporary Culvert	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Camp Creek Bridge - Temporary Culvert	Traffic Control System	10.00	DA	1,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Railing (Type K)	600	LF	47.00	28,200	22,560	-20%	35,250	25%	30,867	24,694	38,584
45	Project		Jenny Creek Bridge	Sheet Pile Coffer Dam For Center Footer	2,400	SF	38.40	92,161	73,729	-20%	119,809	30%	100,878	80,702	131,141
45	Project		Jenny Creek Bridge	Earth Work Coffer Dam Construction for side footers	1,186	CY	15.26	18,097	14,478	-20%	23,526	30%	19,809	15,847	25,752
45	Project		Jenny Creek Bridge	Backfill, structural, common earth, 105 H.P. dozer, 50' haul, fro	142	CY	39.77	5,648	4,518	-20%	7,342	30%	6,182	4,946	8,037
45	Project		Jenny Creek Bridge	Structure Excavation (Type D)	320	CY	20.27	6,486	5,189	-20%	8,432	30%	7,099	5,679	9,229
45	Project		Jenny Creek Bridge	Structure Excavation (Bridge)	209	CY	58.08	12,138	9,710	-20%	15,779	30%	13,286	10,629	17,272
45	Project		Jenny Creek Bridge	Steel piles, "H" Sections, 50' long, HP14 X 89, excludes mobili	2,640	LF	86.12	227,362	181,890	-20%	295,571	30%	248,866	199,093	323,526
45	Project		Jenny Creek Bridge	Piling special costs, pre-augering for Pile and Tie Down Ancho	2,640	LF	311.56	822,527	658,022	-20%	1,069,286	30%	900,321	720,257	1,170,418
45	Project		Jenny Creek Bridge	Mobilization, 150 ton, set up and remove crane, with pile leads	2.00	EA	22,228.11	44,456	35,565	-20%	57,793	30%	48,661	38,929	63,259
45	Project		Jenny Creek Bridge	A736 Barrier Wall	776	LF	388.00	301,085	240,868	-20%	391,411	30%	329,562	263,649	428,430
45	Project		Jenny Creek Bridge	Expansion joint, neoprene, liquid, 1" x 2", cold applied	58.00	LF	44.09	2,557	2,046	-20%	3,325	30%	2,799	2,239	3,639
45	Project		Jenny Creek Bridge	Columns Structural Concrete includes forms, Grade 60 rebar,	174	CY	1,953.07	339,835	271,868	-20%	441,785	30%	371,976	297,581	483,569
45	Project		Jenny Creek Bridge	Deck Structural concrete, in place, includes forms, Grade 60 r	317	CY	1,143.38	362,451	289,961	-20%	471,186	30%	396,731	317,385	515,751
45	Project		Jenny Creek Bridge	Footer Structural concrete,footing, reinforced, includes forms(4	281	CY	421.72	118,503	94,802	-20%	154,053	30%	129,710	103,768	168,624
45	Project		Jenny Creek Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	22.00	CY	293.49	6,457	5,166	-20%	8,394	30%	7,068	5,654	9,188
45	Project		Jenny Creek Bridge	Precast 61" Bulb Tee 73'	8.00	EA	49,373.69	394,990	315,992	-20%	513,486	30%	432,347	345,878	562,052
45	Project		Jenny Creek Bridge	Precast 61" Bulb Tee 100'	8.00	EA	78,816.06	630,528	504,423	-20%	819,687	30%	690,163	552,131	897,212
45	Project		Jenny Creek Bridge	Bridge Demolition	3,102	SF	60.00	186,120	148,896	-20%	241,956	30%	203,723	162,978	264,840

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Jenny Creek Bridge - Paving	Roadway Excavation	30,000	CY	40.00	1,200,000	960,000	-20%	1,500,000	25%	1,313,495	1,050,796	1,641,869
45	Project		Jenny Creek Bridge - Paving	Ditch Excavation	210	CY	35.00	7,350	5,880	-20%	9,188	25%	8,045	6,436	10,056
45	Project		Jenny Creek Bridge - Paving	Imported Borrow	35,000	CY	45.00	1,575,000	1,260,000	-20%	1,968,750	25%	1,723,962	1,379,170	2,154,953
45	Project		Jenny Creek Bridge - Paving	Hot Mix Asphalt (Type A)	600	T	130.00	78,000	62,400	-20%	97,500	25%	85,377	68,302	106,721
45	Project		Jenny Creek Bridge - Paving	Class 2 Aggregate Base	370	CY	65.00	24,050	19,240	-20%	30,063	25%	26,325	21,060	32,906
45	Project		Jenny Creek Bridge - Paving	Midwest Guardrail System	200	LF	40.61	8,122	6,498	-20%	10,153	25%	8,890	7,112	11,113
45	Project		Jenny Creek Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Jenny Creek Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Jenny Creek Bridge - Paving	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Jenny Creek Bridge - Paving	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Jenny Creek Bridge - Paving	Temporary Hydroseed	1,770	SY	9.22	16,319	13,056	-20%	20,399	25%	17,863	14,290	22,329
45	Project		Jenny Creek Bridge - Paving	Rolled Erosion Control / Jute Mesh	1,770	SY	16.62	29,417	23,534	-20%	36,772	25%	32,200	25,760	40,250
45	Project		Jenny Creek Bridge - Paving	Temporary Fiber Roll	2,490	LF	8.10	20,169	16,135	-20%	25,211	25%	22,077	17,661	27,596
45	Project		Jenny Creek Bridge - Paving	Temporary Concrete Washout	2,000	LS	1.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Jenny Creek Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Jenny Creek Bridge - Paving	Water Pollution Control	0.10	%	2,884,400.00	288,440	230,752	-20%	360,550	25%	315,720	252,576	394,651
45	Project		Jenny Creek Bridge - Paving	Roadside Sign - One Post	8.00	EA	270.00	2,160	1,728	-20%	2,700	25%	2,364	1,891	2,955
45	Project		Jenny Creek Bridge - Paving	Construction Area Signs	2,000	LS	1.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Jenny Creek Bridge - Paving	Thermoplastic Traffic Stripe	1,000	LF	0.86	860	688	-20%	1,075	25%	941	753	1,177
45	Project		Jenny Creek Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Jenny Creek Bridge - Paving	Traffic Control System	20.00	DA	1,000.00	20,000	16,000	-20%	25,000	25%	21,892	17,513	27,364
45	Project		Jenny Creek Bridge - Paving	Temporary Railing (Type K)	300	LF	47.00	14,100	11,280	-20%	17,625	25%	15,434	12,347	19,292
45	Project		Other Structures	Pedestrian Bridge Total	800	SF	60.00	48,000	43,200	-10%	62,400	30%	52,540	47,286	68,302
45	Project		Other Structures	Bridge Demolition Ped Bridge Campground	800	SF	60.00	48,000	43,200	-10%	62,400	30%	52,540	47,286	68,302
45	Project		Other Structures	Bridge Demolition Timber JC Boyle	1,800	SF	60.00	108,000	97,200	-10%	140,400	30%	118,215	106,393	153,679
45	Project		Scotch Creek - Temporary Culvert	Roadway Excavation	550	CY	40.00	22,000	17,600	-20%	27,500	25%	24,081	19,265	30,101
45	Project		Scotch Creek - Temporary Culvert	Ditch Excavation	10.00	CY	35.00	350	280	-20%	438	25%	383	306	479
45	Project		Scotch Creek - Temporary Culvert	Imported Borrow	2,300	CY	45.00	103,500	82,800	-20%	129,375	25%	113,289	90,631	141,611
45	Project		Scotch Creek - Temporary Culvert	Hot Mix Asphalt (Type A)	510	T	130.00	66,300	53,040	-20%	82,875	25%	72,571	58,056	90,713
45	Project		Scotch Creek - Temporary Culvert	Class 2 Aggregate Base	380	CY	65.00	24,700	19,760	-20%	30,875	25%	27,036	21,629	33,795
45	Project		Scotch Creek - Temporary Culvert	Rock Slope Protection (Class?) Method B	10.00	CY	100.00	1,000	800	-20%	1,250	25%	1,095	876	1,368
45	Project		Scotch Creek - Temporary Culvert	Rock Slope Protection Fabric Class 8	30.00	SY	10.13	304	243	-20%	380	25%	333	266	416
45	Project		Scotch Creek - Temporary Culvert	36" Alternative Pipe Culvert	250	LF	261.42	65,355	52,284	-20%	81,694	25%	71,536	57,229	89,420
45	Project		Scotch Creek - Temporary Culvert	Temporary Reinforced Silt Fence	300	LF	7.58	2,274	1,819	-20%	2,843	25%	2,489	1,991	3,111
45	Project		Scotch Creek - Temporary Culvert	Temporary Fence (Type ESA)	300	LF	5.03	1,509	1,207	-20%	1,886	25%	1,652	1,321	2,065
45	Project		Scotch Creek - Temporary Culvert	Temporary Hydroseed	590	SY	9.22	5,440	4,352	-20%	6,800	25%	5,954	4,763	7,443
45	Project		Scotch Creek - Temporary Culvert	Rolled Erosion Control / Jute Mesh	590	SY	16.62	9,806	7,845	-20%	12,257	25%	10,733	8,587	13,417
45	Project		Scotch Creek - Temporary Culvert	Temporary Fiber Roll	450	LF	8.10	3,645	2,916	-20%	4,556	25%	3,990	3,192	4,987
45	Project		Scotch Creek - Temporary Culvert	Temporary Concrete Washout	2,000	LS	1.50	2,999	2,399	-20%	3,749	25%	3,283	2,626	4,104
45	Project		Scotch Creek - Temporary Culvert	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Scotch Creek - Temporary Culvert	Water Pollution Control	0.10	%	283,509.90	28,351	22,681	-20%	35,439	25%	31,032	24,826	38,791
45	Project		Scotch Creek - Temporary Culvert	Construction Area Signs	1.00	LS	2,000.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Scotch Creek - Temporary Culvert	Temporary Traffic Stripe	520	LF	0.78	408	326	-20%	510	25%	446	357	558
45	Project		Scotch Creek - Temporary Culvert	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Scotch Creek - Temporary Culvert	Traffic Control System	10.00	DA	1,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Scotch Creek - Temporary Culvert	Temporary Railing (Type K)	500	LF	47.00	23,500	18,800	-20%	29,375	25%	25,723	20,578	32,153
45	Project		Scotch Creek - Culvert	Roadway Excavation	3,000	CY	40.00	120,000	96,000	-20%	150,000	25%	131,350	105,080	164,187
45	Project		Scotch Creek - Culvert	Ditch Excavation	10.00	CY	35.00	350	280	-20%	438	25%	383	306	479
45	Project		Scotch Creek - Culvert	Imported Borrow	3,000	CY	45.00	135,000	108,000	-20%	168,750	25%	147,768	118,215	184,710
45	Project		Scotch Creek - Culvert	Hot Mix Asphalt (Type A)	170	T	130.00	22,100	17,680	-20%	27,625	25%	24,190	19,352	30,238
45	Project		Scotch Creek - Culvert	Class 2 Aggregate Base	120	CY	65.00	7,800	6,240	-20%	9,750	25%	8,538	6,830	10,672
45	Project		Scotch Creek - Culvert	Rock Slope Protection Class III, Method B	5.00	CY	100.00	500	400	-20%	625	25%	547	438	684
45	Project		Scotch Creek - Culvert	Rock Slope Protection Fabric Class 8	12.00	SY	10.13	122	97	-20%	152	25%	133	106	166
45	Project		Scotch Creek - Culvert	Structural Concrete, Box Culvert	10.00	CY	4,835.00	48,350	38,680	-20%	60,438	25%	52,923	42,338	66,154
45	Project		Scotch Creek - Culvert	Midwest Guardrail System	400	LF	34.19	13,676	10,941	-20%	17,095	25%	14,969	11,976	18,712
45	Project		Scotch Creek - Culvert	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Scotch Creek - Culvert	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Scotch Creek - Culvert	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Scotch Creek - Culvert	Temporary Hydroseed	220	SY	9.22	2,028	1,623	-20%	2,536	25%	2,220	1,776	2,775
45	Project		Scotch Creek - Culvert	Rolled Erosion Control / Jute Mesh	220	SY	16.62	3,656	2,925	-20%	4,571	25%	4,002	3,202	5,003
45	Project		Scotch Creek - Culvert	Temporary Fiber Roll	450	LF	8.10	3,645	2,916	-20%	4,556	25%	3,990	3,192	4,987
45	Project		Scotch Creek - Culvert	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Scotch Creek - Culvert	Water Pollution Control	0.10	%	334,221.56	33,422	26,738	-20%	41,778	25%	36,583	29,267	45,729
45	Project		Scotch Creek - Culvert	Construction Area Signs	1.00	LS	2,500.00	2,500	2,000	-20%	3,125	25%	2,736	2,189	3,421
45	Project		Scotch Creek - Culvert	Thermoplastic Traffic Stripe	200	LF	0.86	172	138	-20%	215	25%	188	151	235

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices Qty	Unit	Rate	Estimate	Low	%	High	%	Escalated to Year of Construction Estimate	Est Low	Est High
45	Project		Scotch Creek - Culvert	Traffic Control System	1.00	LS	10,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Scotch Creek - Culvert	Temporary Railing (Type K)	200	LF	33.57	6,714	5,371	-20%	8,393	25%	7,349	5,879	9,187
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Roadway Excavation	3,000	CY	40.00	120,000	96,000	-20%	150,000	25%	131,350	105,080	164,187
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Imported Borrow	2,500	CY	45.00	112,500	90,000	-20%	140,625	25%	123,140	98,512	153,925
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Rock Slope Protection Class III, Method B	250	CY	100.00	25,000	20,000	-20%	31,250	25%	27,364	21,892	34,206
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Rock Slope Protection Fabric Class 8	700	SY	10.13	7,091	5,673	-20%	8,864	25%	7,762	6,209	9,702
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	60" CORRUGATED STEEL PIPE (.138" THICK)	80.00	LF	270.00	21,600	17,280	-20%	27,000	25%	23,643	18,914	29,554
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Temporary Reinforced Silt Fence	600	LF	7.58	4,548	3,638	-20%	5,685	25%	4,978	3,983	6,223
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Temporary Fence (Type ESA)	600	LF	5.03	3,018	2,414	-20%	3,773	25%	3,303	2,643	4,129
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Water Pollution Control	0.10	%	286,191.00	28,619	22,895	-20%	35,774	25%	31,326	25,061	39,157
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Construction Area Signs	1.00	LS	600.00	600	480	-20%	750	25%	657	525	821
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Traffic Control System	1.00	LS	10,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Temporary Railing (Type K)	80.00	LF	33.57	2,686	2,149	-20%	3,357	25%	2,940	2,352	3,675
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Replace and Reconstruct 60-inch Culvert No.1 at Beaver Cree	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Replace and Reconstruct 60-inch Culvert No.2 at Beaver Cree	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Copco Rd at Raymond Gulch Culvert	Rock Slope Protection Class III, Method B	150	CY	100.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Copco Rd at Raymond Gulch Culvert	Rock Slope Protection Fabric Class 8	400	SY	10.13	4,052	3,242	-20%	5,065	25%	4,435	3,548	5,544
45	Project		Copco Rd at Raymond Gulch Culvert	Temporary Reinforced Silt Fence	600	LF	7.58	4,548	3,638	-20%	5,685	25%	4,978	3,983	6,223
45	Project		Copco Rd at Raymond Gulch Culvert	Temporary Fence (Type ESA)	600	LF	5.03	3,018	2,414	-20%	3,773	25%	3,303	2,643	4,129
45	Project		Copco Rd at Raymond Gulch Culvert	Water Pollution Control	1.00	LS	19,052.00	19,052	15,242	-20%	23,815	25%	20,854	16,683	26,067
45	Project		Copco Rd at Raymond Gulch Culvert	Traffic Control System	1.00	LS	1,000.00	1,000	800	-20%	1,250	25%	1,095	876	1,368
45	Project		Copco Rd at Raymond Gulch Culvert	60-inch Culvert at Raymond Gulch	1.00	LS	10,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Patricia Avenue Culverts	Rock Slope Protection Class III, Method B	150	CY	100.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Patricia Avenue Culverts	Rock Slope Protection Fabric Class 8	400	SY	10.13	4,052	3,242	-20%	5,065	25%	4,435	3,548	5,544
45	Project		Patricia Avenue Culverts	Water Pollution Control	0.10	%	19,052.00	1,905	1,524	-20%	2,382	25%	2,085	1,668	2,607
45	Project		Patricia Avenue Culverts	Traffic Control System	1.00	LS	1,000.00	1,000	800	-20%	1,250	25%	1,095	876	1,368
45	Project		Topsy Grade Culverts	Trench Excavation	275	CY	40.00	11,000	8,800	-20%	13,750	25%	12,040	9,632	15,050
45	Project		Topsy Grade Culverts	Clearing & Grubbing	1.00	LS	2,000.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Topsy Grade Culverts	Rock Slope Protection Class III, Method B	800	CY	100.00	80,000	64,000	-20%	100,000	25%	87,566	70,053	109,458
45	Project		Topsy Grade Culverts	Rock Slope Protection Fabric Class 8	2,350	SY	10.13	23,806	19,044	-20%	29,757	25%	26,057	20,846	32,571
45	Project		Topsy Grade Culverts	24" corrugated steel pipe (.138" thick)	200	LF	137.50	27,500	22,000	-20%	34,375	25%	30,101	24,081	37,626
45	Project		Topsy Grade Culverts	Temporary Reinforced Silt Fence	1,000	LF	7.58	7,580	6,064	-20%	9,475	25%	8,297	6,638	10,371
45	Project		Topsy Grade Culverts	Temporary Fence (Type ESA)	1,000	LF	5.03	5,030	4,024	-20%	6,288	25%	5,506	4,405	6,882
45	Project		Topsy Grade Culverts	Water Pollution Control	0.10	%	144,305.50	14,431	11,544	-20%	18,038	25%	15,795	12,636	19,744
45	Project		Topsy Grade Culverts	Traffic Control System	1.00	LS	5,000.00	5,000	4,000	-20%	6,250	25%	5,473	4,378	6,841
45	Project		JC Boyle Unnamed Culverts	Rock Slope Protection Class III, Method B	115	CY	100.00	11,500	9,200	-20%	14,375	25%	12,588	10,070	15,735
45	Project		JC Boyle Unnamed Culverts	Rock Slope Protection Fabric Class 8	350	SY	10.13	3,546	2,836	-20%	4,432	25%	3,881	3,105	4,851
45	Project		JC Boyle Unnamed Culverts	Water Pollution Control	0.10	%	15,045.50	1,505	1,204	-20%	1,881	25%	1,647	1,317	2,059
45	Project		JC Boyle Unnamed Culverts	Traffic Control System	1.00	LS	1,000.00	1,000	800	-20%	1,250	25%	1,095	876	1,368
45	Project		Copco Road at Unnamed Creek Culvert No. 1	Copco Road at Unnamed Creek Culvert No. 1	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Copco Road at Unnamed Creek Culvert No. 2	Copco Road at Unnamed Creek Culvert No. 2	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		6'x6'x34' Box Culvert installation	6'x6'x34' Box Culvert installation	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Paving - Lakeview Disposal Access Road	Pre: none; Post: 0.7 miles 6" AB overlay (no drainage improve	1.00	EA	170,000.00	170,000	-	-20%	340,000	25%	191,227	-	382,454
45	Project		Paving - Copco 1 Dam Access	Pre: 2500CY roadway excavation, 0.9 miles 9" AB overlay (no	1.00	EA	250,000.00	250,000	190,000	-20%	370,000	25%	270,400	205,504	400,192
45	Project		Paving - Copco Rd from Copco 1 access to Copco Bridge	Pre: 1 mile 9" AB repair; Post: 1 mile 9" AB repair, 0.2 mile HM	1.00	EA	318,000.00	318,000	208,000	-20%	585,000	25%	352,204	230,372	647,922
45	Project		Paving - Copco 1 Ager Beswick Rd Barge Access	Pre: minor excavation and 9"' AB section; Post: none	1.00	EA	60,000.00	60,000	-	-20%	120,000	25%	64,896	-	129,792
45	Project		Paving - US 97 Dalles CA Hwy	Pre: none; Post: none (high only)	1.00	EA	-	-	-	-20%	966,000	25%	-	-	1,086,619
45	Project		Paving - OR 66 Green Springs hwy	Pre: none; Post: none (high only)	1.00	EA	-	-	-	-20%	988,000	25%	-	-	1,111,366
45	Project		Paving - JC Boyle Keno Worden	Pre: none; Post: none (high only)	1.00	EA	-	-	-	-20%	988,000	25%	-	-	1,111,366
45	Project		Paving - Topsy Grade Rd	Pre: 0.9 mile 9" AB repair; Post: 0.9 mile 9" AB repair	1.00	EA	880,000.00	880,000	440,000	-20%	1,320,000	25%	970,844	485,422	1,456,266
45	Project		Paving - JC Boyle Dam Access Rd (2,940 ft to dam toe)	Pre: minor excavation; 0.25 mile new 9" AB, 0.7 mile 9" AB re	1.00	EA	335,000.00	335,000	212,000	-20%	374,000	25%	368,133	232,968	410,991
45	Project		Paving - JC Boyle Power Canal Access Rd	Pre: 1.5 mile 9" AB repair; post: 1.5 mile 9" AB repair; no guar	1.00	EA	432,000.00	432,000	216,000	-20%	744,000	25%	476,596	238,298	820,805
45	Project		Paving - JC Boyle Powerhouse Access Rd	Pre: none; Post: none (high only)	1.00	EA	-	-	-	-20%	216,000	25%	-	-	242,971
45	Project		Paving - Copco Rd I5 to Ager Rd	Pre: none; Post: 1 mile new asphalt overlay	1.00	EA	1,090,000.00	1,090,000	545,000	-20%	2,100,000	25%	1,226,102	613,051	2,362,214
45	Project		Paving - Copco Rd Ager Rd to Lakeview Rd	Pre: 0.5 miles crack sealer, 0.75 miles new asphalt; Post: 1 mi	1.00	EA	1,625,000.00	1,625,000	1,185,000	-20%	5,235,000	25%	1,799,782	1,312,457	5,798,068
45	Project		Paving - Copco Rd to Lakeview Rd to Dagget Rd	Pre: 1 mile crack sealer, 1.5 miles new asphalt; Post: 2 miles	1.00	EA	2,980,000.00	2,980,000	2,370,000	-20%	10,470,000	25%	3,300,524	2,624,913	11,596,136
45	Project		Paving - Copco Rd Daggett Rd to Copco 1 Access Rd	Pre: 1.5 mile 9" AB repair; Post: 1.5 mile 9" AB repair, no guar	1.00	EA	432,000.00	432,000	216,000	-20%	744,000	25%	476,596	238,298	820,805
46			**RECREATION IMPROVEMENTS**												
46	Project		Campground - Jenny Creek expansion & upgrade	Picnic table	7.00	EA	2,363.80	16,547	10,500	-37%	21,000	27%	18,112	11,493	22,986
46	Project		Campground - Jenny Creek expansion & upgrade	Fire grate	7.00	EA	675.37	4,728	3,000	-37%	6,000	27%	5,175	3,284	6,567

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
46	Project		Campground - Jenny Creek expansion & upgrade	Trash bins	7.00	EA	1,000.00	7,000	5,000	-29%	10,000	43%	7,662	5,473	10,946
46	Project		Campground - Jenny Creek expansion & upgrade	Parking	7.00	EA	562.81	3,940	2,500	-37%	5,000	27%	4,312	2,736	5,473
46	Project		Campground - Jenny Creek expansion & upgrade	Shade structure	3.00	EA	14,633.07	43,899	26,000	-41%	65,000	48%	48,051	28,459	71,148
46	Project		Campground - Jenny Creek expansion & upgrade	Restroom (single vault toilet)	2.00	EA	57,406.66	114,813	114,813	0%	204,000	78%	125,672	125,672	223,294
46	Project		Campground - Jenny Creek expansion & upgrade	Assumed earthwork	450	CY	9.00	4,052	2,400	-41%	4,800	18%	4,435	2,627	5,254
46	Project		Campground - Jenny Creek expansion & upgrade	Signage	2.00	EA	5,000.00	10,000	5,000	-50%	15,000	50%	10,946	5,473	16,419
46	Project		Campground - Jenny Creek expansion & upgrade	Operations and maintenance	5.00	YR	33,768.63	168,843	-	0%	600,000	255%	184,812	-	656,748
46	Project		Campground - Topsy upgrade	boat ramp	1.00	EA	10,000.00	10,000	10,000	0%	10,000	0%	10,946	10,946	10,946
46	Project		Campground - Topsy upgrade	trash bins	1.00	EA	1,000.00	1,000	1,000	0%	1,000	0%	1,095	1,095	1,095
46	Project		Campground - Topsy upgrade	Operations and maintenance	5.00	YR	11,256.21	56,281	-	0%	200,000	255%	61,604	-	218,916
46	Project		Campground - New campgrounds	picnic table	20.00	EA	2,363.80	47,276	47,276	0%	47,276	0%	51,747	51,747	51,747
46	Project		Campground - New campgrounds	fire grate	20.00	EA	675.37	13,507	13,507	0%	13,507	0%	14,785	14,785	14,785
46	Project		Campground - New campgrounds	trash bins	20.00	EA	1,000.00	20,000	20,000	0%	20,000	0%	21,892	21,892	21,892
46	Project		Campground - New campgrounds	restroom (single vault toilet)	6.00	EA	57,406.66	344,440	344,440	0%	344,440	0%	377,017	377,017	377,017
46	Project		Campground - New campgrounds	parking	20.00	EA	562.81	11,256	11,256	0%	11,256	0%	12,321	12,321	12,321
46	Project		Campground - New campgrounds	boat ramp	2.00	EA	11,256.21	22,512	14,633	-35%	22,512	0%	24,642	16,017	24,642
46	Project		Campground - New campgrounds	trash bins	2.00	EA	1,000.00	2,000	1,300	-35%	2,000	0%	2,189	1,423	2,189
46	Project		Campground - New campgrounds	picnic table	2.00	EA	2,363.80	4,728	4,255	-10%	4,728	0%	5,175	4,657	5,175
46	Project		Campground - New campgrounds	fire grate	2.00	EA	675.37	1,351	1,216	-10%	1,351	0%	1,478	1,331	1,478
46	Project		Campground - New campgrounds	trash bins	2.00	EA	1,000.00	2,000	2,000	0%	2,000	0%	2,189	2,189	2,189
46	Project		Campground - New campgrounds	assumed earthwork	1,200	CY	9.00	10,806	9,725	-10%	10,806	0%	11,828	10,645	11,828
46	Project		Campground - New campgrounds	signage	4.00	EA	5,000.00	20,000	10,000	-50%	30,000	50%	21,892	10,946	32,837
46	Project		Campground - New campgrounds	Operations and maintenance	5.00	YR	67,537.25	337,686	-	0%	1,200,000	255%	369,624	-	1,313,495
46	Project		Recreation area - Fall Creek upgrade	restroom (single vault toilet)	1.00	EA	57,406.66	57,407	51,666	-10%	103,332	80%	62,836	56,553	113,105
46	Project		Recreation area - Fall Creek upgrade	picnic table	5.00	EA	2,363.80	11,819	8,400	-29%	12,600	7%	12,937	9,194	13,792
46	Project		Recreation area - Fall Creek upgrade	shade structure	2.00	EA	14,633.07	29,266	26,340	-10%	43,899	50%	32,034	28,831	48,051
46	Project		Recreation area - Fall Creek upgrade	fire grate	4.00	EA	675.37	2,701	1,800	-33%	3,000	11%	2,957	1,970	3,284
46	Project		Recreation area - Fall Creek upgrade	trash bins	5.00	EA	1,000.00	5,000	4,000	-20%	6,000	20%	5,473	4,378	6,567
46	Project		Recreation area - Fall Creek upgrade	parking	6.00	EA	562.81	3,377	2,000	-41%	4,000	18%	3,696	2,189	4,378
46	Project		Recreation area - Fall Creek upgrade	reconstructed trail	0.50	MI	35,659.67	17,830	7,920	-56%	31,680	78%	19,516	8,669	34,676
46	Project		Recreation area - Fall Creek upgrade	assumed earthwork	300	CY	9.00	2,701	1,600	-41%	3,200	18%	2,957	1,751	3,503
46	Project		Recreation area - Fall Creek upgrade	signage	2.00	EA	5,000.00	10,000	5,000	-50%	15,000	50%	10,946	5,473	16,419
46	Project		Recreation area - Fall Creek upgrade	Operations and maintenance	5.00	YR	16,884.31	84,422	-	0%	300,000	255%	92,406	-	328,374
46	Project		Recreation area - Iron Gate Hatchery day use site	shade structure	3.00	EA	14,633.07	43,899	26,000	-41%	52,000	18%	48,051	28,459	56,918
46	Project		Recreation area - Iron Gate Hatchery day use site	picnic table	6.00	EA	2,363.80	14,183	8,400	-41%	16,800	18%	15,524	9,194	18,389
46	Project		Recreation area - Iron Gate Hatchery day use site	trash bins	7.00	EA	1,000.00	7,000	5,000	-29%	9,000	29%	7,662	5,473	9,851
46	Project		Recreation area - Iron Gate Hatchery day use site	parking	6.00	EA	562.81	3,377	2,000	-41%	4,000	18%	3,696	2,189	4,378
46	Project		Recreation area - Iron Gate Hatchery day use site	fire grate	6.00	EA	675.37	4,052	2,400	-41%	4,800	18%	4,435	2,627	5,254
46	Project		Recreation area - Iron Gate Hatchery day use site	restroom (single vault toilet)	2.00	EA	57,406.66	114,813	114,813	0%	204,000	78%	125,672	125,672	223,294
46	Project		Recreation area - Iron Gate Hatchery day use site	boat ramp	1.00	EA	11,256.21	11,256	10,131	-10%	10,131	-10%	12,321	11,089	11,089
46	Project		Recreation area - Iron Gate Hatchery day use site	assumed earthwork	450	CY	9.00	4,052	2,400	-41%	4,800	18%	4,435	2,627	5,254
46	Project		Recreation area - Iron Gate Hatchery day use site	signage	2.00	EA	5,000.00	10,000	5,000	-50%	15,000	50%	10,946	5,473	16,419
46	Project		Recreation area - Iron Gate Hatchery day use site	Operations and maintenance	5.00	YR	16,884.31	84,422	-	0%	300,000	255%	92,406	-	328,374
46	Project		Recreation area - River fishing access sites	parking	18.00	EA	562.81	10,131	-	0%	12,000	18%	11,089	-	13,135
46	Project		Recreation area - River fishing access sites	portable toilet	6.00	EA	787.93	4,728	4,728	0%	5,600	18%	5,175	5,175	6,130
46	Project		Recreation area - River fishing access sites	trash bins	6.00	EA	1,000.00	6,000	6,000	0%	8,000	33%	6,567	6,567	8,757
46	Project		Recreation area - River fishing access sites	signage	6.00	EA	5,000.00	30,000	30,000	0%	40,000	33%	32,837	32,837	43,783
46	Project		Recreation area - River fishing access sites	trail refurbishment	7,920	LF	6.75	53,490	53,490	0%	63,360	18%	58,548	58,548	69,353
46	Project		Recreation area - River fishing access sites	Operations and maintenance	5.00	YR	11,256.21	56,281	-	0%	200,000	255%	61,604	-	218,916
46	Project		Recreation area - New day use sites	picnic table	4.00	EA	2,363.80	9,455	-	0%	12,600	33%	10,349	-	13,792
46	Project		Recreation area - New day use sites	fire grate	4.00	EA	675.37	2,701	-	0%	3,600	33%	2,957	-	3,940
46	Project		Recreation area - New day use sites	trash bins	4.00	EA	1,000.00	4,000	-	0%	6,000	50%	4,378	-	6,567
46	Project		Recreation area - New day use sites	shade structure	2.00	EA	14,633.07	29,266	-	0%	39,000	33%	32,034	-	42,689
46	Project		Recreation area - New day use sites	assumed earthwork	200	CY	9.00	1,801	-	0%	2,400	33%	1,971	-	2,627
46	Project		Recreation area - New day use sites	signage	2.00	EA	5,000.00	10,000	-	0%	15,000	50%	10,946	-	16,419
46	Project		Recreation area - New day use sites	Operations and maintenance	5.00	YR	22,512.42	112,562	-	0%	400,000	255%	123,208	-	437,832
46	Project		Recreation area - New boat ramps	New boat ramps	4.00	EA	11,256.21	45,025	20,000	-56%	80,000	78%	49,283	21,892	87,566
46	Project		Non-motorized rec trails - JC Boyle to Iron Gate	Trail	20.00	MI	35,659.67	713,193	-	0%	1,267,200	78%	780,647	-	1,387,051
46	Project		Non-motorized rec trails - JC Boyle to Iron Gate	Signage	2.00	EA	5,000.00	10,000	-	0%	15,000	50%	10,946	-	16,419

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
46	Project		Non-motorized rec trails	Walking trails for recreation access to river	7.00	MI	35,659.67	249,618	158,400	-37%	316,800	27%	273,226	173,381	346,763
46	Project		Non-motorized rec trails - Walking/wildlife viewing/interpretive	Trail Grading	5.00	MI	35,659.67	178,298	-	0%	316,800	78%	195,162	-	346,763
46	Project		Non-motorized rec trails - Walking/wildlife viewing/interpretive	trash bins	1.00	EA	1,000.00	1,000	-	0%	1,000	0%	1,095	-	1,095
46	Project		Non-motorized rec trails - Walking/wildlife viewing/interpretive	Signage	2.00	EA	5,000.00	10,000	-	0%	15,000	50%	10,946	-	16,419
46	Project		General Conditions	Contractor overhead	15%	%	3,337,792.01	500,669	450,602	-10%	650,869	30%	548,022	493,219	712,428
46	Project		General Conditions	Contractor profit	8%	%	3,337,792.01	267,023	240,321	-10%	347,130	30%	292,278	263,050	379,962
46	Project		General Conditions	Insurance	1%	%	4,105,484.17	41,055	36,949	-10%	53,371	30%	44,938	40,444	58,419
46	Project		General Conditions	Bond	1%	%	4,105,484.17	41,055	36,949	-10%	53,371	30%	44,938	40,444	58,419
47			**FLOOD PROOFING**												
47	Project	10.010	Raise homes	Cost to raise homes and add 2 stairs	45.00	EA	30,187.71	1,358,447	1,086,758	-20%	1,765,981	30%	1,498,682	1,198,946	1,948,287
48			**PUBLIC HEALTH AND SAFETY**												
48	Project		Public Health and Safety	Cattle exclusion fencing	182,160	LF	11.90	2,167,704	2,489,116	15%	3,042,253	40%	2,363,345	2,713,766	3,316,825
50			**MITIGATION MEASURES**												
51			**GROUNDWATER IMPROVEMENTS**												
51	Project		Groundwater improvements	Outreach to well owners	1.00	SUM	55,000.00	55,000	55,000	0%	55,000	0%	59,488	59,488	59,488
51	Project		Groundwater improvements	Drill and install new monitoring wells	5.00	EA	16,000.00	80,000	48,000	-40%	80,000	0%	88,259	52,955	88,259
51	Project		Groundwater improvements	Sentinel water level monitoring of new wells and landowner for	36.00	MO	2,800.00	100,800	86,400	-14%	115,200	14%	115,743	99,208	132,278
51	Project		Groundwater improvements	WQ laboratory analytical testing	1.00	SUM	37,500.00	37,500	15,000	-60%	60,000	60%	41,371	16,548	66,194
51	Project		Groundwater improvements	Well replacements	20.00	EA	63,375.00	1,267,500	810,000	-36%	1,725,000	36%	1,483,366	947,950	2,018,782
51	Project		Groundwater improvements	Well abandonment	20.00	EA	2,625.00	52,500	30,000	-43%	75,000	43%	58,488	33,421	83,554
51	Project		Groundwater improvements	Temporary water supply	16.00	EA	3,406.25	54,500	36,000	-34%	73,000	34%	60,716	40,106	81,326
51	Project		Groundwater improvements	Permitting and Reporting	1.00	SUM	66,500.00	66,500	37,000	-44%	96,000	44%	74,084	41,220	106,949
52			**WATER SUPPLY/RIGHTS**												
52	Project		Water supply rights	Hay production	3,379	T	175.00	591,357	506,877	-14%	675,836	14%	652,403	559,203	745,604
52	Project		Water supply rights	Water supply for domestic use for water rights	1.00	LS	28.01	8,666	8,436	-3%	9,053	4%	9,561	9,306	9,988
52	Project		Water supply rights	Sediment removal at intakes	254	CY	500.00	126,999	63,500	-50%	190,499	50%	140,110	70,055	210,164
52	Project		Water supply rights	Groundwater wells - domestic	9.00	EA	10,000.00	90,000	40,000	-56%	100,000	11%	99,291	44,129	110,323
52	Project		Water supply rights	Groundwater wells - municipal	1.00	EA	100,000.00	100,000	93,000	-7%	100,000	0%	110,323	102,601	110,323
52	Project		Water supply rights	Sediment basin	39.00	EA	1,851.85	72,222	72,222	0%	72,222	0%	79,678	79,678	79,678
53			**CULTURAL RESOURCES**												
53			**2017/18 Support**												
53	Project		Cultural Resources Tasks	Generally	12.00	MO	168,958.33	2,027,500	1,824,750	-10%	2,230,250	10%	2,027,500	1,824,750	2,230,250
53			**2018/19 Support**												
53	Project		Cultural Resources Tasks	Generally	12.00	MO	168,958.33	2,027,500	1,824,750	-10%	2,230,250	10%	2,068,050	1,861,245	2,274,855
			2019 H2 Support												
53	Project		Task management	Principal Scientist/Planner	208	HR	900.00	187,200	168,480	-10%	205,920	10%	194,688	175,219	214,157
53	Project		Task 1.2A Agency consultation	Principal Scientist/Planner	83.20	HR	180.00	14,976	13,478	-10%	16,474	10%	15,575	14,018	17,133
53	Project		Task 1.2A Agency consultation	Senior Scientist/Planner	41.60	HR	160.00	6,656	5,990	-10%	7,322	10%	6,922	6,230	7,614
53	Project		Task 1.2B Tribal consultation and work plans	Principal Scientist/Planner	256	HR	180.00	46,080	41,472	-10%	50,688	10%	47,923	43,131	52,716
53	Project		Task 1.2B Tribal consultation and work plans	Senior Scientist/Planner	128	HR	160.00	20,480	18,432	-10%	22,528	10%	21,299	19,169	23,429
53	Project		Task 1.2B Tribal consultation and work plans	Technical Editor	16.00	HR	105.00	1,680	1,512	-10%	1,848	10%	1,747	1,572	1,922
53	Project		Task 1.2B Tribal consultation and work plans	GIS/CADD/Graphics	24.00	HR	90.00	2,160	1,944	-10%	2,376	10%	2,246	2,022	2,471
			2020-2024 Support												
53	Project		Task management	Principal Scientist/Planner	1,040	HR	180.00	187,200	168,480	-10%	205,920	10%	210,795	189,715	231,874
53	Project		Task 1.2A Agency consultation	Principal Scientist/Planner	416	HR	180.00	74,880	67,392	-10%	82,368	10%	84,318	75,886	92,750
53	Project		Task 1.2A Agency consultation	Senior Scientist/Planner	208	HR	160.00	33,280	29,952	-10%	36,608	10%	37,475	33,727	41,222
53	Project		Task 1.2B Tribal consultation and work plans	Principal Scientist/Planner	1,280	HR	180.00	230,400	207,360	-10%	253,440	10%	259,440	233,496	285,384
53	Project		Task 1.2B Tribal consultation and work plans	Senior Scientist/Planner	640	HR	160.00	102,400	92,160	-10%	112,640	10%	115,307	103,776	126,837
53	Project		Task 1.2B Tribal consultation and work plans	Technical Editor	80.00	HR	105.00	8,400	7,560	-10%	9,240	10%	9,459	8,513	10,405
53	Project		Task 1.2B Tribal consultation and work plans	GIS/CADD/Graphics	120	HR	90.00	10,800	9,720	-10%	11,880	10%	12,161	10,945	13,377
53	Project		Task 2.6L Curation	Principal Scientist/Planner	80.00	HR	180.00	14,400	12,960	-10%	15,840	10%	16,110	14,499	17,721
53	Project		Task 2.6L Curation	Scientist/Planner	1,640	HR	120.00	196,800	177,120	-10%	216,480	10%	220,165	198,148	242,181
53	Project		Task 2.6L Curation	Curation	410	EA	500.00	205,000	184,500	-10%	225,500	10%	229,338	206,405	252,272
53	Project		Task 2.6L Curation	Other direct costs	1.00	SUM	5,000.00	5,000	4,500	-10%	5,500	10%	5,594	5,034	6,153

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Principal Scientist/Planner	200	HR	180.00	36,000	32,400	-10%	39,600	10%	38,938	35,044	42,831
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Senior Scientist/Planner	290	HR	160.00	46,400	41,760	-10%	51,040	10%	50,186	45,168	55,205
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Scientist/Planner	1,180	HR	120.00	141,600	127,440	-10%	155,760	10%	153,155	137,839	168,470
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Technical Editor	40.00	HR	105.00	4,200	3,780	-10%	4,620	10%	4,543	4,088	4,997
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Junior Scientist/Planner	10.00	HR	95.00	950	855	-10%	1,045	10%	1,028	925	1,130
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	GIS/CADD/Graphics	100	HR	90.00	9,000	8,100	-10%	9,900	10%	9,734	8,761	10,708
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Tribal monitor subcontract	149	DA	617.00	91,933	82,740	-10%	101,126	10%	99,435	89,491	109,378
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Travel and perdiem	1.00	SUM	35,858.00	35,858	32,272	-10%	39,444	10%	38,784	34,906	42,662
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Principal Scientist/Planner	200	HR	180.00	36,000	32,400	-10%	39,600	10%	40,495	36,446	44,545
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Senior Scientist/Planner	98.00	HR	160.00	15,680	14,112	-10%	17,248	10%	17,638	15,874	19,402
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Scientist/Planner	972	HR	120.00	116,640	104,976	-10%	128,304	10%	131,204	118,084	144,325
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Technical Editor	40.00	HR	105.00	4,200	3,780	-10%	4,620	10%	4,724	4,252	5,197
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Junior Scientist/Planner	20.00	HR	95.00	1,900	1,710	-10%	2,090	10%	2,137	1,924	2,351
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	GIS/CADD/Graphics	120	HR	90.00	10,800	9,720	-10%	11,880	10%	12,149	10,934	13,363
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Field Technician	768	HR	75.00	57,600	51,840	-10%	63,360	10%	64,792	58,313	71,271
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Tribal monitor subcontract	77.00	DA	647.85	49,884	44,896	-10%	54,873	10%	56,113	50,502	61,725
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Travel and perdiem	1.00	SUM	30,900.00	30,900	27,810	-10%	33,990	10%	34,758	31,282	38,234
53	Project		Task 2.6N Discoveries - Burial recovery	Human remains	100	EA	15,000.00	1,500,000	1,350,000	-10%	1,650,000	10%	1,689,061	1,520,155	1,857,968
53	Project		Task 2.6N Discoveries - Burial recovery	Other direct costs	1.00	SUM	500.00	500	450	-10%	550	10%	563	507	619
53	Project		Task 2.6N Discoveries - Arch resources	Archaelogical unit cost	60.00	EA	30,000.00	1,800,000	1,620,000	-10%	1,980,000	10%	2,026,874	1,824,186	2,229,561
53	Project		Task 2.6N Discoveries - Arch resources	Other direct costs	1.00	SUM	500.00	500	450	-10%	550	10%	563	507	619
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Principal Scientist/Planner	240	HR	180.00	43,200	38,880	-10%	47,520	10%	47,660	42,894	52,426
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Senior Scientist/Planner	1,808	HR	160.00	289,280	260,352	-10%	318,208	10%	319,143	287,229	351,057
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Scientist/Planner	1,928	HR	120.00	231,360	208,224	-10%	254,496	10%	255,244	229,719	280,768
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Technical Editor	40.00	HR	105.00	4,200	3,780	-10%	4,620	10%	4,634	4,170	5,097
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Junior Scientist/Planner	40.00	HR	95.00	3,800	3,420	-10%	4,180	10%	4,192	3,773	4,612
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	GIS/CADD/Graphics	120	HR	90.00	10,800	9,720	-10%	11,880	10%	11,915	10,723	13,106
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Field Technician	7,680	HR	75.00	576,000	518,400	-10%	633,600	10%	635,462	571,915	699,008
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Tribal monitor subcontract	452	EA	617.00	278,884	250,996	-10%	306,772	10%	307,674	276,906	338,441
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Other direct costs	1.00	SUM	127,984.00	127,984	115,186	-10%	140,782	10%	141,196	127,076	155,316
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Principal Scientist/Planner	240	HR	180.00	43,200	38,880	-10%	47,520	10%	52,586	47,328	57,845
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Senior Scientist/Planner	1,176	HR	160.00	188,160	169,344	-10%	206,976	10%	229,043	206,139	251,947
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Scientist/Planner	1,536	HR	120.00	184,320	165,888	-10%	202,752	10%	224,368	201,932	246,805
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Technical Editor	40.00	HR	105.00	4,200	3,780	-10%	4,620	10%	5,113	4,601	5,624
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Junior Scientist/Planner	40.00	HR	95.00	3,800	3,420	-10%	4,180	10%	4,626	4,163	5,088
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	GIS/CADD/Graphics	230	HR	90.00	20,700	18,630	-10%	22,770	10%	25,198	22,678	27,717
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Field Technician	7,680	HR	75.00	576,000	518,400	-10%	633,600	10%	701,151	631,036	771,267
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Tribal monitor subcontract	294	EA	647.85	190,468	171,421	-10%	209,515	10%	231,852	208,667	255,037
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Other direct costs	1.00	SUM	57,448.00	57,448	51,703	-10%	63,193	10%	69,930	62,937	76,923
53	Project		TCP Project allowance	TCP Project allowance	1.00	SUM	1,000,000.00	1,000,000	1,000,000	0%	1,000,000	0%	1,000,000	1,000,000	1,000,000
53	Project		Cultural resources allowance	Allowance for additional discoveries (reconciled with risk log)	1.00	SUM	1,000,000.00	1,000,000	1,000,000	0%	1,000,000	0%	1,000,000	1,000,000	1,000,000
60			**MONITORING AND OTHER COSTS**												
61			**AQUATIC RESOURCES**												
61	Project		Mainstem spawning (AR-1)	Tributory confluence monitoring (passage)	960	HR	46.13	44,280	39,852	-10%	66,420	50%	48,866	43,980	73,299
61	Project		Mainstem spawning (AR-1)	Confluence Area Maintenance (downstream tribs)	900	HR	46.13	41,513	37,361	-10%	62,269	50%	45,812	41,231	68,718
61	Project		Mainstem spawning (AR-1)	Confluence Area Maintenance (upstream tribs)	400	HR	102.50	41,000	36,900	-10%	61,500	50%	45,246	40,722	67,870
61	Project		Mainstem spawning (AR-1)	Mainstem Spawning Gravel Survey (45.3 miles)	100	HR	148.63	14,863	13,376	-10%	22,294	50%	16,402	14,762	24,603
61	Project		Mainstem spawning (AR-1)	Tributary Spawning Gravel Survey (13.9 miles)	200	HR	102.50	20,500	18,450	-10%	30,750	50%	22,623	20,361	33,935
61	Project		Mainstem spawning (AR-1)	Reporting and Coordination	1,280	HR	102.50	131,200	118,080	-10%	196,800	50%	144,789	130,310	217,183
61	Project		Mainstem spawning (AR-1)	Spawning Gravel Augmentation	16,132	CY	256.25	4,133,825	3,720,443	-10%	6,200,738	50%	4,561,971	4,105,774	6,842,957
61	Project		Mainstem spawning (AR-1)	Laborer (30 days)	240	HR	35.88	8,610	7,749	-10%	12,915	50%	9,502	8,552	14,253
61	Project		Mainstem spawning (AR-1)	200 Class Excavator (30 days)	240	HR	256.25	61,500	55,350	-10%	92,250	50%	67,870	61,083	101,804
61	Project		Juvenile outmigration (AR-2)	Tributary Confluence Monitoring (Passage)	960	HR	46.13	44,280	39,852	-10%	66,420	50%	48,866	43,980	73,299
61	Project		Juvenile outmigration (AR-2)	Tributary Confluence Monitoring (WQ)	960	HR	46.13	44,280	39,852	-10%	66,420	50%	48,866	43,980	73,299
61	Project		Juvenile outmigration (AR-2)	2018 Mainstem Winter Seining Recon	400	HR	107.63	43,050	38,745	-10%	64,575	50%	47,509	42,758	71,263
61	Project		Juvenile outmigration (AR-2)	2019 Mainstem Winter Seining	400	HR	153.75	61,500	55,350	-10%	92,250	50%	67,870	61,083	101,804
61	Project		Juvenile outmigration (AR-2)	Fish Transport (1 Truck)	400	HR	46.13	18,450	16,605	-10%	27,675	50%	20,361	18,325	30,541
61	Project		Juvenile outmigration (AR-2)	Fish Rescue and Relocation Crew	1,120	HR	153.75	172,200	154,980	-10%	258,300	50%	190,035	171,032	285,053
61	Project		Juvenile outmigration (AR-2)	Fish Transport (2 Trucks)	3,360	HR	46.13	154,980	139,482	-10%	232,470	50%	171,032	153,928	256,547
61	Project		Juvenile outmigration (AR-2)	Reporting and Coordination	1,280	HR	102.50	131,200	118,080	-10%	196,800	50%	144,789	130,310	217,183
61	Project		Juvenile outmigration (AR-2)	Miscellaneous Equipment	5.00	EA	6,150.00	30,750	27,675	-10%	46,125	50%	33,935	30,541	50,902
61	Project		Juvenile outmigration (AR-2)	H2O Monitoring Equipment	5.00	EA	30,750.00	153,750	138,375	-10%	230,625	50%	169,674	152,707	254,511

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					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
61	Project		Juvenile outmigration (AR-2)	H2O Monitoring Equipment	26.00	EA	307.50	7,995	7,196	-10%	11,993	50%	8,823	7,941	13,235
61	Project		Juvenile outmigration (AR-2)	Technician Equipment	14.00	EA	1,230.00	17,220	15,498	-10%	25,830	50%	19,004	17,103	28,505
61	Project		Juvenile outmigration (AR-2)	Transport Vehicle Rental ($300/day for 21 days)	672	HR	46.13	30,996	27,896	-10%	46,494	50%	34,206	30,786	51,309
61	Project		Juvenile outmigration (AR-2)	Transport Vehicle Operational Cost ($0.75/mi)	53,760	MI	0.92	49,594	44,634	-10%	74,390	50%	54,730	49,257	82,095
61	Project		Sucker rescue and relocation plan (AR-6)	Sucker Recapture Study (Spring and Fall)	280	HR	307.50	86,100	77,490	-10%	129,150	50%	95,018	85,516	142,526
61	Project		Sucker rescue and relocation plan (AR-6)	Sucker Salvage	280	HR	307.50	86,100	77,490	-10%	129,150	50%	95,018	85,516	142,526
61	Project		Sucker rescue and relocation plan (AR-6)	Sucker Transport (1 Truck)	140	HR	46.13	6,458	5,812	-10%	9,686	50%	7,126	6,414	10,689
61	Project		Sucker rescue and relocation plan (AR-6)	Reporting and Coordination	960	HR	102.50	98,400	88,560	-10%	147,600	50%	108,591	97,732	162,887
61	Project		Sucker rescue and relocation plan (AR-6)	Boat Electrofisher	300	HR	36.90	11,070	9,963	-10%	16,605	50%	12,217	10,995	18,325
61	Project		Sucker rescue and relocation plan (AR-6)	Boats (2 boats)	224	HR	92.25	20,664	18,598	-10%	30,996	50%	22,804	20,524	34,206
61	Project		Sucker rescue and relocation plan (AR-6)	Technician Equipment	12.00	EA	1,230.00	14,760	13,284	-10%	22,140	50%	16,289	14,660	24,433
61	Project		Sucker rescue and relocation plan (AR-6)	Tagging Equipment	1.00	EA	12,300.00	12,300	11,070	-10%	18,450	50%	13,574	12,217	20,361
61	Project		Sucker rescue and relocation plan (AR-6)	Transport Vehicle Rental ($300/day)	168	HR	46.13	7,749	6,974	-10%	11,624	50%	8,552	7,696	12,827
61	Project		Sucker rescue and relocation plan (AR-6)	Transport Vehicle Operational Cost ($0.75/mi)	7,200	MI	0.92	6,642	5,978	-10%	9,963	50%	7,330	6,597	10,995
61	Project		Freshwater mussel relocation (AR-7)	Freshwater Mussel Reconnaissance	280	HR	107.63	30,135	27,122	-10%	45,203	50%	33,256	29,931	49,884
61	Project		Freshwater mussel relocation (AR-7)	Mussel Salvage and Relocation	700	HR	107.63	75,338	67,804	-10%	113,006	50%	83,140	74,826	124,710
61	Project		Freshwater mussel relocation (AR-7)	Mussel Transport (1 Truck)	140	HR	46.13	6,458	5,812	-10%	9,686	50%	7,126	6,414	10,689
61	Project		Freshwater mussel relocation (AR-7)	Reporting and Coordination	960	HR	102.50	98,400	88,560	-10%	147,600	50%	108,591	97,732	162,887
61	Project		Freshwater mussel relocation (AR-7)	Miscellaneous Equipment	1.00	EA	6,150.00	6,150	5,535	-10%	9,225	50%	6,787	6,108	10,180
61	Project		Freshwater mussel relocation (AR-7)	Diving Gear	5.00	EA	1,230.00	6,150	5,535	-10%	9,225	50%	6,787	6,108	10,180
61	Project		Freshwater mussel relocation (AR-7)	Technician Equipment	10.00	EA	1,230.00	12,300	11,070	-10%	18,450	50%	13,574	12,217	20,361
61	Project		Freshwater mussel relocation (AR-7)	Transport Vehicle Rental ($300/day)	8.00	HR	922.50	7,380	6,642	-10%	11,070	50%	8,144	7,330	12,217
61	Project		Freshwater mussel relocation (AR-7)	Transport Vehicle Operational Cost ($0.75/mi)	14,000	MI	0.92	12,915	11,624	-10%	19,373	50%	14,253	12,827	21,379
62			**TERRESTRIAL RESOURCES MEASURES**												
62	Project		Habitat restoration plan (TER-1)	Annual maintenance and monitoring	3.00	EA	68,019.00	204,057	122,434	-40%	269,496	32%	248,394	149,036	328,051
62	Project		Habitat restoration plan (TER-1)	Annual reporting	3.00	EA	9,840.00	29,520	17,712	-40%	37,800	28%	35,934	21,560	46,013
62	Project		Habitat restoration plan (TER-1)	Post construction regulatory compliance and reporting	1.00	EA	14,760.00	14,760	8,856	-40%	18,900	28%	18,676	11,206	23,915
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Remove all nest platforms near construction, year 1	1.00	EA	53,640.30	53,640	-	0%	67,848	26%	58,017	-	73,384
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Nest exclusion monitoring, year 1	1.00	EA	110,896.80	110,897	-	0%	188,048	70%	119,946	-	203,393
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Remove all nest platforms near construction, year 2	1.00	EA	33,333.00	33,333	-	0%	46,632	40%	37,495	-	52,455
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Nest exclusion monitoring, year 2	1.00	EA	110,896.80	110,897	-	0%	188,048	70%	124,744	-	211,528
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Regulatory compliance and reporting, permitting	1.00	EA	9,840.00	9,840	-	0%	12,600	28%	11,069	-	14,173
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Remove nests near construction, year 1	1.00	EA	28,019.40	28,019	-	0%	55,048	96%	30,306	-	59,540
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Nest exclusion monitoring, year 1	1.00	EA	68,839.00	68,839	-	0%	146,600	113%	74,456	-	158,563
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Remove nests near construction, year 2	1.00	EA	22,463.90	22,464	-	0%	27,320	22%	25,269	-	30,731
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Nest exclusion monitoring, year 2	1.00	EA	68,839.00	68,839	-	0%	146,600	113%	77,435	-	164,905
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Regulatory compliance and reporting, permitting	1.00	EA	7,380.00	7,380	-	0%	12,600	71%	8,301	-	14,173
62	Project		Nesting Bird Surveys (TER-2); Biological monitoring	Nesting bird surveys prior to vegetation clearing	1.00	EA	59,741.10	59,741	-	0%	212,568	256%	65,908	-	234,512
62	Project		Nesting Bird Surveys (TER-2); Biological monitoring	Daily biological monitoring throughout construction	3,114	HR	109.47	340,882	-	0%	540,568	59%	376,072	-	596,372
62	Project		Nesting Bird Surveys (TER-2); Biological monitoring	Regulatory compliance and reporting during construction	1.00	EA	63,960.00	63,960	23,665	-63%	63,960	0%	70,563	26,108	70,563
62	Project		Nesting Bird Surveys (TER-2); Biological monitoring	Special status wildlife and habitat monitoring	1.00	EA	61,008.00	61,008	-	0%	107,520	76%	71,371	-	125,783
62	Project		Wetlands at Reservoirs (TER-5)	Wetland Project	10.00	AC	35,875.00	358,750	-	0%	700,000	95%	454,632	-	887,086
62	Project		Wetlands at Reservoirs (TER-5)	Monitoring	960	HR	64.79	62,197	-	0%	73,920	19%	78,820	-	93,676
62	Project		Special Status Bats (TER-6)	Pre-Demolition Exclusion	1.00	SUM	74,536.36	74,536	40,828	-45%	72,718	-2%	79,068	43,311	77,140
62	Project		Special Status Bats (TER-6)	Bat Exclusion Plan (Draft/Final)	1.00	SUM	8,171.51	8,172	7,972	-2%	7,972	-2%	8,668	8,457	8,457
62	Project		Special Status Bats (TER-6)	Field Prep/Health and Safety	1.00	SUM	2,882.20	2,882	2,812	-2%	2,812	-2%	3,057	2,983	2,983
62	Project		Special Status Bats (TER-6)	Biological Monitoring During Demolition	1.00	SUM	96,129.83	96,130	96,130	0%	96,130	0%	106,469	106,469	106,469
62	Project		Special Status Bats (TER-6)	Agency Coordination/Meetings	1.00	SUM	11,233.18	11,233	11,233	0%	11,233	0%	12,109	12,109	12,109
62	Project		Special Status Bats (TER-6)	Design Replacement Roosts	1.00	SUM	11,697.71	11,698	11,698	0%	11,698	0%	12,411	12,411	12,411
62	Project		Special Status Bats (TER-6)	Construct/Install Replacement Roosts	1.00	SUM	14,481.82	14,482	-	0%	25,643	77%	15,611	-	27,642
62	Project		Special Status Bats (TER-6)	Monitor Replacement Roosts (3 years)	1.00	SUM	145,169.93	145,170	-	0%	239,027	65%	170,090	-	280,058
63			**WATER QUALITY MONITORING**												
63	Project		Field installation & equipment	Keno	1.00	SUM	60,900.00	60,900	38,000	-38%	79,170	30%	63,336	39,520	82,337
63	Project		Field installation & equipment	JC Boyle	1.00	SUM	158,550.00	158,550	120,000	-24%	206,115	30%	171,488	129,792	222,934
63	Project		Field installation & equipment	Copco	1.00	SUM	90,300.00	90,300	-	0%	117,390	30%	97,668	-	126,969
63	Project		Field installation & equipment	Iron Gate	1.00	SUM	77,700.00	77,700	74,000	-5%	101,010	30%	80,808	76,960	105,050
63	Project		Field installation & equipment	Walker Bridge	1.00	SUM	80,850.00	80,850	77,000	-5%	105,105	30%	87,447	83,283	113,682
63	Project		Field installation & equipment	Seiad Valley	1.00	SUM	65,100.00	65,100	42,000	-35%	84,630	30%	70,412	45,427	91,536
63	Project		Field installation & equipment	Orleans	1.00	SUM	67,200.00	67,200	44,000	-35%	87,360	30%	69,888	45,760	90,854
63	Project		Field installation & equipment	Klamath	1.00	SUM	61,950.00	61,950	59,000	-5%	80,535	30%	64,428	61,360	83,756
63	Project		Field installation & equipment	Shasta	1.00	SUM	68,250.00	68,250	45,000	-34%	88,725	30%	76,772	50,619	99,804

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
63	Project		Field installation & equipment	Scott	1.00	SUM	68,250.00	68,250	45,000	-34%	88,725	30%	76,772	50,619	99,804
63	Project		Field installation & equipment	Salmon	0.00	SUM	-	-	-	0%	-	0%	-	-	-
63	Project		Field installation & equipment	Trinity	0.00	SUM	-	-	-	0%	-	0%	-	-	-
63	Project		Field installation & equipment	Equipment replacement	1.00	SUM	315,000.00	315,000	200,000	-37%	500,000	59%	388,654	246,765	616,912
63	Project		Operation & Maintenance	Keno	17.00	QTR	16,800.00	285,600	130,000	-54%	464,000	62%	326,120	148,444	529,831
63	Project		Operation & Maintenance	JC Boyle	21.00	QTR	16,800.00	352,800	170,000	-52%	400,000	13%	427,595	206,041	484,802
63	Project		Operation & Maintenance	Copco	13.00	QTR	16,800.00	218,400	-	0%	400,000	83%	254,135	-	465,449
63	Project		Operation & Maintenance	Iron Gate	25.00	QTR	4,200.00	105,000	92,000	-12%	116,000	10%	124,895	109,432	137,979
63	Project		Operation & Maintenance	Walker Bridge	13.00	QTR	11,550.00	150,150	132,000	-12%	275,000	83%	174,718	153,598	319,996
63	Project		Operation & Maintenance	Seiad Valley	21.00	QTR	4,200.00	88,200	36,000	-59%	100,000	13%	106,899	43,632	121,201
63	Project		Operation & Maintenance	Orleans	25.00	QTR	4,200.00	105,000	42,000	-60%	116,000	10%	124,895	49,958	137,979
63	Project		Operation & Maintenance	Klamath	25.00	QTR	4,200.00	105,000	36,000	-66%	116,000	10%	124,895	42,821	137,979
63	Project		Operation & Maintenance	Shasta	9.00	QTR	5,250.00	47,250	27,000	-43%	105,000	122%	56,022	32,013	124,494
63	Project		Operation & Maintenance	Scott	9.00	QTR	5,250.00	47,250	27,000	-43%	105,000	122%	56,022	32,013	124,494
63	Project		Operation & Maintenance	Salmon	0.00	SUM	-	-	-	0%	45,000	0%	-	-	50,619
63	Project		Operation & Maintenance	Trinity	0.00	SUM	-	-	-	0%	45,000	0%	-	-	50,619
63	Project		Sediment, Sampling & Recording	Keno	17.00	QTR	12,600.00	214,200	1,040,000	386%	348,000	62%	244,590	1,187,552	397,373
63	Project		Sediment, Sampling & Recording	JC Boyle	21.00	QTR	15,750.00	330,750	170,000	-49%	375,000	13%	400,871	206,041	454,502
63	Project		Sediment, Sampling & Recording	Copco	13.00	QTR	15,750.00	204,750	-	0%	375,000	83%	238,252	-	436,359
63	Project		Sediment, Sampling & Recording	Iron Gate	25.00	QTR	25,200.00	630,000	552,000	-12%	696,000	10%	749,370	656,591	827,875
63	Project		Sediment, Sampling & Recording	Walker Bridge	13.00	QTR	25,200.00	327,600	288,000	-12%	600,000	83%	381,203	335,123	698,174
63	Project		Sediment, Sampling & Recording	Seiad Valley	21.00	QTR	25,200.00	529,200	216,000	-59%	600,000	13%	641,393	261,793	727,203
63	Project		Sediment, Sampling & Recording	Orleans	25.00	QTR	25,200.00	630,000	252,000	-60%	696,000	10%	749,370	299,748	827,875
63	Project		Sediment, Sampling & Recording	Klamath	25.00	QTR	16,800.00	420,000	288,000	-31%	464,000	10%	499,580	342,569	551,917
63	Project		Sediment, Sampling & Recording	Shasta	9.00	QTR	23,100.00	207,900	99,000	-52%	462,000	122%	246,498	117,380	547,773
63	Project		Sediment, Sampling & Recording	Scott	9.00	QTR	23,100.00	207,900	99,000	-52%	462,000	122%	246,498	117,380	547,773
63	Project		Sediment, Sampling & Recording	Salmon	0.00	SUM	-	-	-	0%	198,000	0%	-	-	222,723
63	Project		Sediment, Sampling & Recording	Trinity	0.00	SUM	-	-	-	0%	198,000	0%	-	-	222,723
63	Project		Sediment, Sampling & Recording	Data Management	1.00	SUM	462,000.00	462,000	293,000	-37%	600,600	30%	567,821	360,112	738,168
63	Project		Sediment, Sampling & Recording	ODCs	1.00	SUM	163,800.00	163,800	115,000	-30%	372,000	127%	190,635	133,840	432,943
63	Project		Sediment, Sampling & Recording	Esturary and river sampling for toxins	4.00	SUM	52,500.00	210,000	200,000	-5%	273,000	30%	234,041	222,896	304,253
63	Project		Sediment, Sampling & Recording	TSS and NTU laboratory relationship study by USGS	1.00	SUM	157,500.00	157,500	150,000	-5%	204,750	30%	175,531	167,172	228,190
63	Project		Aerial photos & LiDAR	Annual aircraft surveys + 1 after 5 year gap	5.00	EA	63,000.00	315,000	283,500	-10%	472,500	50%	379,026	341,123	568,539
63	Project		Volitional fish passage monitoring	Annual field survey; 2 wk field survey + study.	5.00	EA	26,250.00	131,250	118,125	-10%	196,875	50%	157,928	142,135	236,891
63	Project		Drone LiDAR in site specific locations, analysis & reporting	Drone LiDAR in site specific locations, analysis & reporting	4.00	EA	21,000.00	84,000	75,600	-10%	126,000	50%	96,452	86,807	144,679
63	Project		Surface comparison and analysis of sediment erosion	Surface comparison and analysis of sediment erosion	4.00	EA	21,000.00	84,000	75,600	-10%	126,000	50%	96,452	86,807	144,679

A.2 Cost Estimate - Partial Removal

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Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
10			**OVERSIGHT**												
10	Project		Compensation & Benefits	7/16-6/17 (year 1)	1	SUM	29,017.00	29,017	29,017	0%	29,017	0%	29,017	29,017	29,017
10	Project		Compensation & Benefits	7/17-12/19 (2.5 years)	1	SUM	1,557,347.00	1,557,347	1,557,347	0%	1,557,347	0%	1,557,347	1,557,347	1,557,347
10	Project		Compensation & Benefits	1/20-6/22 (2.5 years)	1	SUM	3,276,136.00	3,276,136	3,276,136	0%	3,276,136	0%	3,276,136	3,276,136	3,276,136
10	Project		Compensation & Benefits	7/22-6/27 (5 years)	1	SUM	193,967.00	193,967	193,967	0%	193,967	0%	193,967	193,967	193,967
10	Project		Travel and Meetings	7/16-6/17 (year 1)	1	SUM	45,223.00	45,223	45,223	0%	45,223	0%	45,223	45,223	45,223
10	Project		Travel and Meetings	7/17-12/19 (2.5 years)	1	SUM	272,538.00	272,538	272,538	0%	272,538	0%	272,538	272,538	272,538
10	Project		Travel and Meetings	1/20-6/22 (2.5 years)	1	SUM	450,000.00	450,000	450,000	0%	450,000	0%	450,000	450,000	450,000
10	Project		Travel and Meetings	7/22-6/27 (5 years)	1	SUM	45,000.00	45,000	45,000	0%	45,000	0%	45,000	45,000	45,000
10	Project		Dam Removal Contractors	Land Survey Contractor	1	SUM	1,020,000.00	1,020,000	1,020,000	0%	1,020,000	0%	1,020,000	1,020,000	1,020,000
10	Project		Professional Services; CEA Services & Expenses	7/16-6/17 (year 1)	1	SUM	1,054,732.00	1,054,732	1,054,732	0%	1,054,732	0%	1,054,732	1,054,732	1,054,732
10	Project		Professional Services; CEA Services & Expenses	7/17-12/19 (2.5 years)	1	SUM	2,386,949.16	2,386,949	2,386,949	0%	2,386,949	0%	2,386,949	2,386,949	2,386,949
10	Project		Professional Services; CEA Services & Expenses	1/20-6/22 (2.5 years)	1	SUM	2,375,442.96	2,375,443	2,375,443	0%	2,375,443	0%	2,375,443	2,375,443	2,375,443
10	Project		Professional Services; CEA Services & Expenses	7/22-6/27 (5 years)	1	SUM	563,853.35	563,853	563,853	0%	563,853	0%	563,853	563,853	563,853
10	Project		Legal Services; Power + Water, General Counsel	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Legal Services; Power + Water, General Counsel	7/17-12/19 (2.5 years)	1	SUM	500,863.00	500,863	500,863	0%	500,863	0%	500,863	500,863	500,863
10	Project		Legal Services; Power + Water, General Counsel	1/20-6/22 (2.5 years)	1	SUM	694,448.00	694,448	694,448	0%	694,448	0%	694,448	694,448	694,448
10	Project		Legal Services; Power + Water, General Counsel	7/22-6/27 (5 years)	1	SUM	240,843.00	240,843	240,843	0%	240,843	0%	240,843	240,843	240,843
10	Project		Legal Services; Hawkins, General Counsel	7/16-6/17 (year 1)	1	SUM	1,109,894.00	1,109,894	1,109,894	0%	1,109,894	0%	1,109,894	1,109,894	1,109,894
10	Project		Legal Services; Hawkins, General Counsel	7/17-12/19 (2.5 years)	1	SUM	718,211.00	718,211	718,211	0%	718,211	0%	718,211	718,211	718,211
10	Project		Legal Services; Hawkins, General Counsel	1/20-6/22 (2.5 years)	1	SUM	373,112.00	373,112	373,112	0%	373,112	0%	373,112	373,112	373,112
10	Project		Legal Services; Hawkins, General Counsel	7/22-6/27 (5 years)	1	SUM	86,063.00	86,063	86,063	0%	86,063	0%	86,063	86,063	86,063
10	Project		Legal Services; Hawkins, Construction Counsel	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Legal Services; Hawkins, Construction Counsel	7/17-12/19 (2.5 years)	1	SUM	2,551,000.00	2,551,000	2,551,000	0%	2,551,000	0%	2,551,000	2,551,000	2,551,000
10	Project		Legal Services; Hawkins, Construction Counsel	1/20-6/22 (2.5 years)	1	SUM	600,000.00	600,000	600,000	0%	600,000	0%	600,000	600,000	600,000
10	Project		Legal Services; Hawkins, Construction Counsel	7/22-6/27 (5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Board of Consultants	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Board of Consultants	7/17-12/19 (2.5 years)	1	SUM	905,850.00	905,850	905,850	0%	905,850	0%	905,850	905,850	905,850
10	Project		Board of Consultants	1/20-6/22 (2.5 years)	1	SUM	494,100.00	494,100	494,100	0%	494,100	0%	494,100	494,100	494,100
10	Project		Board of Consultants	7/22-6/27 (5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Accounting & Audit Fees	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Accounting & Audit Fees	7/17-12/19 (2.5 years)	1	SUM	246,728.00	246,728	246,728	0%	246,728	0%	246,728	246,728	246,728
10	Project		Accounting & Audit Fees	1/20-6/22 (2.5 years)	1	SUM	612,823.00	612,823	612,823	0%	612,823	0%	612,823	612,823	612,823
10	Project		Accounting & Audit Fees	7/22-6/27 (5 years)	1	SUM	206,252.00	206,252	206,252	0%	206,252	0%	206,252	206,252	206,252
10	Project		Risk Management Services	7/16-6/17 (year 1)	1	SUM	44,519.00	44,519	44,519	0%	44,519	0%	44,519	44,519	44,519
10	Project		Risk Management Services	7/17-12/19 (2.5 years)	1	SUM	91,250.00	91,250	91,250	0%	91,250	0%	91,250	91,250	91,250
10	Project		Risk Management Services	1/20-6/22 (2.5 years)	1	SUM	135,000.00	135,000	135,000	0%	135,000	0%	135,000	135,000	135,000
10	Project		Risk Management Services	7/22-6/27 (5 years)	1	SUM	10,000.00	10,000	10,000	0%	10,000	0%	10,000	10,000	10,000
10	Project		Communications External Services	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Communications External Services	7/17-12/19 (2.5 years)	1	SUM	485,400.00	485,400	485,400	0%	485,400	0%	485,400	485,400	485,400
10	Project		Communications External Services	1/20-6/22 (2.5 years)	1	SUM	950,790.00	950,790	950,790	0%	950,790	0%	950,790	950,790	950,790
10	Project		Communications External Services	7/22-6/27 (5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Insurance & Risk Management	7/16-6/17 (year 1)	1	SUM	25,138.00	25,138	25,138	0%	25,138	0%	25,138	25,138	25,138
10	Project		Insurance & Risk Management	7/17-12/19 (2.5 years)	1	SUM	195,451.00	195,451	195,451	0%	195,451	0%	195,451	195,451	195,451
10	Project		Insurance & Risk Management	1/20-6/22 (2.5 years)	1	SUM	405,475.00	405,475	405,475	0%	405,475	0%	405,475	405,475	405,475
10	Project		Insurance & Risk Management	7/22-6/27 (5 years)	1	SUM	107,895.00	107,895	107,895	0%	107,895	0%	107,895	107,895	107,895
10	Project		Project Specific Insurance	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Project Specific Insurance	7/17-12/19 (2.5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Project Specific Insurance	1/20-6/22 (2.5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
10	Project		Project Specific Insurance	7/22-6/27 (5 years)	1	SUM	100,000.00	100,000	100,000	0%	100,000	0%	100,000	100,000	100,000
10	Project		Admin, IT, Fees	7/16-6/17 (year 1)	1	SUM	38,991.00	38,991	38,991	0%	38,991	0%	38,991	38,991	38,991
10	Project		Admin, IT, Fees	7/17-12/19 (2.5 years)	1	SUM	52,426.00	52,426	52,426	0%	52,426	0%	52,426	52,426	52,426
10	Project		Admin, IT, Fees	1/20-6/22 (2.5 years)	1	SUM	65,973.00	65,973	65,973	0%	65,973	0%	65,973	65,973	65,973
10	Project		Admin, IT, Fees	7/22-6/27 (5 years)	1	SUM	30,732.00	30,732	30,732	0%	30,732	0%	30,732	30,732	30,732

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
10	Project		Project Management, AECOM	Detailed separately	1	sum	2,977,635.66	2,977,636	2,828,754	-5%	3,275,399	10%	2,977,636	2,828,754	3,275,399
10	Project		Outreach, AECOM	Detailed separately	1	sum	1,253,904.32	1,253,904	1,191,209	-5%	1,379,295	10%	1,253,904	1,191,209	1,379,295
20			**ENVIRONMENTAL COMPLIANCE & PERMITTING**												
21			**PERMITTING**												
21	Project		Permitting, AECOM	Detailed separately	1	sum	4,113,000.00	4,113,000	3,907,350	-5%	4,524,300	10%	4,113,000	3,907,350	4,524,300
21	Project		Environmental Legal Serivces; Perkins Coie	7/16-6/17 (year 1)	1	SUM	-	-	-	0%	-	0%	-	-	-
21	Project		Environmental Legal Serivces; Perkins Coie	7/17-12/19 (2.5 years)	1	SUM	1,537,641.00	1,537,641	1,537,641	0%	1,537,641	0%	1,537,641	1,537,641	1,537,641
21	Project		Environmental Legal Serivces; Perkins Coie	1/20-6/22 (2.5 years)	1	SUM	1,068,125.00	1,068,125	1,068,125	0%	1,068,125	0%	1,068,125	1,068,125	1,068,125
21	Project		Environmental Legal Serivces; Perkins Coie	7/22-6/27 (5 years)	1	SUM	-	-	-	0%	-	0%	-	-	-
22			**CEQA & FERC SUPPORT**												
22	Project		Agency Fees and Reimbursements	Oregon Department of Environmental Quality	1	SUM	97,000.00	97,000	97,000	0%	97,000	0%	97,000	97,000	97,000
22	Project		Agency Fees and Reimbursements	CA State Water Resources Control Board	1	SUM	58,950.00	58,950	58,950	0%	58,950	0%	58,950	58,950	58,950
22	Project		Agency Fees and Reimbursements	Still Water Sciences (SWRCB)	1	SUM	1,281,945.00	1,281,945	1,281,945	0%	1,281,945	0%	1,281,945	1,281,945	1,281,945
22	Project		Agency Fees and Reimbursements	Other Environmental Studies	1	SUM	480,000.00	480,000	480,000	0%	480,000	0%	480,000	480,000	480,000
30			**ENGINEERING & CONSTRUCTION MANAGEMENT**												
31			**ENGINEERING - DESIGN DATA**												
31	Project		Engineering - Design Data	Detailed separately	1	sum	1,992,000.00	1,992,000	1,892,400	-5%	2,191,200	10%	1,992,000	1,892,400	2,191,200
32			**ENGINEERING - AECOM**												
32	Project		Construction Cost Estimate	Detailed separately	1	sum	295,000.00	295,000	280,250	-5%	324,500	10%	295,000	280,250	324,500
32	Project		AECOM Preliminary Design & Mitigation	Detailed separately	1	sum	3,585,000.00	3,585,000	3,405,750	-5%	3,943,500	10%	3,585,000	3,405,750	3,943,500
32	Project		AECOM Final Design & Construction Support	Detailed separately	1	sum	1,950,000.00	1,950,000	1,852,500	-5%	2,145,000	10%	1,950,000	1,852,500	2,145,000
32	Project		Review of PDB Final Design	Detailed separately	1	sum	285,000.00	285,000	270,750	-5%	313,500	10%	285,000	270,750	313,500
33			**ENGINEERING - PDB**												
33	Project		Engineering - PDB	Detailed separately	1	sum	6,513,000.00	6,513,000	5,861,700	-10%	8,466,900	30%	6,513,000	5,861,700	8,466,900
34			**PROCUREMENT**												
34	Project		Procurement	Detailed separately	1	sum	1,011,574.86	1,011,575	960,996	-5%	1,112,732	10%	1,011,575	960,996	1,112,732
35			**CONSTRUCTION MANAGEMENT**												
35	Project		Construction Management	Detailed separately	1	sum	10,616,599.33	10,616,599	10,085,769	-5%	11,678,259	10%	10,616,599	10,085,769	11,678,259
40			**CONSTRUCTION**												
41			**DAM REMOVAL**												
41	JC Boyle	1.001	JC Boyle Dam Removal	Removal of Diversion Conduit Bulkheads	14.00	CY	1,323.00	18,522	17,596	-5%	19,448	5%	20,835	19,793	21,876
41	JC Boyle	1.002	JC Boyle Dam Removal	Remove Water from behind Tailrace Cofferdam	500,000	GAL	0.01	-	4,778	0%	6,105	0%	-	-	-
41	JC Boyle	1.003	JC Boyle Dam Removal	Provide Dewatering behind Tailrace Cofferdam	1.00	LS	61,036.38	-	54,933	0%	70,192	0%	-	-	-
41	JC Boyle	1.004	JC Boyle Dam Removal	Construct Embankment Cofferdam in Tailrace around	2,000	CY	108.78	-	195,799	0%	261,065	0%	-	-	-
41	JC Boyle	1.005	JC Boyle Dam Removal	Remove Spillway Concrete	2,100	CY	330.13	693,263	589,274	-15%	831,916	20%	779,827	662,853	935,793
41	JC Boyle	1.006	JC Boyle Dam Removal	Remove Monorail Structural Steel Components	15,000	LB	0.64	9,570	8,613	-10%	12,919	35%	10,765	9,688	14,533
41	JC Boyle	1.007	JC Boyle Dam Removal	Remove Fish Ladder Concrete	1,820	CY	333.49	606,952	546,257	-10%	667,647	10%	682,738	614,464	751,012
41	JC Boyle	1.008	JC Boyle Dam Removal	Remove Gravity Dam Section Concrete	600	CY	339.60	-	173,195	0%	244,511	0%	-	-	-
41	JC Boyle	1.009	JC Boyle Dam Removal	Remove Timber Equipment Ramp on left side of Dam	10,500	LB	0.66	6,969	5,924	-15%	9,409	35%	7,840	6,664	10,584
41	JC Boyle	1.010	JC Boyle Dam Removal	Remove Pressure-Treated Lumber from Footbridge around	3,600	SF	7.19	25,886	23,298	-10%	29,769	15%	29,119	26,207	33,486
41	JC Boyle	1.011	JC Boyle Dam Removal	Remove Storage Shed located on access road	4,480	SF	27.79	-	118,293	0%	136,970	0%	-	-	-
41	JC Boyle	1.012	JC Boyle Dam Removal	Remove Warehouse located on access road	2,580	SF	36.49	-	89,441	0%	103,564	0%	-	-	-
41	JC Boyle	1.013	JC Boyle Dam Removal	Remove Fire System Control Bldg. on left abutment	520	SF	26.00	13,521	12,845	-5%	14,873	10%	15,209	14,448	16,730
41	JC Boyle	1.014	JC Boyle Dam Removal	Remove Dam Communication Bldg. on left abutment	490	SF	27.21	13,332	12,666	-5%	14,666	10%	14,997	14,247	16,497
41	JC Boyle	1.015	JC Boyle Dam Removal	Remove Concrete Slab on left abutment for former Control	6.00	CY	1,778.57	10,671	9,604	-10%	12,272	15%	12,004	10,804	13,804
41	JC Boyle	1.016	JC Boyle Dam Removal	Remove 4'x5' Metal Hatch on top of Concrete Pull Box on left	1.00	CY	1,769.46	1,769	1,593	-10%	1,946	10%	1,990	1,791	2,189
41	JC Boyle	1.017	JC Boyle Dam Removal	Remove Reservoir Level Gauge House on Dam Crest	24.00	SF	138.69	3,328	3,162	-5%	3,661	10%	3,744	3,557	4,118
41	JC Boyle	1.018	JC Boyle Dam Removal	Upstream Riprap	2,200	CY	93.45	205,581	185,023	-10%	226,139	10%	231,251	208,126	254,376
41	JC Boyle	1.019	JC Boyle Dam Removal	Downstream Riprap	1,300	CY	93.02	120,930	108,837	-10%	133,023	10%	136,030	122,427	149,633
41	JC Boyle	1.020	JC Boyle Dam Removal	Miscellaneous Excavation	132,500	CY	10.42	1,380,126	1,173,107	-15%	1,656,151	20%	1,552,454	1,319,586	1,862,945
41	JC Boyle	1.021	JC Boyle Dam Removal	Cutoff Wall Concrete Demolition	70.00	CY	655.64	45,895	43,600	-5%	52,779	15%	51,626	49,044	59,369
41	JC Boyle	1.022	JC Boyle Dam Removal	Cutoff Wall Anchors	285	EA	12.86	3,664	3,481	-5%	4,030	10%	4,121	3,915	4,533
41	JC Boyle	1.023	JC Boyle Dam Removal	Remove & Dispose Hand Rails and Light Poles	5,000	LB	0.85	4,227	4,016	-5%	4,861	15%	4,755	4,517	5,468
41	JC Boyle	1.024	JC Boyle Dam Removal	Remove & Dispose Spillway Radial Gates and Hoists	124,000	LB	2.14	264,891	238,402	-10%	357,603	35%	297,967	268,170	402,255
41	JC Boyle	1.025	JC Boyle Dam Removal	Remove & Dispose Stop Logs and Slots (steel)	92,000	LB	0.94	86,725	78,053	-10%	104,070	20%	97,554	87,799	117,065
41	JC Boyle	1.026	JC Boyle Dam Removal	Remove & Dispose of 24" Slide Gate at Entrance to Fish	4,200	LB	0.70	2,919	2,773	-5%	4,233	45%	3,284	3,120	4,761
41	JC Boyle	1.026a	JC Boyle Dam Removal	Remove petroleum products from Red Bam Area	1,600	GAL	13.34	21,338	18,137	-15%	27,739	30%	24,002	20,402	31,203
41	JC Boyle	1.027	JC Boyle Dam Removal	Remove & Dispose of Spillway gate motor & control panel	1.00	EA	1,282.33	1,282	1,154	-10%	1,539	20%	1,442	1,298	1,731
41	JC Boyle	1.028	JC Boyle Dam Removal	Remove & Dispose of Distribution equipment, panelboards	1.00	EA	5,877.55	5,878	5,290	-10%	7,053	20%	6,611	5,950	7,934

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	JC Boyle	1.029	JC Boyle Dam Removal	Remove Powerhouse Concrete down to Elevation 3324.0	1,500	CY	546.51	-	737,786	0%	983,714	0%	-	-	-
41	JC Boyle	1.030	JC Boyle Dam Removal	Remove Structural Steel Item associated with Powerhouse	94,000	LB	0.63	-	53,166	0%	67,935	0%	-	-	-
41	JC Boyle	1.031	JC Boyle Dam Removal	Remove Warehouse near Powerhouse	5,060	SF	32.95	166,704	158,369	-5%	183,375	10%	187,520	178,144	206,272
41	JC Boyle	1.032	JC Boyle Dam Removal	Remove & Dispose of 2 - Governor oil systems	52,500	LB	0.80	-	39,833	0%	48,219	0%	-	-	-
41	JC Boyle	1.033	JC Boyle Dam Removal	Remove & Dispose of Cooling water and bearing oil systems	6,500	LB	1.06	-	6,215	0%	7,941	0%	-	-	-
41	JC Boyle	1.034	JC Boyle Dam Removal	Remove & Dispose of 2 - Francis Turbines	560,000	LB	0.75	-	354,624	0%	521,505	0%	-	-	-
41	JC Boyle	1.035	JC Boyle Dam Removal	Remove & Dispose of 150 Ton crane	240,000	LB	0.82	196,396	166,937	-15%	235,675	20%	220,919	187,781	265,103
41	JC Boyle	1.036	JC Boyle Dam Removal	Remove & Dispose of Compressed Air systems	1,100	LB	0.88	-	875	0%	1,216	0%	-	-	-
41	JC Boyle	1.037	JC Boyle Dam Removal	Remove & Dispose of 2 - CO2 systems	6,600	LB	0.99	-	5,853	0%	7,805	0%	-	-	-
41	JC Boyle	1.038	JC Boyle Dam Removal	Remove & Dispose of Plant Water and Fire Protection	3,100	LB	0.74	-	2,068	0%	2,757	0%	-	-	-
41	JC Boyle	1.039	JC Boyle Dam Removal	Remove & Dispose of Transformer Oil Fire Protection	6,500	LB	0.80	-	4,426	0%	6,248	0%	-	-	-
41	JC Boyle	1.04	JC Boyle Dam Removal	Remove & Dispose of Unwatering Piping	33,000	LB	0.74	-	19,481	0%	30,439	0%	-	-	-
41	JC Boyle	1.041	JC Boyle Dam Removal	Remove & Dispose of Drainage Piping	10,000	LB	0.84	-	7,100	0%	10,024	0%	-	-	-
41	JC Boyle	1.042	JC Boyle Dam Removal	Remove & Dispose of 2-Oil Sump pumps	2,000	LB	1.27	-	2,283	0%	2,917	0%	-	-	-
41	JC Boyle	1.043	JC Boyle Dam Removal	Remove & Dispose of Draft Tube Bulk Head Gates and	65,000	LB	0.71	-	39,403	0%	57,946	0%	-	-	-
41	JC Boyle	1.043a	JC Boyle Dam Removal	Remove petroleum products from Mechanical Equipment	2,700	GAL	10.27	27,735	23,575	-15%	36,056	30%	31,198	26,519	40,558
41	JC Boyle	1.044	JC Boyle Dam Removal	Remove & Dispose of Outdoor Vertical AC Generator, Unit 1:	2.00	EA	158,304.56	-	269,118	0%	364,100	0%	-	-	-
41	JC Boyle	1.045	JC Boyle Dam Removal	Remove & Dispose of Excitation equipment for 53/50 MVA	2.00	EA	13,425.63	-	24,166	0%	29,536	0%	-	-	-
41	JC Boyle	1.046	JC Boyle Dam Removal	Remove & Dispose of Surge protection equip. for 53/50 MVA	2.00	EA	8,153.33	-	14,676	0%	17,937	0%	-	-	-
41	JC Boyle	1.047	JC Boyle Dam Removal	Remove & Dispose of Neutral grounding equip. for 53/50	2.00	EA	3,980.33	-	7,165	0%	8,757	0%	-	-	-
41	JC Boyle	1.048	JC Boyle Dam Removal	Remove & Dispose of Generator Switchgear, 15kV - (6	1.00	EA	19,730.68	-	16,771	0%	24,663	0%	-	-	-
41	JC Boyle	1.049	JC Boyle Dam Removal	Remove & Dispose of Station Service Switchgear, 600 volt -	1.00	EA	10,780.56	-	9,703	0%	11,859	0%	-	-	-
41	JC Boyle	1.050	JC Boyle Dam Removal	Remove & Dispose of Unit and plant control switchboard	1.00	EA	5,903.27	-	5,313	0%	6,494	0%	-	-	-
41	JC Boyle	1.051	JC Boyle Dam Removal	Remove & Dispose of Battery system	1.00	EA	7,430.59	7,431	6,688	-10%	8,174	10%	8,358	7,523	9,194
41	JC Boyle	1.052	JC Boyle Dam Removal	Remove & Dispose of Raceways, Conduit and Cable	1.00	EA	13,891.88	-	12,503	0%	15,281	0%	-	-	-
41	JC Boyle	1.053	JC Boyle Dam Removal	Remove & Dispose of Misc. power & control boards	1.00	EA	7,140.08	-	6,426	0%	7,854	0%	-	-	-
41	JC Boyle	1.054	JC Boyle Dam Removal	Remove & Dispose of 5 Gantry Crane motors - hoist (50Hp*),	1.00	EA	1,729.51	1,730	1,557	-10%	2,075	20%	1,945	1,751	2,335
41	JC Boyle	1.055	JC Boyle Dam Removal	Remove & Dispose of Gantry Crane control equipment (3	1.00	EA	5,869.29	5,869	5,282	-10%	6,456	10%	6,602	5,942	7,262
41	JC Boyle	1.056	JC Boyle Dam Removal	Remove & Dispose of Conduit and Cable	1.00	EA	10,561.93	10,562	9,506	-10%	12,674	20%	11,881	10,693	14,257
41	JC Boyle	1.057	JC Boyle Dam Removal	Remove & Dispose of Exterior Lighting	1.00	EA	10,640.74	10,641	9,577	-10%	12,237	15%	11,969	10,772	13,765
41	JC Boyle	1.058	JC Boyle Dam Removal	Remove & Dispose of Transmission Line No. 59	1.66	MI	31,411.84	52,144	44,322	-15%	65,180	25%	58,655	49,856	73,318
41	JC Boyle	1.059	JC Boyle Dam Removal	Remove & Dispose of Transmission Line No. 98	0.24	MI	27,715.54	6,652	5,654	-15%	8,315	25%	7,482	6,360	9,353
41	JC Boyle	1.060	JC Boyle Dam Removal	Remove & Dispose of Transmission Line No. 58	1.66	MI	31,411.84	52,144	44,322	-15%	65,180	25%	58,655	49,856	73,318
41	JC Boyle	1.061	JC Boyle Dam Removal	Remove Intake Structure Concrete	1,600	CY	294.80	-	424,508	0%	566,010	0%	-	-	-
41	JC Boyle	1.062	JC Boyle Dam Removal	Remove Fish Screen Building	2,010	SF	70.46	-	134,535	0%	155,777	0%	-	-	-
41	JC Boyle	1.063	JC Boyle Dam Removal	Remove 24-inch-dia. Steel Fish Discharge Pipe	37,978	LB	0.31	11,804	10,033	-15%	14,755	25%	13,278	11,286	16,597
41	JC Boyle	1.064	JC Boyle Dam Removal	Remove Concrete Items associated with the 14-ft-diameter	1,010	CY	313.62	316,752	269,239	-15%	364,265	15%	356,303	302,857	409,748
41	JC Boyle	1.065	JC Boyle Dam Removal	Remove Open Concrete Flume	26,000	CY	266.49	-	2,926,073	-10%	3,901,430	20%	-	-	-
41	JC Boyle	1.066	JC Boyle Dam Removal	Remove Structural Steel Items associated with the Forebay	11,500	LB	0.49	5,628	4,784	-15%	7,035	25%	6,331	5,381	7,914
41	JC Boyle	1.067	JC Boyle Dam Removal	Remove Fore bay Concrete	2,500	CY	298.78	746,951	403,353	-10%	537,804	20%	840,218	453,718	604,957
41	JC Boyle	1.068	JC Boyle Dam Removal	Place Concrete Plugs at Tunnel Portals	30.00	CY	1,616.26	48,488	46,063	-5%	50,912	5%	54,542	51,815	57,269
41	JC Boyle	1.069	JC Boyle Dam Removal	Remove Concrete Items associated with Penstocks D/S from	1,800	CY	495.44	891,799	802,619	-10%	1,070,158	20%	1,003,152	902,837	1,203,783
41	JC Boyle	1.070	JC Boyle Dam Removal	Remove Head gate Control Building at Flume Entrance	500	SF	99.08	49,542	44,588	-10%	56,973	15%	55,728	50,155	64,087
41	JC Boyle	1.071	JC Boyle Dam Removal	Remove Fore bay Spillway Gate House	610	SF	89.23	54,431	48,988	-10%	65,318	20%	61,228	55,105	73,473
41	JC Boyle	1.072	JC Boyle Dam Removal	Remove Fore bay Control Building	560	SF	96.68	54,141	48,727	-10%	64,969	20%	60,901	54,811	73,081
41	JC Boyle	1.074	JC Boyle Dam Removal	Remove Insulated Generator Building next to Fore bay	90.00	SF	166.30	14,967	13,470	-10%	17,960	20%	16,835	15,152	20,203
41	JC Boyle	1.075	JC Boyle Dam Removal	Remove Fixed Wheel Gate (gate, Frame, and Hoist)	55,000	LB	0.53	-	23,272	0%	36,363	0%	-	-	-
41	JC Boyle	1.076	JC Boyle Dam Removal	Remove Trash rack and trash rake (steel)	75,000	LB	0.51	-	30,438	0%	47,559	0%	-	-	-
41	JC Boyle	1.077	JC Boyle Dam Removal	Remove stop Logs and slots (steel)	136,000	LB	0.79	-	96,633	0%	134,213	0%	-	-	-
41	JC Boyle	1.078	JC Boyle Dam Removal	Remove Traveling Water Screen	124,000	LB	0.50	-	56,258	0%	78,136	0%	-	-	-
41	JC Boyle	1.079	JC Boyle Dam Removal	Remove Fish By-Pass and Supports (steel)	610,000	LB	0.77	-	422,080	0%	539,325	0%	-	-	-
41	JC Boyle	1.080	JC Boyle Dam Removal	Remove Gates and Hoists	18,500	LB	0.48	8,848	7,521	-15%	11,503	30%	9,953	8,460	12,939
41	JC Boyle	1.081	JC Boyle Dam Removal	Remove Trash rack and trash rake (steel)	47,249	LB	0.60	-	24,001	0%	36,707	0%	-	-	-
41	JC Boyle	1.082	JC Boyle Dam Removal	Remove stop Logs and slots (steel)	37,069	LB	0.62	-	19,692	0%	30,117	0%	-	-	-
41	JC Boyle	1.083	JC Boyle Dam Removal	Remove & Dispose Penstocks and bifurcation (steel)	1,600,000	LB	0.70	1,112,218	945,385	-15%	1,334,661	20%	1,251,094	1,063,429	1,501,312
41	JC Boyle	1.084	JC Boyle Dam Removal	Remove & Dispose Surge Tank (steel)	79,000	LB	0.82	64,445	58,000	-10%	83,778	30%	72,492	65,242	94,239
41	JC Boyle	1.085	JC Boyle Dam Removal	Remove & Dispose 2 - 108" Butterfly valves	148,000	LB	0.74	-	98,855	0%	142,790	0%	-	-	-
41	JC Boyle	1.086	JC Boyle Dam Removal	Remove & Dispose Gate, Stem and Frame	28,000	LB	0.71	19,883	17,895	-10%	23,860	20%	22,366	20,129	26,839
41	JC Boyle	1.087	JC Boyle Dam Removal	Remove & Dispose of Steel Transition Manifolds on Upstream	250,000	LB	0.64	160,863	136,734	-15%	209,122	30%	180,949	153,807	235,234
41	JC Boyle	1.087a	JC Boyle Dam Removal	Remove petroleum products from Mechanical Equipment	380	GAL	16.54	6,284	5,342	-15%	8,169	30%	7,069	6,008	9,189
41	JC Boyle	1.097	JC Boyle Dam Removal	Clear and Grub Disposal Area (Embankment)	10.00	AC	12,954.90	129,549	116,594	-10%	142,504	10%	145,725	131,152	160,297
41	JC Boyle	1.098	JC Boyle Dam Removal	Clear and Grub, 40' width	2.40	AC	12,954.90	31,092	27,983	-10%	34,201	10%	34,974	31,477	38,471
41	JC Boyle	1.099	JC Boyle Dam Removal	4" thick gravel surfacing	2,150	T	29.66	63,762	57,386	-10%	70,139	10%	71,724	64,552	78,896
41	JC Boyle	1.103	JC Boyle Dam Removal	Soil Cover over Concrete Rubble	13,000	CY	8.64	112,348	101,113	-10%	134,818	20%	126,376	113,739	151,651
41	JC Boyle	1.107	JC Boyle Dam Removal	Embankment Fill in Waste way (Fore bay) Scour Hole	55,900	CY	77.16	4,313,417	3,882,075	-10%	4,744,759	10%	4,852,008	4,366,807	5,337,209
41	JC Boyle	1.108	JC Boyle Dam Removal	Topsy Recreational Area - Concrete total	68.00	CY	454.68	30,918	29,372	-5%	34,010	10%	34,779	33,040	38,256
41	JC Boyle	1.109	JC Boyle Dam Removal	Topsy Recreational Area - 6'x80' Floating dock made of	1.00	EA	8,816.20	8,816	8,375	-5%	9,257	5%	9,917	9,421	10,413
41	JC Boyle	1.110	JC Boyle Dam Removal	Topsy Recreational Area - 5'x20' Walkway leading to hex	200	SF	10.02	2,005	1,904	-5%	2,105	5%	2,255	2,142	2,368

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	JC Boyle	1.111	JC Boyle Dam Removal	Topsy Recreational Area - Regrade to natural contour	300	SF	14.63	4,390	4,171	-5%	4,829	10%	4,938	4,691	5,432
41	JC Boyle	1.112	JC Boyle Dam Removal	Pioneer Park - Picnic tables to be removed and hauled away	12.00	EA	156.62	1,879	1,785	-5%	1,973	5%	2,114	2,008	2,220
41	JC Boyle	1.113	JC Boyle Dam Removal	Pioneer Park - 12 Concrete fire rings	5.00	CY	353.89	1,769	1,681	-5%	1,858	5%	1,990	1,891	2,090
41	JC Boyle	1.114	JC Boyle Dam Removal	Pioneer Park - Portable toilets to be removed and hauled	2.00	EA	1,002.35	2,005	1,904	-5%	2,105	5%	2,255	2,142	2,368
41	JC Boyle	1.115	JC Boyle Dam Removal	Pioneer Park - Signs to be removed and hauled away	6.00	EA	141.12	847	804	-5%	889	5%	952	905	1,000
41	JC Boyle	1.116	JC Boyle Dam Removal	Pioneer Park - Dumpster to be removed and hauled away	1.00	EA	2,971.02	2,971	2,674	-10%	3,417	15%	3,342	3,008	3,843
41	JC Boyle	1.118	JC Boyle Dam Removal	Pioneer Park - Regrade to natural contour	0.50	AC	17,560.36	8,780	7,902	-10%	9,658	10%	9,877	8,889	10,864
41	JC Boyle	5.000	JC Boyle Dam Removal	Remove Frame dead end structures 60-80 ft high	2.00	EA	7,101.59	14,203	12,783	-10%	17,044	20%	15,977	14,379	19,172
41	JC Boyle	5.001	JC Boyle Dam Removal	Remove (incl foundation) and Save Transformers 230KV	2.00	EA	2,688.70	5,377	4,840	-10%	6,184	15%	6,049	5,444	6,956
41	JC Boyle	5.002	JC Boyle Dam Removal	Remove (incl foundation) and Save Power Circuit Breakers	2.00	EA	3,640.83	7,282	6,918	-5%	8,010	10%	8,191	7,781	9,010
41	JC Boyle	5.003	JC Boyle Dam Removal	Substation Tie Structure 230KV	1.00	EA	41,482.05	41,482	37,334	-10%	47,704	15%	46,662	41,995	53,661
41	JC Boyle	5.004	JC Boyle Dam Removal	Remove Chain Link Fence	601	LF	17.70	10,639	9,575	-10%	11,703	10%	11,967	10,770	13,164
41	JC Boyle	5.005	JC Boyle Dam Removal	Demolish overhead distribution 2.5 miles (30-45 poles)	45.00	EA	1,160.01	52,200	46,980	-10%	62,640	20%	58,718	52,846	70,462
41	JC Boyle	5.032	JC Boyle Dam Removal	Install 230kV strain transmission structures outside JC Boyle	2.00	EA	132,241.37	264,483	238,034	-10%	317,379	20%	297,507	267,756	357,009
41	Copco 1	2.001	Copco 1 Dam Removal	Furnish, Install, and Remove Barge-Mounted Crane in	1.00	LS	191,823.14	191,823	172,641	-10%	239,779	25%	215,775	194,197	269,719
41	Copco 1	2.002	Copco 1 Dam Removal	Remove Sediment from Diversion Tunnel Intake to provide	30.00	CY	3,434.68	103,040	92,736	-10%	123,649	20%	115,907	104,316	139,088
41	Copco 1	2.003	Copco 1 Dam Removal	Furnish, Install, and Remove Large Crane on Right Abutment	1.00	LS	566,865.71	566,866	481,836	-15%	651,896	15%	637,647	542,000	733,294
41	Copco 1	2.004	Copco 1 Dam Removal	Remove Water from behind Tailrace Cofferdam	200,000	GAL	0.01	2,091	1,882	-10%	2,405	15%	2,353	2,117	2,706
41	Copco 1	2.005	Copco 1 Dam Removal	Riprap Protection on Cofferdam	260	CY	148.31	38,561	32,777	-15%	46,273	20%	43,376	36,869	52,051
41	Copco 1	2.006	Copco 1 Dam Removal	Provide Dewatering behind Tailrace Cofferdam	1.00	LS	89,882.80	89,883	80,895	-10%	107,859	20%	101,106	90,995	121,327
41	Copco 1	2.007	Copco 1 Dam Removal	Remove Current Diversion Tunnel Plug	195	CY	1,390.41	271,129	244,016	-10%	325,355	20%	304,983	274,485	365,980
41	Copco 1	2.008	Copco 1 Dam Removal	Construct Embankment Cofferdam in Tailrace	1,700	CY	165.62	281,551	239,319	-15%	337,862	20%	316,707	269,201	380,049
41	Copco 1	2.009	Copco 1 Dam Removal	Installation of 3 each 72" Blind Flanges	38,000	LB	34.66	1,317,134	1,119,564	-15%	1,712,274	30%	1,481,597	1,259,357	1,926,076
41	Copco 1	2.009.2	Copco 1 Dam Removal	Installation of 16.5 X 18.5 Roller Gate and Gate Structure	1.00	LS	4,098,153.55	4,098,154	3,483,431	-15%	5,327,600	30%	4,609,865	3,918,386	5,992,825
41	Copco 1	2.009.3	Copco 1 Dam Removal	Removal of 16.5 X 18.5 Roller Gate and Gate Structure	1.00	LS	271,584.86	271,585	230,847	-15%	353,060	30%	305,496	259,672	397,145
41	Copco 1	2.010	Copco 1 Dam Removal	Remove Concrete Dam down to Elev. 2476	36,000	CY	227.38	8,185,528	7,366,975	-10%	9,822,633	20%	9,207,605	8,286,845	11,049,126
41	Copco 1	2.011	Copco 1 Dam Removal	Remove Concrete Intake Structure on Right Abutment	21,000	CY	346.51	-	6,185,199	0%	8,732,046	0%	-	-	-
41	Copco 1	2.012	Copco 1 Dam Removal	Remove Structural Steel from Spillway	55,000	LB	1.27	69,659	59,210	-15%	87,074	25%	78,357	66,604	97,946
41	Copco 1	2.013	Copco 1 Dam Removal	Install Diversion Tunnel Plugs	30.00	CY	1,330.24	39,907	28,733	-10%	36,714	15%	44,890	32,321	41,299
41	Copco 1	2.014	Copco 1 Dam Removal	Remove Diversion Tunnel Control Structure Concrete	350	CY	231.13	-	72,805	0%	97,074	0%	-	-	-
41	Copco 1	2.015	Copco 1 Dam Removal	Remove & Dispose of Hand Rails	11,000	LB	1.36	14,919	12,681	-15%	17,903	20%	16,782	14,265	20,139
41	Copco 1	2.016	Copco 1 Dam Removal	Remove & Dispose of Radial Gates	140,500	LB	1.11	156,117	140,505	-10%	195,146	25%	175,610	158,049	219,513
41	Copco 1	2.017	Copco 1 Dam Removal	Remove & Dispose Radial Gate Stop logs	18,000	LB	1.06	19,126	17,214	-10%	23,908	25%	21,515	19,363	26,893
41	Copco 1	2.018	Copco 1 Dam Removal	Remove & Dispose Stop log hoist, track and supports	26,000	LB	1.03	26,842	24,158	-10%	33,552	25%	30,193	27,174	37,742
41	Copco 1	2.019	Copco 1 Dam Removal	Remove & Dispose of 3 sections of 23' of 72" Dia. steel lining	54,000	LB	1.04	-	47,906	0%	67,633	0%	-	-	-
41	Copco 1	2.020	Copco 1 Dam Removal	Remove & Dispose of 3 - 72" butterfly valves (embedded)	55,000	LB	1.10	-	54,264	0%	69,337	0%	-	-	-
41	Copco 1	2.021	Copco 1 Dam Removal	Remove & Dispose of 3 - 72" flapper valves with remote	78,000	LB	5.54	432,104	388,894	-10%	496,920	15%	486,058	437,453	558,967
41	Copco 1	2.022	Copco 1 Dam Removal	Remove & Dispose of Spillway gate motor & control panel	1.00	EA	1,318.63	1,319	1,187	-10%	1,516	15%	1,483	1,335	1,706
41	Copco 1	2.023	Copco 1 Dam Removal	Remove & Dispose Distribution equipment, panelboards	1.00	EA	5,877.55	5,878	5,290	-10%	7,053	20%	6,611	5,950	7,934
41	Copco 1	2.024	Copco 1 Dam Removal	Remove Powerhouse Concrete down to top of rock under the	3,100	CY	387.53	-	1,021,133	0%	1,501,667	0%	-	-	-
41	Copco 1	2.025	Copco 1 Dam Removal	Remove Powerhouse Structural Steel	110,000	LB	1.02	-	95,360	0%	134,625	0%	-	-	-
41	Copco 1	2.026	Copco 1 Dam Removal	Remove & Dispose of 2 - Governor Oil Systems	38,000	LB	1.07	-	36,469	0%	50,651	0%	-	-	-
41	Copco 1	2.027	Copco 1 Dam Removal	Remove & Dispose of Cooling water and bearing oil systems	11,000	LB	3.16	-	31,239	0%	41,652	0%	-	-	-
41	Copco 1	2.028	Copco 1 Dam Removal	Remove & Dispose of 4 - Horizontal Tandem Francis	452,000	LB	0.80	-	325,922	0%	434,562	0%	-	-	-
41	Copco 1	2.029	Copco 1 Dam Removal	Remove & Dispose of 2 - 40 Ton indoor cranes	140,000	LB	0.74	-	88,350	0%	124,729	0%	-	-	-
41	Copco 1	2.030	Copco 1 Dam Removal	Remove & Dispose of Compressed Air System	1,000	LB	1.00	-	897	0%	1,147	0%	-	-	-
41	Copco 1	2.031	Copco 1 Dam Removal	Remove & Dispose of 2 - CO2 Systems	3,100	LB	1.05	-	2,927	0%	3,739	0%	-	-	-
41	Copco 1	2.032	Copco 1 Dam Removal	Remove & Dispose of Plant Water and Fire Protection	2,600	LB	1.35	-	3,160	0%	4,214	0%	-	-	-
41	Copco 1	2.033	Copco 1 Dam Removal	Remove & Dispose of Transformer Oil Fire Protection	5,400	LB	1.22	-	5,927	0%	7,903	0%	-	-	-
41	Copco 1	2.034	Copco 1 Dam Removal	Remove & Dispose of Unwatering Piping	27,000	LB	0.73	-	16,777	0%	24,672	0%	-	-	-
41	Copco 1	2.035	Copco 1 Dam Removal	Remove & Dispose of Drainage Piping	5,000	LB	1.04	-	4,422	0%	6,503	0%	-	-	-
41	Copco 1	2.035a	Copco 1 Dam Removal	Remove petroleum products from mechanical equipment	1,250	GAL	4.39	5,490	4,941	-10%	6,313	15%	6,175	5,558	7,101
41	Copco 1	2.036	Copco 1 Dam Removal	Remove & Dispose of Horizontal AC Generator, Indoor Open	2.00	EA	38,691.77	-	65,776	0%	92,860	0%	-	-	-
41	Copco 1	2.037	Copco 1 Dam Removal	Remove & Dispose of Excitation equipment for 12.5 MVA	1.50	EA	8,472.47	-	10,802	0%	15,886	0%	-	-	-
41	Copco 1	2.038	Copco 1 Dam Removal	Remove & Dispose of Surge protection equip. for 12.5 MVA	2.00	EA	2,504.46	-	4,258	0%	6,512	0%	-	-	-
41	Copco 1	2.039	Copco 1 Dam Removal	Remove & Dispose of Neutral grounding equip. for 12.5 MVA	2.00	EA	2,332.24	-	4,198	0%	5,364	0%	-	-	-
41	Copco 1	2.040	Copco 1 Dam Removal	Remove & Dispose of Generator Switchgear, 5kV-includes	1.00	EA	20,666.10	-	18,599	0%	23,766	0%	-	-	-
41	Copco 1	2.041	Copco 1 Dam Removal	Remove & Dispose of Station Service Switchgear, 600 volt -	1.00	EA	11,311.14	-	10,180	0%	13,008	0%	-	-	-
41	Copco 1	2.042	Copco 1 Dam Removal	Remove & Dispose of Unit and plant control switchboard	1.00	EA	6,110.32	-	5,499	0%	7,027	0%	-	-	-
41	Copco 1	2.043	Copco 1 Dam Removal	Remove & Dispose of Battery System	1.00	EA	20,638.63	20,639	18,575	-10%	23,734	15%	23,216	20,894	26,698
41	Copco 1	2.044	Copco 1 Dam Removal	Remove & Dispose of Raceways, Conduit and Cable	1.00	EA	17,082.48	-	15,374	0%	19,645	0%	-	-	-
41	Copco 1	2.045	Copco 1 Dam Removal	Remove & Dispose of Misc. power & control boards	1.00	EA	6,945.94	-	6,251	0%	7,988	0%	-	-	-
41	Copco 1	2.046	Copco 1 Dam Removal	Remove & Dispose of Step-up Transformers, indoor, oil-filled,	3.00	EA	64,338.39	-	173,714	0%	221,967	0%	-	-	-
41	Copco 1	2.047	Copco 1 Dam Removal	Remove & Dispose of Step-up Transformers, indoor, oil-filled,	3.00	EA	57,252.76	-	154,582	0%	197,522	0%	-	-	-
41	Copco 1	2.048	Copco 1 Dam Removal	Remove & Dispose of Seven 40-Ton Travelling Crane motors	1.00	EA	3,306.69	-	2,976	0%	3,803	0%	-	-	-
41	Copco 1	2.049	Copco 1 Dam Removal	Remove & Dispose of 40-Ton Travelling Crane control	1.00	EA	4,364.61	-	3,928	0%	5,019	0%	-	-	-
41	Copco 1	2.050	Copco 1 Dam Removal	Remove & Dispose of 40-Ton Travelling Crane Festoon Cable	1.00	EA	1,534.84	-	1,381	0%	1,842	0%	-	-	-

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Copco 1	2.051	Copco 1 Dam Removal	Remove & Dispose of Four 15-Ton Overhead Crane Motors -	1.00	EA	959.54	-	864	0%	1,151	0%	-	-	-
41	Copco 1	2.052	Copco 1 Dam Removal	Remove & Dispose of 15-Ton Overhead Crane control	1.00	EA	434.20	-	391	0%	499	0%	-	-	-
41	Copco 1	2.053	Copco 1 Dam Removal	Remove & Dispose of 15-Ton Overhead Crane Festoon	1.00	EA	637.49	-	574	0%	733	0%	-	-	-
41	Copco 1	2.053a	Copco 1 Dam Removal	Remove petroleum products from mechanical equipment	10,500	GAL	10.39	109,116	98,204	-10%	125,483	15%	122,740	110,466	141,151
41	Copco 1	2.054	Copco 1 Dam Removal	Remove & Dispose of 69kV circuit breakers, oil0 filled, PCB	2.00	EA	861.46	1,723	1,551	-10%	1,895	10%	1,938	1,744	2,132
41	Copco 1	2.055	Copco 1 Dam Removal	Remove & Dispose of 69kV disconnect switches, group-	2.00	EA	861.46	1,723	1,551	-10%	1,895	10%	1,938	1,744	2,132
41	Copco 1	2.056	Copco 1 Dam Removal	Remove & Dispose of 60-foot wood poles	12.00	EA	1,296.96	15,563	13,229	-15%	18,676	20%	17,507	14,881	21,008
41	Copco 1	2.057	Copco 1 Dam Removal	Remove & Dispose of 30-foot wood cross arms	24.00	EA	484.41	11,626	9,882	-15%	13,951	20%	13,078	11,116	15,693
41	Copco 1	2.058	Copco 1 Dam Removal	Remove & Dispose of 69-kV insulator strings	12.00	EA	372.92	4,475	3,804	-15%	5,370	20%	5,034	4,279	6,041
41	Copco 1	2.059	Copco 1 Dam Removal	Remove & Dispose of Transmission Line No. 3	1.66	MI	31,411.84	52,144	44,322	-15%	65,180	25%	58,655	49,856	73,318
41	Copco 1	2.060	Copco 1 Dam Removal	Remove & Dispose of Transmission Line No. 15	1.23	MI	33,971.31	41,785	35,517	-15%	52,231	25%	47,002	39,952	58,753
41	Copco 1	2.061	Copco 1 Dam Removal	Remove & Dispose of Transmission Line No. 26-1	0.07	MI	33,525.16	2,347	1,995	-15%	2,933	25%	2,640	2,244	3,300
41	Copco 1	2.062	Copco 1 Dam Removal	Remove & Dispose of Transmission Line No. 26-2	0.07	MI	33,525.16	2,347	1,995	-15%	2,933	25%	2,640	2,244	3,300
41	Copco 1	2.063	Copco 1 Dam Removal	Remove gate house #1 from top of dam	720	SF	72.06	-	44,098	0%	64,850	0%	-	-	-
41	Copco 1	2.064	Copco 1 Dam Removal	Remove gate house #2 from top of dam	690	SF	74.35	-	43,607	0%	64,128	0%	-	-	-
41	Copco 1	2.065	Copco 1 Dam Removal	Remove Concrete Items associated with 10 ft. diam.	1,050	CY	300.38	-	268,089	0%	394,248	0%	-	-	-
41	Copco 1	2.066	Copco 1 Dam Removal	Plug 14-foot diameter penstock with concrete	23.00	CY	3,373.31	-	69,828	0%	89,224	0%	-	-	-
41	Copco 1	2.067	Copco 1 Dam Removal	Remove & Dispose of 8 screens	18,000	LB	1.17	-	18,913	0%	25,217	0%	-	-	-
41	Copco 1	2.068	Copco 1 Dam Removal	Remove & Dispose of 8 Water Gates	18,000	LB	1.10	-	17,822	0%	23,762	0%	-	-	-
41	Copco 1	2.069	Copco 1 Dam Removal	Remove & Dispose of 3 - 30" Dia. x 25' stand pipes	6,000	LB	0.91	-	4,912	0%	6,550	0%	-	-	-
41	Copco 1	2.070	Copco 1 Dam Removal	Remove & Dispose of 14' Dia. penstock pipe	256,000	LB	1.31	-	284,926	0%	419,009	0%	-	-	-
41	Copco 1	2.071	Copco 1 Dam Removal	Remove & Dispose of 10' Dia. penstock pipe	270,000	LB	1.37	-	315,225	0%	463,566	0%	-	-	-
41	Copco 1	2.081	Copco 1 Dam Removal	Site work - Clear and Grub Disposal Area	4.00	AC	13,732.22	54,929	36,685	-15%	51,790	20%	61,788	41,265	58,257
41	Copco 1	2.082	Copco 1 Dam Removal	Site work - Soil Cover for Disposal Area	12,000	CY	6.84	82,107	55	-15%	77	20%	92,359	61	87
41	Copco 1	2.089	Copco 1 Dam Removal	Mallard Cove - Concrete total	106	CY	338.09	35,838	30,462	-15%	41,214	15%	40,313	34,266	46,360
41	Copco 1	2.09	Copco 1 Dam Removal	Mallard Cove - 25'x5' Dock made of composite decking and	1.00	EA	3,009.15	3,009	2,558	-15%	3,461	15%	3,385	2,877	3,893
41	Copco 1	2.091	Copco 1 Dam Removal	Mallard Cove - 20'x5' Gangway w/ aluminum grate and	1.00	EA	2,758.50	2,758	2,345	-15%	3,172	15%	3,103	2,637	3,568
41	Copco 1	2.092	Copco 1 Dam Removal	Mallard Cove - Signs to be removed and hauled away	6.00	EA	152.39	914	823	-10%	1,006	10%	1,029	926	1,131
41	Copco 1	2.093	Copco 1 Dam Removal	Mallard Cove - Wood plank tables to be removed and hauled	8.00	EA	114.29	914	823	-10%	1,006	10%	1,029	926	1,131
41	Copco 1	2.094	Copco 1 Dam Removal	Mallard Cove - Parking area to be regraded	2.50	AC	7,451.08	18,628	16,765	-10%	21,422	15%	20,954	18,858	24,097
41	Copco 1	2.095	Copco 1 Dam Removal	Copco Cove - Concrete Total	84.00	CY	331.83	27,874	23,693	-15%	32,055	15%	31,354	26,651	36,058
41	Copco 1	2.096	Copco 1 Dam Removal	Copco Cove - Dock abutment railing made of 2.5" dia. steel	1.00	EA	1,446.70	1,447	1,302	-10%	1,591	10%	1,627	1,465	1,790
41	Copco 1	2.097	Copco 1 Dam Removal	Copco Cove - Signs to be removed and hauled away	6.00	EA	407.82	2,447	2,202	-10%	2,692	10%	2,752	2,477	3,028
41	Copco 1	2.098	Copco 1 Dam Removal	Copco Cove - Wood plank tables to be removed and hauled	2.00	EA	152.39	305	274	-10%	335	10%	343	309	377
41	Copco 1	2.099	Copco 1 Dam Removal	Copco Cove - Regrade	2.30	AC	6,531.70	15,023	13,521	-10%	17,276	15%	16,899	15,209	19,434
41	Copco 1	2.100	Copco 1 Dam Removal	Diversion Tunnel Lining	1.00	LS	244,844.33	244,844	220,360	-10%	281,571	15%	275,417	247,875	316,729
41	Copco 1	5.006	Copco 1 Dam Removal	Remove Frame Dead End Structures 60-80ft High @ Switch	4.00	EA	6,436.15	25,745	21,883	-15%	33,468	30%	28,959	24,615	37,647
41	Copco 1	5.007	Copco 1 Dam Removal	Remove Power Circuit Breakers 69KV @ Switch Yard	2.00	EA	5,681.20	11,362	10,226	-10%	14,203	25%	12,781	11,503	15,976
41	Copco 1	5.008	Copco 1 Dam Removal	Remove Disconnect Switches @ Switch Yard	4.00	EA	9,731.40	38,926	35,033	-10%	48,657	25%	43,786	39,407	54,733
41	Copco 1	5.009	Copco 1 Dam Removal	Remove All Associated AUX Equipment @ Switch Yard	1.00	LS	48,501.71	48,502	43,652	-10%	60,627	25%	54,558	49,102	68,197
41	Copco 1	5.010	Copco 1 Dam Removal	Remove Distribution Lines 69 KV Copco 1 Switch Yard and	6.00	EA	1,402.44	8,415	7,573	-10%	10,518	25%	9,465	8,519	11,832
41	Copco 1	5.011	Copco 1 Dam Removal	Remove Distribution Poles 2.4 KV Btw Copco 1/ HE Plant/	8.00	EA	1,950.45	15,604	14,043	-10%	19,505	25%	17,552	15,797	21,940
41	Copco 1	5.012	Copco 1 Dam Removal	Remove Production Poles in General Area of Copco 1	7.00	EA	1,956.86	13,698	11,643	-15%	17,807	30%	15,408	13,097	20,031
41	Copco 1	5.013	Copco 1 Dam Removal	Remove Village House Distribution Poles Near Dam (Est 10	10.00	EA	1,293.71	12,937	10,997	-15%	16,818	30%	14,552	12,370	18,918
41	Copco 1	5.014	Copco 1 Dam Removal	Remove 69 KV Distribution Line 1.6 Miles (30 Poles)	30.00	EA	2,096.19	62,886	53,453	-15%	81,751	30%	70,738	60,127	91,959
41	Copco 1	5.015	Copco 1 Dam Removal	Remove Transmission Conductors on Poles 1X/001 and	2.00	EA	2,686.44	5,373	4,567	-15%	6,985	30%	6,044	5,137	7,857
41	Copco 1	5.016	Copco 1 Dam Removal	Remove Transmission Conductors 1.3 Miles Copco 1 to	6,864	LF	7.16	49,138	41,767	-15%	63,880	30%	55,274	46,983	71,856
41	Copco 2	3.001	Copco 2 Dam Removal	Construct and Remove Embankment Cofferdam-Right Side of	3,100	CY	59.70	185,071	148,057	-20%	259,100	40%	208,180	166,544	291,452
41	Copco 2	3.002	Copco 2 Dam Removal	Furnish, Install, and Remove RipRap	465	CY	129.88	60,392	48,314	-20%	84,549	40%	67,933	54,347	95,106
41	Copco 2	3.003	Copco 2 Dam Removal	Provide Dewatering behind Cofferdams	1.00	LS	143,210.99	143,211	128,890	-10%	186,174	30%	161,093	144,984	209,421
41	Copco 2	3.004	Copco 2 Dam Removal	Remove Water from behind Cofferdams	241,000	GAL	0.02	5,834	5,251	-10%	7,584	30%	6,563	5,906	8,531
41	Copco 2	3.005	Copco 2 Dam Removal	Construct and Remove Embankment Cofferdam-Left Side of	1,100	CY	172.54	189,793	147,837	-22%	258,715	36%	213,491	166,297	291,019
41	Copco 2	3.006	Copco 2 Dam Removal	Furnish, Install, and Remove RipRap	250	CY	185.94	46,486	37,189	-20%	65,080	40%	52,290	41,832	73,207
41	Copco 2	3.007	Copco 2 Dam Removal	Provide Dewatering behind left Side Cofferdam	1.00	LS	79,612.67	79,613	71,651	-10%	103,496	30%	89,553	80,598	116,419
41	Copco 2	3.008	Copco 2 Dam Removal	Remove Water from behind Cofferdams	36,000	GAL	0.15	5,352	4,817	-10%	6,958	30%	6,021	5,418	7,827
41	Copco 2	3.009	Copco 2 Dam Removal	Remove Water from behind Tailrace Cofferdam	400,000	GAL	0.03	-	9,258	0%	13,373	0%	-	-	-
41	Copco 2	3.010	Copco 2 Dam Removal	Provide Dewatering behind Tailrace Cofferdam	1.00	LS	49,938.86	-	44,945	0%	64,921	0%	-	-	-
41	Copco 2	3.011	Copco 2 Dam Removal	Construct Embankment Cofferdam across Tailrace	1,700	CY	115.34	-	156,862	0%	274,508	0%	-	-	-
41	Copco 2	3.014	Copco 2 Dam Removal	Remove Concrete in Dam	4,430	CY	253.02	1,120,868	909,431	-15%	1,551,383	45%	1,260,824	1,022,987	1,745,095
41	Copco 2	3.015	Copco 2 Dam Removal	Remove concrete equipment slab from top of embankment	5.00	CY	353.89	1,769	1,504	-15%	2,300	30%	1,990	1,692	2,588
41	Copco 2	3.016	Copco 2 Dam Removal	Remove Concrete Wing wall	240	CY	217.45	52,187	44,359	-15%	67,843	30%	58,703	49,898	76,314
41	Copco 2	3.017	Copco 2 Dam Removal	Right Abutment Removal - Random Fill	1,510	CY	52.34	-	67,185	0%	98,801	0%	-	-	-
41	Copco 2	3.018	Copco 2 Dam Removal	Right Abutment Removal - Remove Hand Placed Riprap	5,400	SF	2.26	-	10,379	0%	15,264	0%	-	-	-
41	Copco 2	3.019	Copco 2 Dam Removal	Right Abutment Removal - Gunite Curtain Wall	180	CY	333.73	-	51,060	0%	75,089	0%	-	-	-
41	Copco 2	3.020	Copco 2 Dam Removal	Remove & Dispose - Hand rails and Light Poles	5,000	LB	0.84	4,183	3,556	-15%	5,020	20%	4,706	4,000	5,647
41	Copco 2	3.021	Copco 2 Dam Removal	Remove & Dispose - Radial Gates and Hoists	66,000	LB	0.81	53,452	45,434	-15%	72,160	35%	60,126	51,107	81,170
41	Copco 2	3.022	Copco 2 Dam Removal	Remove & Dispose - 5-Radial Gate Stop logs & Slots (steel)	95,800	LB	0.93	89,381	75,974	-15%	120,665	35%	100,542	85,461	135,732

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Copco 2	3.023	Copco 2 Dam Removal	Remove & Dispose - Spillway intake gate motor & control	1.00	EA	1,297.31	1,297	1,168	-10%	1,492	15%	1,459	1,313	1,678
41	Copco 2	3.024	Copco 2 Dam Removal	Remove & Dispose - Spillway radial gate motor & control	1.00	EA	1,297.31	1,297	1,168	-10%	1,492	15%	1,459	1,313	1,678
41	Copco 2	3.025	Copco 2 Dam Removal	Remove & Dispose - Spillway trash rake motor, festoon cable	1.00	EA	551.31	551	496	-10%	634	15%	620	558	713
41	Copco 2	3.026	Copco 2 Dam Removal	Remove & Dispose - Distribution equipment, panelboards	1.00	EA	5,877.55	5,878	5,290	-10%	6,759	15%	6,611	5,950	7,603
41	Copco 2	3.027	Copco 2 Dam Removal	Remove Copper Shingles from Roof of Powerhouse	7,000	SF	2.07	-	12,302	0%	16,644	0%	-	-	-
41	Copco 2	3.028	Copco 2 Dam Removal	Remove Powerhouse Concrete down to spring-line of turbine	1,110	CY	514.15	-	485,097	0%	827,518	0%	-	-	-
41	Copco 2	3.029	Copco 2 Dam Removal	Remove Structural Steel items associated with Powerhouse	220,000	LB	0.96	-	169,407	0%	296,463	0%	-	-	-
41	Copco 2	3.030	Copco 2 Dam Removal	Remove Control House Concrete	30.00	CY	317.78	9,533	7,627	-20%	12,870	35%	10,724	8,579	14,477
41	Copco 2	3.031	Copco 2 Dam Removal	Remove Control House Structural Steel Items	3,500	LB	0.88	3,088	2,471	-20%	4,324	40%	3,474	2,779	4,864
41	Copco 2	3.032	Copco 2 Dam Removal	Remove Shop Building	4,300	SF	69.45	-	238,898	0%	388,210	0%	-	-	-
41	Copco 2	3.033	Copco 2 Dam Removal	Remove & Dispose - 2 - Governor oil systems	38,000	LB	1.06	-	34,345	0%	50,507	0%	-	-	-
41	Copco 2	3.034	Copco 2 Dam Removal	Remove & Dispose - Cooling water and bearing oil systems	13,300	LB	0.93	-	10,552	0%	15,518	0%	-	-	-
41	Copco 2	3.035	Copco 2 Dam Removal	Remove & Dispose - Oil / Water separator tank and piping	2,700	LB	0.93	-	2,142	0%	3,149	0%	-	-	-
41	Copco 2	3.036	Copco 2 Dam Removal	Remove & Dispose - 12 - Cast Iron Columns	54,000	LB	0.83	-	35,754	0%	53,631	0%	-	-	-
41	Copco 2	3.037	Copco 2 Dam Removal	Remove & Dispose - 2 - Francis Turbines	660,000	LB	0.83	-	438,002	0%	711,753	0%	-	-	-
41	Copco 2	3.038	Copco 2 Dam Removal	Remove & Dispose - 2 - 40 Ton indoor cranes	140,000	LB	1.17	-	130,617	0%	212,253	0%	-	-	-
41	Copco 2	3.039	Copco 2 Dam Removal	Remove & Dispose - Compressed Air Systems	1,000	LB	1.13	-	960	0%	1,411	0%	-	-	-
41	Copco 2	3.040	Copco 2 Dam Removal	Remove & Dispose - 2 - CO2 Systems	2,100	LB	1.23	-	2,187	0%	3,216	0%	-	-	-
41	Copco 2	3.041	Copco 2 Dam Removal	Remove & Dispose - Plant Water and Fire Protection	3,100	LB	1.41	-	3,717	0%	5,466	0%	-	-	-
41	Copco 2	3.042	Copco 2 Dam Removal	Remove & Dispose - Transformer Oil Fire Protection	6,500	LB	0.87	-	4,788	0%	7,042	0%	-	-	-
41	Copco 2	3.043	Copco 2 Dam Removal	Remove & Dispose - Unwatering Piping	32,000	LB	0.75	-	20,499	0%	30,145	0%	-	-	-
41	Copco 2	3.044	Copco 2 Dam Removal	Remove & Dispose - Drainage Piping	10,000	LB	1.39	-	11,795	0%	17,346	0%	-	-	-
41	Copco 2	3.044a	Copco 2 Dam Removal	Remove & Dispose - Petroleum Products from Mechanical	3,300	GAL	4.54	14,972	13,475	-10%	17,217	15%	16,841	15,157	19,367
41	Copco 2	3.044b	Copco 2 Dam Removal	Remove & Dispose - Remove Petroleum Products at or near	3,300	GAL	4.54	14,972	13,475	-10%	17,217	15%	16,841	15,157	19,367
41	Copco 2	3.045	Copco 2 Dam Removal	Remove & Dispose - AC Generator, Indoor Vertical	2.00	EA	82,295.42	-	148,132	0%	189,279	0%	-	-	-
41	Copco 2	3.046	Copco 2 Dam Removal	Remove & Dispose - Excitation equipment for 15 MVA	2.00	EA	8,173.98	-	14,713	0%	18,800	0%	-	-	-
41	Copco 2	3.047	Copco 2 Dam Removal	Remove & Dispose - Surge protection equip. for 15 MVA	2.00	EA	2,582.65	-	4,649	0%	5,940	0%	-	-	-
41	Copco 2	3.048	Copco 2 Dam Removal	Remove & Dispose - Neutral grounding equip. for 15 MVA	2.00	EA	2,514.72	-	4,526	0%	5,784	0%	-	-	-
41	Copco 2	3.049	Copco 2 Dam Removal	Remove & Dispose - Generator Switchgear, 7.2kV-includes	1.00	EA	27,340.22	-	24,606	0%	31,441	0%	-	-	-
41	Copco 2	3.050	Copco 2 Dam Removal	Remove & Dispose - Station Service Switchgear, 600-volt (5	1.00	EA	24,083.60	-	21,675	0%	27,696	0%	-	-	-
41	Copco 2	3.051	Copco 2 Dam Removal	Remove & Dispose - Unit and plant control switchboard	1.00	EA	7,551.93	-	6,797	0%	8,685	0%	-	-	-
41	Copco 2	3.052	Copco 2 Dam Removal	Remove & Dispose - Battery system	1.00	EA	10,473.21	-	9,426	0%	12,044	0%	-	-	-
41	Copco 2	3.053	Copco 2 Dam Removal	Remove & Dispose - Raceways, Conduit and Cable	1.00	EA	15,384.27	-	13,846	0%	17,692	0%	-	-	-
41	Copco 2	3.054	Copco 2 Dam Removal	Remove & Dispose - Misc. Power & Control Boards	1.00	EA	5,724.44	-	5,152	0%	6,583	0%	-	-	-
41	Copco 2	3.055	Copco 2 Dam Removal	Remove & Dispose - 7 - 40-Ton Travelling Crane motors-hoist	1.00	EA	3,548.91	-	3,194	0%	4,259	0%	-	-	-
41	Copco 2	3.056	Copco 2 Dam Removal	Remove & Dispose - 40-Ton Travelling Crane control	1.00	EA	11,203.08	-	10,083	0%	13,444	0%	-	-	-
41	Copco 2	3.057	Copco 2 Dam Removal	Remove & Dispose - 40-Ton Travelling Crane Festoon Cable	1.00	EA	2,557.66	-	2,302	0%	3,069	0%	-	-	-
41	Copco 2	3.058a	Copco 2 Dam Removal	Remove Oil from Oil-Filled Step-up Transformers	23,000	GAL	10.59	243,653	207,105	-15%	280,201	15%	274,077	232,965	315,188
41	Copco 2	3.061	Copco 2 Dam Removal	Remove Intake Structure Concrete	1,650	CY	299.68	-	420,307	0%	741,718	0%	-	-	-
41	Copco 2	3.062	Copco 2 Dam Removal	Remove Concrete Items associated with 16-foot I.D. Wood	1,310	CY	299.39	-	333,367	0%	568,685	0%	-	-	-
41	Copco 2	3.063	Copco 2 Dam Removal	Place Concrete Plugs for Tunnels	100	CY	1,827.07	182,707	99,392	-15%	152,012	30%	205,521	111,803	170,993
41	Copco 2	3.064	Copco 2 Dam Removal	Remove Concrete Items associated with Penstocks D/S from	3,500	CY	298.85	-	836,779	0%	1,359,765	0%	-	-	-
41	Copco 2	3.065	Copco 2 Dam Removal	Remove & Dispose of Caterpillar Gate (steel)	50,000	LB	0.92	-	38,993	0%	52,755	0%	-	-	-
41	Copco 2	3.066	Copco 2 Dam Removal	Remove & Dispose of Trash rack and trash rake (steel)	86,000	LB	0.63	-	46,219	0%	70,687	0%	-	-	-
41	Copco 2	3.067	Copco 2 Dam Removal	Remove & Dispose of Stop Logs and slots for intake (steel)	220,000	LB	0.78	-	145,176	0%	222,034	0%	-	-	-
41	Copco 2	3.068	Copco 2 Dam Removal	Remove & Dispose of Wood Staves Soaked in Creosote	1,100,000	LB	0.93	1,021,716	715,201	-30%	1,328,231	30%	1,149,292	804,504	1,494,079
41	Copco 2	3.069	Copco 2 Dam Removal	Remove & Dispose of Cradles (steel)	290,000	LB	0.94	273,748	191,623	-30%	355,872	30%	307,929	215,550	400,308
41	Copco 2	3.070	Copco 2 Dam Removal	Remove & Dispose of Bands (steel)	463,000	LB	0.92	426,777	298,744	-30%	554,811	30%	480,067	336,047	624,086
41	Copco 2	3.071	Copco 2 Dam Removal	Remove & Dispose of Penstock after bifurcation to butterfly	860,000	LB	1.08	-	647,928	0%	1,203,295	0%	-	-	-
41	Copco 2	3.072	Copco 2 Dam Removal	Remove & Dispose of Bifurcated vent pipes and support	19,500	LB	1.13	-	15,423	0%	28,643	0%	-	-	-
41	Copco 2	3.073	Copco 2 Dam Removal	Remove & Dispose of 2 - 138" Butterfly Valves	148,000	LB	0.88	-	90,934	0%	168,878	0%	-	-	-
41	Copco 2	5.017	Copco 2 Dam Removal	Disconnect and Remove Medium Voltage Circuit Breakers	2.00	EA	678.35	1,357	1,153	-15%	1,899	40%	1,526	1,297	2,137
41	Copco 2	5.018	Copco 2 Dam Removal	Disconnect and Remove Medium Voltage Circuit Breakers	5.00	LB	590.84	2,954	2,511	-15%	4,136	40%	3,323	2,825	4,652
41	Copco 2	5.019	Copco 2 Dam Removal	Disconnect and Remove Transformers 12KV @ substation	1.00	EA	816.83	817	694	-15%	1,144	40%	919	781	1,286
41	Copco 2	5.020	Copco 2 Dam Removal	Disconnect and Remove cable connection between Copco 2	0.10	MI	94,661.96	9,466	8,046	-15%	13,253	40%	10,648	9,051	14,907
41	Copco 2	5.021	Copco 2 Dam Removal	Remove All associated Aux Equipment @ substation	1.00	LS	24,184.84	24,185	20,557	-15%	33,859	40%	27,205	23,124	38,087
41	Copco 2	5.022	Copco 2 Dam Removal	Demolish overhead transmission line and structure 69KV	5.00	MI	118,983.58	594,918	505,680	-15%	832,885	40%	669,202	568,821	936,882
41	Copco 2	5.023	Copco 2 Dam Removal	Demolish transmission conductor from existing structure pole.	1.50	MI	7,073.23	10,610	9,018	-15%	14,854	40%	11,935	10,144	16,708
41	Copco 2	5.024	Copco 2 Dam Removal	Remove structures between pole 2/007 and Iron Gate	6.00	EA	3,754.31	22,526	20,273	-10%	31,536	40%	25,339	22,805	35,474
41	Iron Gate	4.001	Iron Gate Dam Removal	Furnish, Install, and Remove Barge-Mounted Crane in	1.00	LS	191,823.14	191,823	172,641	-10%	220,597	15%	215,775	194,197	248,141
41	Iron Gate	4.002	Iron Gate Dam Removal	Furnish, Install, and Remove Temporary Air Vent Hose from	50.00	EA	315.45	-	13,407	0%	18,927	0%	-	-	-
41	Iron Gate	4.003	Iron Gate Dam Removal	Remove Reinforced Concrete Ring Located D/S of Closure	46.00	CY	1,012.49	46,575	39,589	-15%	58,218	25%	52,390	44,532	65,488
41	Iron Gate	4.004	Iron Gate Dam Removal	Remove Reinforced Concrete Stoplog Structure	6.00	CY	1,738.55	10,431	9,388	-10%	11,996	15%	11,734	10,560	13,494
41	Iron Gate	4.005	Iron Gate Dam Removal	Remove Water from behind Tailrace Cofferdam	300,000	GAL	0.01	-	2,662	0%	3,602	0%	-	-	-
41	Iron Gate	4.006	Iron Gate Dam Removal	Provide Dewatering behind Tailrace Cofferdam for removal of	1.00	LS	29,462.94	-	25,044	0%	33,882	0%	-	-	-
41	Iron Gate	4.007	Iron Gate Dam Removal	Construct Embankment Cofferdam across Tailrace to remove	1,650	CY	112.09	-	166,451	0%	212,687	0%	-	-	-
41	Iron Gate	4.010	Iron Gate Dam Removal	Upstream Cofferdam to be Removed in the Wet	20,000	CY	14.70	294,012	249,910	-15%	338,114	15%	330,723	281,115	380,332

KRRC Cost Estimate - Partial Removal June 2018

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Iron Gate	4.011	Iron Gate Dam Removal	Remove 9' dia. hinged blind flange	19,000	LB	6.49	123,371	104,866	-15%	148,046	20%	138,776	117,960	166,531
41	Iron Gate	4.012	Iron Gate Dam Removal	Remove 18" plug valve and 7' of 18" drainage pipe	2,620	LB	2.70	7,061	6,002	-15%	8,473	20%	7,943	6,751	9,531
41	Iron Gate	4.013.1	Iron Gate Dam Removal	Furnish and Install 1-16.5'x18' roller gate, stem, and operator	110,000	LB	34.16	3,757,547	3,381,793	-10%	4,133,302	10%	4,226,730	3,804,057	4,649,403
41	Iron Gate	4.013.2	Iron Gate Dam Removal	Remove Existing sluice and diversion gates from shaft by	110,000	LB	4.38	482,328	434,095	-10%	530,561	10%	542,554	488,298	596,809
41	Iron Gate	4.013.3	Iron Gate Dam Removal	Remove 16.5'X 18' sluice and diversion gates from shaft in	110,000	LB	0.58	64,216	57,794	-10%	70,637	10%	72,234	65,011	79,457
41	Iron Gate	4.014	Iron Gate Dam Removal	Remove Concrete in Observation Platform, Crest Wall and	780	CY	298.81	233,072	209,765	-10%	256,379	10%	262,174	235,957	288,392
41	Iron Gate	4.015	Iron Gate Dam Removal	Remove Concrete in Diversion Tunnel Intake Structure	715	CY	300.06	214,542	193,088	-10%	246,723	15%	241,330	217,197	277,530
41	Iron Gate	4.016	Iron Gate Dam Removal	Remove Concrete in Diversion Tunnel Gate Tower	650	CY	196.63	127,809	108,637	-15%	146,980	15%	143,767	122,202	165,333
41	Iron Gate	4.017	Iron Gate Dam Removal	Remove Steel Footbridge to Gate Tower	13,000	LB	1.10	14,259	12,120	-15%	16,398	15%	16,039	13,633	18,445
41	Iron Gate	4.018	Iron Gate Dam Removal	Remove Concrete in Diversion Tunnel Footbridge Abutment	39.00	CY	197.94	7,720	6,562	-15%	8,878	15%	8,684	7,381	9,986
41	Iron Gate	4.019	Iron Gate Dam Removal	Place Concrete Plugs for Diversion Tunnel	43.00	CY	1,672.11	71,901	64,711	-10%	79,091	10%	80,879	72,791	88,966
41	Iron Gate	4.020	Iron Gate Dam Removal	Remove Concrete Closure Gates in Gate Tower	85.00	CY	894.09	75,998	64,598	-15%	87,397	15%	85,487	72,664	98,310
41	Iron Gate	4.021	Iron Gate Dam Removal	Remove Upstream Riprap	92,400	CY	21.05	1,944,680	1,652,978	-15%	2,333,616	20%	2,187,500	1,859,375	2,625,000
41	Iron Gate	4.022	Iron Gate Dam Removal	Remove Downstream Riprap	23,400	CY	15.64	365,879	310,997	-15%	439,054	20%	411,564	349,829	493,876
41	Iron Gate	4.023	Iron Gate Dam Removal	Miscellaneous Excavation	270,000	CY	6.72	1,815,450	1,543,132	-15%	2,178,539	20%	2,042,134	1,735,814	2,450,561
41	Iron Gate	4.023.1	Iron Gate Dam Removal	Miscellaneous Excavation	761,159	CY	15.55	11,836,796	10,061,276	-15%	14,204,155	20%	13,314,785	11,317,568	15,977,742
41	Iron Gate	4.024	Iron Gate Dam Removal	Cutoff Wall Concrete Demolition	2,440	CY	112.84	275,336	247,803	-10%	316,637	15%	309,716	278,744	356,173
41	Iron Gate	4.025	Iron Gate Dam Removal	Earth Fill Crest Raise	13,000	CY	15.68	203,841	173,265	-15%	234,417	15%	229,293	194,899	263,687
41	Iron Gate	4.026	Iron Gate Dam Removal	Sheet pile Crest Raise	800	LF	281.18	224,946	191,204	-15%	258,688	15%	253,034	215,079	290,989
41	Iron Gate	4.027	Iron Gate Dam Removal	Remove 5 Monitoring Wells	5.00	EA	2,332.81	11,664	10,498	-10%	13,414	15%	13,120	11,808	15,089
41	Iron Gate	4.028	Iron Gate Dam Removal	Remove and Dispose of Trash Sluice Gate - 10 ft x 9 ft H	4,500	LB	1.01	4,544	3,408	-25%	5,680	25%	5,112	3,834	6,390
41	Iron Gate	4.029	Iron Gate Dam Removal	Remove and Dispose of Intake Structure	72,000	LB	0.90	64,663	54,964	-15%	77,596	20%	72,738	61,827	87,285
41	Iron Gate	4.030	Iron Gate Dam Removal	Remove and Dispose of Sluice and Diversion Tunnel Gate	28,000	LB	1.09	30,649	26,052	-15%	36,779	20%	34,476	29,304	41,371
41	Iron Gate	4.031	Iron Gate Dam Removal	Remove and Dispose of Hoist Stem - 6" Dia. Sch 160x150'	7,500	LB	1.01	7,578	6,441	-15%	9,093	20%	8,524	7,245	10,229
41	Iron Gate	4.032	Iron Gate Dam Removal	Remove and Dispose of Air Vent Pipe - 8" Dia. Sch 40 x160'	4,650	LB	2.12	9,855	8,377	-15%	11,826	20%	11,085	9,423	13,303
41	Iron Gate	4.034	Iron Gate Dam Removal	Remove and Dispose of Air Vent Pipe - 12" Dia. Sch 40 x560'	30,250	LB	2.26	68,353	58,100	-15%	82,024	20%	76,888	65,355	92,266
41	Iron Gate	4.035	Iron Gate Dam Removal	Remove and Dispose of Outlet Works Stop Logs	2,670	LB	1.01	2,696	2,022	-25%	3,370	25%	3,033	2,275	3,791
41	Iron Gate	4.036	Iron Gate Dam Removal	Remove and Dispose of Hydraulic Pump Motor (10 HP est) &	1.00	EA	415.82	416	312	-25%	520	25%	468	351	585
41	Iron Gate	4.037	Iron Gate Dam Removal	Remove and Dispose of Distribution Equipment, Junction	1.00	EA	2,019.67	2,020	1,515	-25%	2,525	25%	2,272	1,704	2,840
41	Iron Gate	4.038	Iron Gate Dam Removal	Remove and Dispose of Power Cable and 4" Conduit from	800	FT	49.86	39,887	33,904	-15%	45,870	15%	44,867	38,137	51,598
41	Iron Gate	4.039	Iron Gate Dam Removal	Remove Powerhouse Concrete	5,200	CY	402.36	-	1,883,040	0%	2,406,107	0%	-	-	-
41	Iron Gate	4.040	Iron Gate Dam Removal	Remove and Dispose of Turbine Unit	344,058	LB	0.95	-	278,446	0%	376,721	0%	-	-	-
41	Iron Gate	4.041	Iron Gate Dam Removal	Remove and Dispose of Draft Tube Bulkheads	16,500	LB	0.98	-	13,800	0%	19,482	0%	-	-	-
41	Iron Gate	4.042	Iron Gate Dam Removal	Remove and Dispose of Crane	24,000	LB	1.07	-	21,776	0%	32,023	0%	-	-	-
41	Iron Gate	4.043	Iron Gate Dam Removal	Remove and Dispose of Governor	20,310	LB	1.04	-	17,878	0%	25,240	0%	-	-	-
41	Iron Gate	4.044	Iron Gate Dam Removal	Remove and Dispose of Bearing Oil System and Cooling	9,182	LB	1.06	-	8,297	0%	11,713	0%	-	-	-
41	Iron Gate	4.045	Iron Gate Dam Removal	Remove and Dispose of CO2 Systems	2,568	LB	1.01	-	2,343	0%	3,124	0%	-	-	-
41	Iron Gate	4.046	Iron Gate Dam Removal	Remove and Dispose of Plant Water and Fire Protection	9,182	LB	1.05	-	8,636	0%	11,515	0%	-	-	-
41	Iron Gate	4.047	Iron Gate Dam Removal	Remove and Dispose of Sump Pumps	2,000	LB	1.05	-	1,883	0%	2,510	0%	-	-	-
41	Iron Gate	4.048	Iron Gate Dam Removal	Remove and Dispose of Pumps	22,000	LB	1.09	-	21,676	0%	28,901	0%	-	-	-
41	Iron Gate	4.049	Iron Gate Dam Removal	Remove and Dispose of Exposed Piping Around the Plant	19,291	LB	1.05	-	18,257	0%	24,342	0%	-	-	-
41	Iron Gate	4.050	Iron Gate Dam Removal	Remove and Dispose of Unwatering Piping	19,291	LB	0.88	-	15,270	0%	19,512	0%	-	-	-
41	Iron Gate	4.051	Iron Gate Dam Removal	Remove and Dispose of Drainage Piping	9,518	LB	1.12	-	9,591	0%	12,256	0%	-	-	-
41	Iron Gate	4.052	Iron Gate Dam Removal	Remove and Dispose of Transformer Oil and Fire Protection	9,182	LB	1.00	-	8,739	0%	10,119	0%	-	-	-
41	Iron Gate	4.053	Iron Gate Dam Removal	Remove and Dispose of Compressed Air System	1,450	LB	0.91	-	1,182	0%	1,510	0%	-	-	-
41	Iron Gate	4.053a	Iron Gate Dam Removal	Remove & Dispose - Petroleum Products from Mechanical	1,100	GAL	10.05	11,057	10,504	-5%	12,163	10%	12,438	11,816	13,681
41	Iron Gate	4.054	Iron Gate Dam Removal	Remove and Dispose of AC Generator, Outdoor Horizontal	1.00	EA	91,158.88	-	82,043	0%	104,833	0%	-	-	-
41	Iron Gate	4.055	Iron Gate Dam Removal	Remove and Dispose of Excitation equipment for 18.975 MVA	1.00	EA	2,384.74	-	2,146	0%	2,742	0%	-	-	-
41	Iron Gate	4.056	Iron Gate Dam Removal	Remove and Dispose of Surge protection equip. for 18.975	1.00	EA	1,891.05	-	1,702	0%	2,175	0%	-	-	-
41	Iron Gate	4.057	Iron Gate Dam Removal	Remove and Dispose of Neutral grounding equip. for 18.975	1.00	EA	3,980.33	-	3,582	0%	4,577	0%	-	-	-
41	Iron Gate	4.058	Iron Gate Dam Removal	Remove and Dispose of Station Service Switchgear, 600 volt -	1.00	EA	7,378.96	-	6,641	0%	8,486	0%	-	-	-
41	Iron Gate	4.059	Iron Gate Dam Removal	Remove and Dispose of Unit and plant control switchboard	1.00	EA	23,948.92	-	21,554	0%	27,541	0%	-	-	-
41	Iron Gate	4.060	Iron Gate Dam Removal	Remove and Dispose of Battery System - assume 60	1.00	EA	15,350.22	15,350	13,815	-10%	17,653	15%	17,267	15,540	19,857
41	Iron Gate	4.061	Iron Gate Dam Removal	Remove and Dispose of Raceways, Bus, Conduit and Cable	1.00	EA	18,352.70	-	16,517	0%	21,106	0%	-	-	-
41	Iron Gate	4.062	Iron Gate Dam Removal	Remove and Dispose of Misc. power & control boards	1.00	EA	5,642.84	-	5,079	0%	6,489	0%	-	-	-
41	Iron Gate	4.063	Iron Gate Dam Removal	Remove and Dispose of Transformer (3 phase, 275 kVA,	1.00	EA	9,142.79	-	8,229	0%	10,514	0%	-	-	-
41	Iron Gate	4.064	Iron Gate Dam Removal	Remove and Dispose of Governor Oil Pump Motors (10 hp	2.00	EA	244.50	-	440	0%	562	0%	-	-	-
41	Iron Gate	4.065	Iron Gate Dam Removal	Remove and Dispose of Vertical Motors, outdoor, (480V, 100	4.00	EA	712.83	2,851	2,138	-25%	3,564	25%	3,207	2,405	4,009
41	Iron Gate	4.066	Iron Gate Dam Removal	Remove and Dispose of Transformer (3 phase, 300 kVA,	1.00	EA	10,482.18	10,482	9,434	-10%	12,055	15%	11,791	10,612	13,560
41	Iron Gate	4.067	Iron Gate Dam Removal	Remove and Dispose of Step-up Transformer, outdoor, oil-	1.00	EA	85,541.22	85,541	76,987	-10%	98,372	15%	96,222	86,600	110,656
41	Iron Gate	4.068	Iron Gate Dam Removal	Remove and Dispose of Lattice steel structure, with 69-kV	1.00	EA	6,973.83	6,974	6,276	-10%	8,020	15%	7,845	7,060	9,021
41	Iron Gate	4.069	Iron Gate Dam Removal	Remove and Dispose of Generator Switchgear, outdoor,	1.00	EA	24,487.62	24,488	22,039	-10%	28,161	15%	27,545	24,791	31,677
41	Iron Gate	4.070	Iron Gate Dam Removal	Remove and Dispose of Single Phase Pole Transformers (25	3.00	EA	2,514.24	7,543	6,788	-10%	8,674	15%	8,485	7,636	9,757
41	Iron Gate	4.071	Iron Gate Dam Removal	Remove Concrete in Penstock Intake Structure	460	CY	302.54	139,169	118,294	-15%	160,044	15%	156,546	133,064	180,028
41	Iron Gate	4.072	Iron Gate Dam Removal	Remove Concrete in Penstock Encasement	710	CY	300.16	213,116	191,805	-10%	245,084	15%	239,727	215,754	275,686
41	Iron Gate	4.073	Iron Gate Dam Removal	Remove Concrete in 3 Penstock Anchors and 7 Penstock	3,110	CY	298.85	929,437	790,022	-15%	1,068,853	15%	1,045,491	888,667	1,202,314
41	Iron Gate	4.074	Iron Gate Dam Removal	Remove Steel Footbridge to Intake Structure	11,000	LB	1.11	12,161	10,337	-15%	13,986	15%	13,680	11,628	15,732
41	Iron Gate	4.075	Iron Gate Dam Removal	Remove Concrete in Intake Structure Footbridge Abutment	5.00	CY	820.58	4,103	3,487	-15%	4,718	15%	4,615	3,923	5,307

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Iron Gate	4.076	Iron Gate Dam Removal	Remove and Dispose of Intake Structure	131,630	LB	1.04	136,401	115,941	-15%	156,862	15%	153,433	130,418	176,448
41	Iron Gate	4.077	Iron Gate Dam Removal	Remove and Dispose of Gate Hoist Stem - 6" Sch160x40'	1,800	LB	1.01	1,818	1,363	-25%	2,272	25%	2,045	1,534	2,556
41	Iron Gate	4.078	Iron Gate Dam Removal	Remove and Dispose of Water Fill line- 12" Dia STD x 27'	1,350	LB	1.01	1,363	1,022	-25%	1,704	25%	1,534	1,150	1,917
41	Iron Gate	4.079	Iron Gate Dam Removal	Remove and Dispose of Air Vent - 12" Dia STD x 32'	1,600	LB	1.01	1,616	1,212	-25%	2,020	25%	1,817	1,363	2,272
41	Iron Gate	4.080	Iron Gate Dam Removal	Remove and Dispose of Gage Wells	2,612	LB	1.01	2,638	1,978	-25%	3,297	25%	2,967	2,225	3,709
41	Iron Gate	4.081	Iron Gate Dam Removal	Remove and Dispose of Penstock Vent - 46" Dia, 0.25" Thick	7,440	LB	2.08	15,466	13,146	-15%	17,786	15%	17,398	14,788	20,007
41	Iron Gate	4.082	Iron Gate Dam Removal	Remove and Dispose of Penstock - 12" Dia, 0.25" Thick x	294,428	LB	1.47	433,061	368,102	-15%	498,020	15%	487,135	414,065	560,205
41	Iron Gate	4.083	Iron Gate Dam Removal	Remove and Dispose of Bypass Outlet - 96" Dia, 0.25" Thick	12,850	LB	0.90	11,547	9,815	-15%	13,279	15%	12,989	11,041	14,937
41	Iron Gate	4.084	Iron Gate Dam Removal	Remove and Dispose of Outlet Valve on bypass outlet - 66"	18,000	LB	1.62	29,193	24,814	-15%	33,572	15%	32,838	27,912	37,764
41	Iron Gate	4.085	Iron Gate Dam Removal	Remove and Dispose Overhead trolley Crane Motor (4hp est)	1.00	EA	1,188.04	1,188	891	-25%	1,485	25%	1,336	1,002	1,670
41	Iron Gate	4.086	Iron Gate Dam Removal	Remove and Dispose Distribution equipment, Junction Boxes	1.00	EA	2,970.11	2,970	2,228	-25%	3,713	25%	3,341	2,506	4,176
41	Iron Gate	4.087	Iron Gate Dam Removal	Remove and Dispose Power Cable and Conduit	1.00	EA	91,734.75	91,735	77,975	-15%	105,495	15%	103,189	87,711	118,667
41	Iron Gate	4.097	Iron Gate Dam Removal	Clear and Grub Disposal Area	29.00	AC	6,292.60	182,485	155,113	-15%	209,858	15%	205,271	174,481	236,062
41	Iron Gate	4.101	Iron Gate Dam Removal	Remove Building No. 2	800	SF	73.00	58,404	52,563	-10%	67,164	15%	65,696	59,127	75,551
41	Iron Gate	4.102	Iron Gate Dam Removal	Remove Building No. 3	1,088	SF	75.55	82,199	73,979	-10%	94,529	15%	92,463	83,217	106,332
41	Iron Gate	4.103	Iron Gate Dam Removal	Remove Concrete in Fish Ladder	1,240	CY	300.19	372,241	316,405	-15%	428,077	15%	418,721	355,913	481,529
41	Iron Gate	4.104	Iron Gate Dam Removal	Remove Concrete in Holding Ponds #1 thru #6	1,380	CY	196.04	270,529	243,476	-10%	311,109	15%	304,309	273,878	349,955
41	Iron Gate	4.105	Iron Gate Dam Removal	Remove Concrete in Fish Facility Items	1,200	CY	194.03	232,832	197,908	-15%	267,757	15%	261,905	222,619	301,191
41	Iron Gate	4.106	Iron Gate Dam Removal	Remove Miscellaneous Metalwork in Fish Facilities	12,000	LB	0.95	11,351	9,648	-15%	13,621	20%	12,768	10,853	15,322
41	Iron Gate	4.107	Iron Gate Dam Removal	Remove Concrete Associated with 30" Dia. water supply line	80.00	CY	194.03	15,522	13,194	-15%	17,850	15%	17,460	14,841	20,079
41	Iron Gate	4.108	Iron Gate Dam Removal	Remove Concrete in Aerator Structure	65.00	CY	191.23	12,430	10,565	-15%	14,294	15%	13,982	11,884	16,079
41	Iron Gate	4.109	Iron Gate Dam Removal	Remove Wood in Aerator Structure	6,000	LB	0.83	4,990	3,742	-25%	6,237	25%	5,613	4,210	7,016
41	Iron Gate	4.110	Iron Gate Dam Removal	Remove Structural Steel in Aerator Structure	2,500	LB	1.01	2,525	1,893	-25%	3,156	25%	2,840	2,130	3,550
41	Iron Gate	4.111	Iron Gate Dam Removal	Remove Asphalt Pavement	3,900	SF	6.54	25,489	21,665	-15%	29,312	15%	28,671	24,370	32,972
41	Iron Gate	4.112	Iron Gate Dam Removal	Remove Restroom Building near Aerator Structure	340	SF	60.38	20,528	18,475	-10%	23,607	15%	23,091	20,782	26,555
41	Iron Gate	4.113	Iron Gate Dam Removal	Remove Storage Shed near Aerator Structure	90.00	SF	70.22	6,320	5,688	-10%	7,268	15%	7,109	6,398	8,175
41	Iron Gate	4.114	Iron Gate Dam Removal	Remove Toe Drain Pipe	260	LF	27.00	7,021	5,968	-15%	8,074	15%	7,897	6,713	9,082
41	Iron Gate	4.115	Iron Gate Dam Removal	Remove Toe Drain Manhole	25.00	LF	59.40	1,485	1,114	-25%	1,856	25%	1,670	1,253	2,088
41	Iron Gate	4.116	Iron Gate Dam Removal	Berm Removal	53,000	CY	13.82	732,558	659,302	-10%	842,442	15%	824,028	741,625	947,633
41	Iron Gate	4.117	Iron Gate Dam Removal	Remove and Dispose of Intake Structures Trashracks	5,000	LB	0.89	4,455	3,341	-25%	5,569	25%	5,011	3,759	6,264
41	Iron Gate	4.118	Iron Gate Dam Removal	Remove and Dispose of Pipe Conduit, 30" Dia. x 0.25" Thick	76,640	LB	1.03	78,948	67,106	-15%	94,738	20%	88,806	75,485	106,567
41	Iron Gate	4.119	Iron Gate Dam Removal	Remove and Dispose of Sluice Gate Valve, 30" Dia.	3,000	LB	1.01	3,030	2,272	-25%	3,787	25%	3,408	2,556	4,260
41	Iron Gate	4.120	Iron Gate Dam Removal	Remove and Dispose of Sluice Gate Stem, 2" Dia.	360	LB	1.01	364	273	-25%	454	25%	409	307	511
41	Iron Gate	4.121	Iron Gate Dam Removal	Remove and Dispose of Butterfly Valve, 30" Dia.	2,435	LB	1.01	2,459	1,844	-25%	3,074	25%	2,766	2,074	3,457
41	Iron Gate	4.122	Iron Gate Dam Removal	Remove and Dispose of Piping- 30-in. Dia. x 0.25 Thickness	7,200	LB	0.60	4,332	3,682	-15%	5,198	20%	4,872	4,142	5,847
41	Iron Gate	4.123	Iron Gate Dam Removal	Remove and Dispose of Piping- 24-in. Dia. x 0.25 Thickness	15,872	LB	0.50	8,005	6,804	-15%	9,606	20%	9,004	7,654	10,805
41	Iron Gate	4.124	Iron Gate Dam Removal	Remove and Dispose of Piping- 20-in. Dia. x 0.25 Thickness	4,505	LB	0.58	2,599	2,209	-15%	3,119	20%	2,923	2,485	3,508
41	Iron Gate	4.125	Iron Gate Dam Removal	Remove and Dispose of Piping- 18-in. Dia. x 0.25 Thickness	29,088	LB	0.38	11,115	9,448	-15%	13,338	20%	12,503	10,627	15,003
41	Iron Gate	4.126	Iron Gate Dam Removal	Remove and Dispose of Piping- 16-in. Dia. x 0.25 Thickness	6,972	LB	0.56	3,898	3,314	-15%	4,678	20%	4,385	3,727	5,262
41	Iron Gate	4.127	Iron Gate Dam Removal	Remove and Dispose of Piping- 12-in. Dia. x 0.25 Thickness	2,176	LB	0.46	992	843	-15%	1,190	20%	1,116	948	1,339
41	Iron Gate	4.128	Iron Gate Dam Removal	Remove and Dispose of Piping- 10-in. Dia. x 0.25 Thickness	1,932	LB	0.45	864	734	-15%	1,036	20%	972	826	1,166
41	Iron Gate	4.129	Iron Gate Dam Removal	Remove and Dispose of Piping- 8-in. Dia. x 0.25 Thickness x	3,588	LB	0.23	818	695	-15%	982	20%	920	782	1,104
41	Iron Gate	4.130	Iron Gate Dam Removal	Remove and Dispose of Piping- 3-in. Dia. x STD x 30'	1,088	LB	0.38	412	350	-15%	494	20%	463	394	556
41	Iron Gate	4.131	Iron Gate Dam Removal	Remove and Dispose of Gate Valves	21,792	LB	0.98	21,312	18,116	-15%	25,575	20%	23,974	20,378	28,768
41	Iron Gate	4.132	Iron Gate Dam Removal	Remove and Dispose of Basin #1	2,880	LB	2.89	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.133	Iron Gate Dam Removal	Remove and Dispose of Basin #2	3,860	LB	2.16	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.134	Iron Gate Dam Removal	Remove and Dispose of Basin #3	2,880	LB	2.89	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.135	Iron Gate Dam Removal	Remove and Dispose of Basin #4	3,580	LB	2.33	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.136	Iron Gate Dam Removal	Remove and Dispose of Basin #5	1,440	LB	5.79	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.137	Iron Gate Dam Removal	Remove and Dispose of Basin #6	1,440	LB	5.79	8,336	7,086	-15%	10,003	20%	9,377	7,970	11,252
41	Iron Gate	4.138	Iron Gate Dam Removal	Remove and Dispose of Holding Tank	7,400	LB	1.53	11,355	9,652	-15%	13,627	20%	12,773	10,857	15,328
41	Iron Gate	4.139	Iron Gate Dam Removal	Remove and Dispose of Misc.: Motors, control panels, cables,	1.00	EA	1,782.06	1,782	1,337	-25%	2,228	25%	2,005	1,503	2,506
41	Iron Gate	4.140	Iron Gate Dam Removal	Wanaka Springs - Concrete Total	28.00	CY	306.28	8,576	7,290	-15%	9,862	15%	9,647	8,200	11,094
41	Iron Gate	4.141	Iron Gate Dam Removal	Wanaka Springs - Double Pipe Railings	60.00	LF	47.52	2,851	2,138	-25%	3,564	25%	3,207	2,405	4,009
41	Iron Gate	4.142	Iron Gate Dam Removal	Wanaka Springs - Wood picnic tables to be removed and	5.00	EA	118.80	594	446	-25%	743	25%	668	501	835
41	Iron Gate	4.143	Iron Gate Dam Removal	Wanaka Springs - 25'x5' Wooden floating dock	125	SF	23.76	2,970	2,228	-25%	3,713	25%	3,341	2,506	4,176
41	Iron Gate	4.144	Iron Gate Dam Removal	Wanaka Springs - Rip and reseed site and access road	2.50	AC	6,798.10	16,995	14,446	-15%	19,545	15%	19,117	16,250	21,985
41	Iron Gate	4.145	Iron Gate Dam Removal	Wanaka Springs - Signs to be removed and hauled away	3.00	EA	356.41	1,069	802	-25%	1,337	25%	1,203	902	1,503
41	Iron Gate	4.146	Iron Gate Dam Removal	Wanaka Springs - 15'x5' Gangplank with Railings	75.00	SF	23.76	1,782	1,337	-25%	2,228	25%	2,005	1,503	2,506
41	Iron Gate	4.147	Iron Gate Dam Removal	Juniper Point - Concrete Total	19.00	CY	359.74	6,835	5,810	-15%	7,860	15%	7,688	6,535	8,842
41	Iron Gate	4.148	Iron Gate Dam Removal	Juniper Point - 2, 4x4 Toilet Vaults	32.00	SF	118.80	3,802	2,851	-25%	4,752	25%	4,276	3,207	5,346
41	Iron Gate	4.149	Iron Gate Dam Removal	Juniper Point - Wood picnic tables to be removed and hauled	8.00	EA	118.80	950	713	-25%	1,188	25%	1,069	802	1,336
41	Iron Gate	4.150	Iron Gate Dam Removal	Juniper Point - Signs to be removed and hauled away	4.00	EA	356.41	1,426	1,069	-25%	1,782	25%	1,604	1,203	2,005
41	Iron Gate	4.151	Iron Gate Dam Removal	Juniper Point - Dock pile railing	50.00	LF	47.52	2,376	1,782	-25%	2,970	25%	2,673	2,005	3,341
41	Iron Gate	4.152	Iron Gate Dam Removal	Juniper Point - 50'x5' Composite dock with poly floats	250	SF	31.34	7,834	7,051	-10%	8,618	10%	8,812	7,931	9,694
41	Iron Gate	4.153	Iron Gate Dam Removal	Juniper Point - 20'x5' Composite gangplank with railings	100	SF	23.76	2,376	1,782	-25%	2,970	25%	2,673	2,005	3,341
41	Iron Gate	4.155	Iron Gate Dam Removal	Juniper Point - Regrade to Natural Contour, rip, and reseed	2.00	AC	10,546.17	21,092	17,928	-15%	24,256	15%	23,726	20,167	27,285
41	Iron Gate	4.156	Iron Gate Dam Removal	Camp Creek - Concrete Total	110	CY	306.56	33,722	28,664	-15%	38,780	15%	37,932	32,243	43,622

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
41	Iron Gate	4.157	Iron Gate Dam Removal	Camp Creek - 180'Lx16'Wx8'D Earth jetty to remove and/or	855	CY	73.54	62,876	53,445	-15%	72,307	15%	70,727	60,118	81,336
41	Iron Gate	4.158	Iron Gate Dam Removal	Camp Creek - Well house 10'x16' concrete block building	160	SF	72.74	11,638	10,475	-10%	12,802	10%	13,092	11,783	14,401
41	Iron Gate	4.159	Iron Gate Dam Removal	Camp Creek - 2, 20'x5' Composite decking gangplanks	200	SF	23.76	4,752	3,564	-25%	5,940	25%	5,346	4,009	6,682
41	Iron Gate	4.160	Iron Gate Dam Removal	Camp Creek - 2, 20'x5' Floating composite w/ aluminum	200	SF	23.76	4,752	3,564	-25%	5,940	25%	5,346	4,009	6,682
41	Iron Gate	4.161	Iron Gate Dam Removal	Camp Creek - Concrete block double toilet bldg 10'x16'	160	SF	72.74	11,638	10,475	-10%	12,802	10%	13,092	11,783	14,401
41	Iron Gate	4.162	Iron Gate Dam Removal	Camp Creek - Dump stations and approx. 2000 gal buried	1.00	EA	6,596.62	6,597	5,607	-15%	7,916	20%	7,420	6,307	8,904
41	Iron Gate	4.163	Iron Gate Dam Removal	Camp Creek - Power poles and lines	3.00	EA	1,818.16	5,454	4,636	-15%	6,545	20%	6,136	5,215	7,363
41	Iron Gate	4.164	Iron Gate Dam Removal	Camp Creek - Remove waterlines and 3 faucets and regrade	600	LF	5.94	3,564	2,673	-25%	4,455	25%	4,009	3,007	5,011
41	Iron Gate	4.166	Iron Gate Dam Removal	Camp Creek - Steel pipe/plank picnic tables to be removed	5.00	EA	118.80	594	446	-25%	743	25%	668	501	835
41	Iron Gate	4.167	Iron Gate Dam Removal	Camp Creek - Relocate concrete tables	12.00	EA	118.80	1,426	1,069	-25%	1,782	25%	1,604	1,203	2,005
41	Iron Gate	4.168	Iron Gate Dam Removal	Camp Creek - Regrade, rip, and reseed	4.00	AC	8,861.29	35,445	30,128	-15%	40,762	15%	39,871	33,890	45,852
41	Iron Gate	4.169	Iron Gate Dam Removal	Camp Creek - Signs to be removed and hauled away	7.00	EA	356.41	2,495	1,871	-25%	3,119	25%	2,806	2,105	3,508
41	Iron Gate	4.170	Iron Gate Dam Removal	Dutch Creek - 50'4'3' Dock Concrete Abutment	22.00	CY	333.37	7,334	6,601	-10%	8,068	10%	8,250	7,425	9,075
41	Iron Gate	4.171	Iron Gate Dam Removal	Dutch Creek - Double Pipe Railing	100	LF	47.52	4,752	3,564	-25%	5,940	25%	5,346	4,009	6,682
41	Iron Gate	4.172	Iron Gate Dam Removal	Mirror Cove - Concrete Total	89.00	CY	235.88	20,994	18,894	-10%	23,093	10%	23,615	21,254	25,977
41	Iron Gate	4.173	Iron Gate Dam Removal	Mirror Cove - 10'x16' Toilet Vault	160	SF	96.23	15,397	13,857	-10%	16,937	10%	17,320	15,588	19,052
41	Iron Gate	4.174	Iron Gate Dam Removal	Mirror Cove - 2, 30'x5' Composite Gangplanks w/ aluminum	300	SF	21.43	6,430	5,787	-10%	7,073	10%	7,233	6,510	7,957
41	Iron Gate	4.175	Iron Gate Dam Removal	Mirror Cove - Double pipe railings on dock	80.00	LF	47.52	3,802	2,851	-25%	4,752	25%	4,276	3,207	5,346
41	Iron Gate	4.177	Iron Gate Dam Removal	Mirror Cove - Regrade site	3.00	AC	12,512.61	37,538	31,907	-15%	43,169	15%	42,225	35,891	48,559
41	Iron Gate	4.178	Iron Gate Dam Removal	Mirror Cove - Signs to be removed and hauled away	7.00	EA	356.41	2,495	1,871	-25%	3,119	25%	2,806	2,105	3,508
41	Iron Gate	4.179	Iron Gate Dam Removal	Overlook Point - 1 concrete picnic table base	1.00	CY	356.41	356	267	-25%	446	25%	401	301	501
41	Iron Gate	4.180	Iron Gate Dam Removal	Overlook Point - Steel frame table to be removed and hauled	1.00	EA	118.80	119	89	-25%	149	25%	134	100	167
41	Iron Gate	4.181	Iron Gate Dam Removal	Overlook Point - Regrade steep access road and site to	0.50	AC	30,630.71	15,315	13,018	-15%	17,613	15%	17,228	14,644	19,812
41	Iron Gate	4.182	Iron Gate Dam Removal	Long Gulch - 80'x25x4" Concrete boat ramp to be removed	25.00	CY	310.44	7,761	6,985	-10%	8,537	10%	8,730	7,857	9,603
41	Iron Gate	4.183	Iron Gate Dam Removal	Long Gulch - Remove picnic tables (steel frames with planks)	2.00	EA	118.80	238	178	-25%	297	25%	267	200	334
41	Iron Gate	4.184	Iron Gate Dam Removal	Long Gulch - Regrade ramp area to natural contours, rip,	0.05	AC	29,701.07	1,485	1,114	-25%	1,856	25%	1,670	1,253	2,088
41	Iron Gate	4.185	Iron Gate Dam Removal	Concrete Lining Installation for Diversion Tunnel	1.00	LS	1,196,251.74	1,196,252	1,076,627	-10%	1,315,877	10%	1,345,621	1,211,058	1,480,183
41	Iron Gate	5.025	Iron Gate Dam Removal	Remove Distribution Poles near Iron Gate Hydro Plant	5.00	EA	1,190.24	5,951	5,059	-15%	7,141	20%	6,694	5,690	8,033
41	Iron Gate	5.026	Iron Gate Dam Removal	Remove 69kV/6.6kV Transformer @Substation	1.00	EA	2,273.46	2,273	1,932	-15%	2,842	25%	2,557	2,174	3,197
41	Iron Gate	5.027	Iron Gate Dam Removal	Remove 6.6kV Power Circuit Breaker @Substation	1.00	EA	1,524.31	1,524	1,296	-15%	1,905	25%	1,715	1,457	2,143
41	Iron Gate	5.028	Iron Gate Dam Removal	Remove Generator @Substation	1.00	EA	4,767.78	4,768	4,053	-15%	5,960	25%	5,363	4,559	6,704
41	Iron Gate	5.029	Iron Gate Dam Removal	Remove all auxiliary equipment @Substation (Allowance)	1.00	LS	26,865.48	26,865	22,836	-15%	33,582	25%	30,220	25,687	37,775
41	Iron Gate	5.030	Iron Gate Dam Removal	New Connection @Iron Gate Hatchery from PacifiCorp's	1.00	LS	298,809.00	298,809	268,928	-10%	328,690	10%	336,119	302,508	369,731
42			**RESTORATION EARTHWORKS & HABITAT**												
42	Copco 1 & 2		Tributary Connectivity	Removal of sediment and similar obstructions to ensure	7.00	EA	119,000.00	833,000	749,700	-10%	1,124,550	35%	955,752	860,177	1,290,265
42	Copco 1 & 2		Wetlands, Floodplain and Off-channel Habitat Features Site 1	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Wetlands, Floodplain and Off-channel Habitat Features Site 1	Grading and shaping of floodplain sediments (no export)	81,367	CY	8.00	650,936	585,842	-10%	878,764	35%	732,214	658,993	988,490
42	Copco 1 & 2		Wetlands, Floodplain and Off-channel Habitat Features Site 1	Floodplain roughness for 50% of area	5.60	AC	30,000.00	168,000	151,200	-10%	226,800	35%	188,977	170,079	255,119
42	Copco 1 & 2		Site 2 (25.5 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 2 (25.5 acres)	Grading and shaping of floodplain sediments (no export)	164,252	CY	8.00	1,314,016	1,182,614	-10%	1,773,922	35%	1,478,089	1,330,280	1,995,421
42	Copco 1 & 2		Site 2 (25.5 acres)	Floodplain roughness for 50% of area	12.75	AC	30,000.00	382,500	344,250	-10%	516,375	35%	430,260	387,234	580,852
42	Copco 1 & 2		Site 3 (13.9 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 3 (13.9 acres)	Grading and shaping of floodplain sediments (no export)	78,556	CY	8.00	628,448	565,603	-10%	848,405	35%	706,919	636,227	954,340
42	Copco 1 & 2		Site 3 (13.9 acres)	Floodplain roughness for 50% of area	6.95	AC	30,000.00	208,500	187,650	-10%	281,475	35%	234,534	211,081	316,621
42	Copco 1 & 2		Site 4 (10.5 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 4 (10.5 acres)	Grading and shaping of floodplain sediments (no export)	50,600	CY	8.00	404,800	364,320	-10%	546,480	35%	455,345	409,810	614,716
42	Copco 1 & 2		Site 4 (10.5 acres)	Floodplain roughness for 50% of area	5.25	AC	30,000.00	157,500	141,750	-10%	212,625	35%	177,166	159,449	239,174
42	Copco 1 & 2		Site 5 (4.2 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 5 (4.2 acres)	Grading and shaping of floodplain sediments (no export)	20,267	CY	8.00	162,136	145,922	-10%	218,884	35%	182,381	164,143	246,214
42	Copco 1 & 2		Site 5 (4.2 acres)	Floodplain roughness for 50% of area	2.10	AC	30,000.00	63,000	56,700	-10%	85,050	35%	70,866	63,780	95,670
42	Copco 1 & 2		Site 6 (5.3 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Copco 1 & 2		Site 6 (5.3 acres)	Grading and shaping of floodplain sediments (no export)	17,148	CY	8.00	137,184	123,466	-10%	185,198	35%	154,313	138,882	208,323
42	Copco 1 & 2		Site 6 (5.3 acres)	Floodplain roughness for 50% of area	2.65	AC	30,000.00	79,500	71,550	-10%	107,325	35%	89,427	80,484	120,726
42	Copco 1 & 2		Site 6 (5.3 acres)	Bank Stability and Channel Fringe Complexity	2,500	LF	253.00	632,500	569,250	-10%	853,875	35%	725,706	653,135	979,703
42	Copco 1 & 2		Large Wood Habitat Features	Ground-Based Placement	20.00	EA	27,990.00	559,800	503,820	-10%	755,730	35%	642,293	578,064	867,095
42	Copco 1 & 2		Large Wood Habitat Features	Helicopter Placement (@ 50 members staged and placed per	8.00	EA	57,000.00	456,000	410,400	-10%	615,600	35%	523,197	470,877	706,316
42	Copco 1 & 2		General Conditions	Contractor overhead	15%	%	7,287,820.00	1,093,173	983,856	-10%	1,475,784	35%	1,234,142	1,110,728	1,666,092
42	Copco 1 & 2		General Conditions	Insurance	1%	%	8,380,993.00	83,810	75,429	-10%	113,143	35%	94,618	85,156	127,734
42	Copco 1 & 2		General Conditions	Bond	1%	%	8,380,993.00	83,810	75,429	-10%	113,143	35%	94,618	85,156	127,734
42	Iron Gate		Tributary Connectivity	Removal of sediment and similar obstructions to ensure	5.00	EA	119,000.00	595,000	535,500	-10%	803,250	35%	682,680	614,412	921,618
42	Iron Gate		Site 1 (14.2 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Iron Gate		Site 1 (14.2 acres)	Grading and shaping of floodplain sediments (no export)	60,000	CY	8.00	480,000	432,000	-10%	648,000	35%	539,935	485,941	728,912
42	Iron Gate		Site 1 (14.2 acres)	Floodplain roughness for 50% of area	7.10	AC	30,000.00	213,000	191,700	-10%	287,550	35%	239,596	215,636	323,455
42	Iron Gate		Site 2 (5.8 acres)	Equipment & road access into site	3,000	LF	25.00	75,000	67,500	-10%	101,250	35%	84,365	75,928	113,892
42	Iron Gate		Site 2 (5.8 acres)	Grading and shaping of floodplain sediments (no export)	19,000	CY	8.00	152,000	136,800	-10%	205,200	35%	170,979	153,881	230,822
42	Iron Gate		Site 2 (5.8 acres)	Floodplain roughness for 50% of area	2.90	AC	30,000.00	87,000	78,300	-10%	117,450	35%	97,863	88,077	132,115

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
42	Iron Gate		Site 3 (23.1 acres)	Equipment & road access into site	2,000	LF	25.00	50,000	45,000	-10%	67,500	35%	56,243	50,619	75,928
42	Iron Gate		Site 3 (23.1 acres)	Grading and shaping of floodplain sediments (no export)	95,000	CY	8.00	760,000	684,000	-10%	1,026,000	35%	854,897	769,407	1,154,110
42	Iron Gate		Site 3 (23.1 acres)	Floodplain roughness for 75% of area	17.30	AC	30,000.00	519,000	467,100	-10%	700,650	35%	583,804	525,424	788,136
42	Iron Gate		Bank Stability and Channel Fringe Complexity	Develop process-based restoration and velocity variations	1,000	LF	253.00	253,000	227,700	-10%	341,550	35%	290,282	261,254	391,881
42	Iron Gate		Large Wood Habitat Features	Ground-Based Placement	20.00	EA	27,990.00	559,800	503,820	-10%	755,730	35%	642,293	578,064	867,095
42	Iron Gate		Large Wood Habitat Features	Helicopter Placement (@ 50 members staged and placed per	4.00	EA	57,000.00	228,000	205,200	-10%	307,800	35%	261,598	235,439	353,158
42	Iron Gate		General Conditions	Contractor overhead	15%	%	4,046,800.00	607,020	546,318	-10%	819,477	35%	687,017	618,315	927,473
42	Iron Gate		General Conditions	Contractor profit (included in rates & prices)	0%	%	4,046,800.00	-	-	0%	-	0%	-	-	-
42	Iron Gate		General Conditions	Insurance	1%	%	4,653,820.00	46,538	41,884	-10%	62,827	35%	52,671	47,404	71,106
42	Iron Gate		General Conditions	Bond	1%	%	4,653,820.00	46,538	41,884	-10%	62,827	35%	52,671	47,404	71,106
42	JC Boyle		Tributary Connectivity	Removal of sediment and similar obstructions to ensure	2.00	EA	119,000.00	238,000	214,200	-10%	321,300	35%	273,072	245,765	368,647
42	JC Boyle		Site 1 (3.3 acres)	Equipment & road access into site	500	LF	25.00	12,500	11,250	-10%	16,875	35%	14,061	12,655	18,982
42	JC Boyle		Site 1 (3.3 acres)	Grading and shaping of floodplain sediments (no export)	37,000	CY	8.00	296,000	266,400	-10%	399,600	35%	332,960	299,664	449,496
42	JC Boyle		Site 1 (3.3 acres)	Floodplain roughness for 50% of area	1.65	AC	30,000.00	49,500	44,550	-10%	66,825	35%	55,681	50,113	75,169
42	JC Boyle		Site 2 (43.8 acres)	Equipment & road access into site	500	LF	25.00	12,500	11,250	-10%	16,875	35%	14,061	12,655	18,982
42	JC Boyle		Site 2 (43.8 acres)	Grading and shaping of floodplain sediments (no export)	35,000	CY	8.00	280,000	252,000	-10%	378,000	35%	314,962	283,466	425,199
42	JC Boyle		Site 2 (43.8 acres)	Floodplain roughness for 50% of area	21.90	AC	30,000.00	657,000	591,300	-10%	886,950	35%	739,036	665,132	997,698
42	JC Boyle		Site 3 (65.8 acres)	Equipment & road access into site	500	LF	25.00	12,500	11,250	-10%	16,875	35%	14,061	12,655	18,982
42	JC Boyle		Site 3 (65.8 acres)	Grading and shaping of floodplain sediments (no export)	53,000	CY	8.00	424,000	381,600	-10%	572,400	35%	476,942	429,248	643,872
42	JC Boyle		Site 3 (65.8 acres)	Floodplain roughness for 30% of area	20.00	AC	30,000.00	600,000	540,000	-10%	810,000	35%	674,918	607,427	911,140
42	JC Boyle		Site 4 (21.3 acres)	Equipment & road access into site	500	LF	25.00	12,500	11,250	-10%	16,875	35%	14,061	12,655	18,982
42	JC Boyle		Site 4 (21.3 acres)	Grading and shaping of floodplain sediments (no export)	17,000	CY	8.00	136,000	122,400	-10%	183,600	35%	152,982	137,683	206,525
42	JC Boyle		Site 4 (21.3 acres)	Floodplain roughness for 50% of area	10.65	AC	30,000.00	319,500	287,550	-10%	431,325	35%	359,394	323,455	485,182
42	JC Boyle		Bank Stability and Channel Fringe Complexity	Develop process-based restoration and velocity variations	2,000	LF	253.00	506,000	455,400	-10%	683,100	35%	580,565	522,508	783,762
42	JC Boyle		Large Wood Habitat Features	Ground-Based Placement	30.00	EA	27,990.00	839,700	755,730	-10%	1,133,595	35%	963,439	867,095	1,300,643
42	JC Boyle		Large Wood Habitat Features	Helicopter Placement (50 members staged and placed per	2.00	EA	57,000.00	114,000	102,600	-10%	153,900	35%	130,799	117,719	176,579
42	JC Boyle		General Conditions	Contractor overhead	15%	%	4,509,700.00	676,455	608,810	-10%	913,214	35%	764,724	688,252	1,032,378
42	JC Boyle		General Conditions	Contractor profit (included in rates & prices)	0%	%	4,509,700.00	-	-	0%	-	0%	-	-	-
42	JC Boyle		General Conditions	Insurance	1%	%	5,186,155.00	51,862	46,675	-10%	70,013	35%	58,629	52,766	79,149
42	JC Boyle		General Conditions	Bond	1%	%	5,186,155.00	51,862	46,675	-10%	70,013	35%	58,629	52,766	79,149
43			**RESTORATION OF VEGETATION**												
43	JC Boyle		Restoration of Vegetation	On-Site Pilot Growing Experiment	0.18	%	636,843.00	114,632	100,667	-12%	132,873	16%	115,847	101,734	134,282
43	JC Boyle		Restoration of Vegetation	Seed Collection	0.18	%	1,167,800.00	210,204	159,426	-24%	261,486	24%	221,213	167,775	275,181
43	JC Boyle		Restoration of Vegetation	Seed Propagation	0.18	%	2,803,989.00	504,718	189,718	-62%	648,718	29%	555,301	208,732	713,733
43	JC Boyle		Restoration of Vegetation	Weed Eradication	0.18	%	3,049,095.15	548,837	433,359	-21%	664,315	21%	606,617	478,982	734,252
43	JC Boyle		Restoration of Vegetation	Pioneer Seeding	0.18	%	2,150,000.00	387,000	252,000	-35%	594,000	53%	435,322	283,466	668,169
43	JC Boyle		Restoration of Vegetation	Container Plant Growing	0.18	%	1,057,742.00	190,394	69,627	-63%	311,160	63%	217,088	79,389	354,787
43	JC Boyle		Restoration of Vegetation	Establ. Prd. Maint. & Monitor'g	0.18	%	8,043,339.82	1,447,801	776,357	-46%	2,198,979	52%	1,761,471	944,557	2,675,394
43	JC Boyle		Restoration of Vegetation	Long-Term Maint. & Monitor'g	0.18	%	8,189,100.00	1,474,038	668,469	-55%	2,493,180	69%	1,923,473	872,286	3,253,352
43	JC Boyle		Restoration of Vegetation	Emergent Wetland	0.85	AC	35,203.00	29,775	20,555	-31%	41,297	39%	34,260	23,651	47,519
43	JC Boyle		Restoration of Vegetation	Bank Wetland	4.21	AC	21,453.20	90,220	54,232	-40%	116,796	29%	103,198	62,034	133,597
43	JC Boyle		Restoration of Vegetation	Bank Riparian	32.92	AC	30,175.20	993,384	643,821	-35%	1,362,911	37%	1,144,047	741,466	1,569,618
43	JC Boyle		Restoration of Vegetation	Floodplain Riparian	55.08	AC	13,817.40	761,037	507,182	-33%	1,043,992	37%	876,122	583,879	1,201,866
43	JC Boyle		Restoration of Vegetation	Uplands below RW	24.20	AC	9,714.00	235,062	175,776	-25%	318,207	35%	273,032	204,169	369,607
43	JC Boyle		Restoration of Vegetation	Rocky Wake Zone	16.37	AC	9,719.00	159,096	118,909	-25%	221,113	39%	184,792	138,114	256,825
43	JC Boyle		Restoration of Vegetation	Disturbed Uplands above RWZ	42.29	AC	9,502.00	401,819	302,294	-25%	559,998	39%	466,536	350,982	650,192
43	JC Boyle		Restoration of Vegetation	Uplands Stockpiles	6.73	AC	8,856.67	59,595	44,882	-25%	83,046	39%	64,832	48,826	90,344
43	JC Boyle		Restoration of Vegetation	Undisturbed Uplands	10.07	AC	4,850.00	48,829	37,251	-24%	59,904	23%	56,385	43,015	69,173
43	JC Boyle		Restoration of Vegetation	Contractor overhead	1.00	LS	1,391,623.54	1,391,624	879,961	-37%	2,005,720	44%	1,643,136	1,030,506	2,379,157
43	Iron Gate		Restoration of Vegetation	On-Site Pilot Growing Experiment	0.42	%	636,843.00	267,601	235,001	-12%	310,185	16%	270,438	237,492	313,474
43	Iron Gate		Restoration of Vegetation	Seed Collection	0.42	%	1,167,800.00	490,710	372,171	-24%	610,425	24%	516,409	391,662	642,394
43	Iron Gate		Restoration of Vegetation	Seed Propagation	0.42	%	2,803,989.00	1,178,236	442,886	-62%	1,514,396	29%	1,296,320	487,273	1,666,170
43	Iron Gate		Restoration of Vegetation	Weed Eradication	0.42	%	3,049,095.15	1,281,230	1,011,653	-21%	1,550,806	21%	1,416,113	1,118,156	1,714,070
43	Iron Gate		Restoration of Vegetation	Pioneer Seeding	0.42	%	2,150,000.00	903,430	588,280	-35%	1,386,660	53%	1,016,236	661,735	1,559,804
43	Iron Gate		Restoration of Vegetation	Container Plant Growing	0.42	%	1,057,742.00	444,463	162,540	-63%	726,386	63%	506,780	185,329	828,231
43	Iron Gate		Restoration of Vegetation	Establ. Prd. Maint. & Monitor'g	0.42	%	8,043,339.82	3,379,811	1,812,363	-46%	5,133,395	52%	4,112,057	2,205,016	6,245,560
43	Iron Gate		Restoration of Vegetation	Long-Term Maint. & Monitor'g	0.42	%	8,189,100.00	3,441,060	1,560,504	-55%	5,820,190	69%	4,490,241	2,036,303	7,594,770
43	Iron Gate		Restoration of Vegetation	Emergent Wetland	1.78	AC	35,203.00	62,658	43,255	-31%	86,907	39%	72,099	49,772	100,000
43	Iron Gate		Restoration of Vegetation	Bank Wetland	7.59	AC	21,453.20	162,728	97,818	-40%	210,662	29%	186,135	111,888	240,965
43	Iron Gate		Restoration of Vegetation	Bank Riparian	23.87	AC	30,175.20	720,169	466,748	-35%	988,064	37%	829,395	537,538	1,137,919
43	Iron Gate		Restoration of Vegetation	Floodplain Riparian	34.82	AC	13,817.40	481,147	320,653	-33%	660,039	37%	553,907	369,143	759,851
43	Iron Gate		Restoration of Vegetation	Uplands below RW	333	AC	9,714.00	3,230,647	2,415,835	-25%	4,373,379	35%	3,752,497	2,806,068	5,079,817
43	Iron Gate		Restoration of Vegetation	Rocky Wake Zone	11.20	AC	9,719.00	108,851	81,355	-25%	151,281	39%	126,431	94,495	175,715
43	Iron Gate		Restoration of Vegetation	Disturbed Uplands above RWZ	70.53	AC	9,502.00	670,217	504,215	-25%	934,054	39%	778,163	585,424	1,084,494
43	Iron Gate		Restoration of Vegetation	Uplands Stockpiles	38.76	AC	8,856.67	343,285	258,534	-25%	478,368	39%	373,450	281,252	520,404

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
43	Iron Gate		Restoration of Vegetation	Undisturbed Uplands	20.99	AC	4,850.00	101,810	77,669	-24%	124,901	23%	117,563	89,688	144,227
43	Iron Gate		Restoration of Vegetation	Contractor overhead	1.00	LS	3,094,512.21	3,094,512	2,008,187	-35%	4,458,145	44%	3,660,630	2,354,359	5,298,930
43	Copco 1		Restoration of Vegetation	On-Site Pilot Growing Experiment	0.40	%	636,843.00	253,909	222,977	-12%	294,314	16%	256,601	225,340	297,434
43	Copco 1		Restoration of Vegetation	Seed Collection	0.40	%	1,167,800.00	465,602	353,129	-24%	579,191	24%	489,986	371,623	609,525
43	Copco 1		Restoration of Vegetation	Seed Propagation	0.40	%	2,803,989.00	1,117,950	420,225	-62%	1,436,910	29%	1,229,992	462,341	1,580,919
43	Copco 1		Restoration of Vegetation	Weed Eradication	0.40	%	3,049,095.15	1,215,674	959,891	-21%	1,471,458	21%	1,343,656	1,060,945	1,626,368
43	Copco 1		Restoration of Vegetation	Pioneer Seeding	0.40	%	2,150,000.00	857,205	558,180	-35%	1,315,710	53%	964,239	627,877	1,479,995
43	Copco 1		Restoration of Vegetation	Container Plant Growing	0.40	%	1,057,742.00	421,722	154,224	-63%	689,220	63%	480,850	175,847	785,853
43	Copco 1		Restoration of Vegetation	Establ. Prd. Maint. & Monitor'g	0.40	%	8,043,339.82	3,206,880	1,719,631	-46%	4,870,739	52%	3,901,659	2,092,194	5,925,999
43	Copco 1		Restoration of Vegetation	Long-Term Maint. & Monitor'g	0.40	%	8,189,100.00	3,264,994	1,480,659	-55%	5,522,394	69%	4,260,493	1,932,113	7,206,175
43	Copco 1		Restoration of Vegetation	Emergent Wetland	1.79	AC	35,203.00	63,017	43,503	-31%	87,405	39%	72,512	50,058	100,574
43	Copco 1		Restoration of Vegetation	Bank Wetland	7.65	AC	21,453.20	164,188	98,696	-40%	212,553	29%	187,806	112,893	243,127
43	Copco 1		Restoration of Vegetation	Bank Riparian	48.01	AC	30,175.20	1,448,583	938,839	-35%	1,987,438	37%	1,668,284	1,081,229	2,288,865
43	Copco 1		Restoration of Vegetation	Floodplain Riparian	58.23	AC	13,817.40	804,552	536,182	-33%	1,103,686	37%	926,218	617,264	1,270,588
43	Copco 1		Restoration of Vegetation	Uplands below RW	306	AC	9,714.00	2,968,059	2,219,475	-25%	4,017,909	35%	3,447,493	2,577,989	4,666,927
43	Copco 1		Restoration of Vegetation	Rocky Wake Zone	15.06	AC	9,719.00	146,354	109,386	-25%	203,405	39%	169,993	127,053	236,257
43	Copco 1		Restoration of Vegetation	Disturbed Uplands above RWZ	8.02	AC	9,502.00	76,226	57,346	-25%	106,233	39%	88,503	66,582	123,343
43	Copco 1		Restoration of Vegetation	Uplands Stockpiles	3.37	AC	8,856.67	29,844	22,476	-25%	41,587	39%	32,466	24,451	45,242
43	Copco 1		Restoration of Vegetation	Undisturbed Uplands	13.39	AC	4,850.00	64,957	49,554	-24%	79,689	23%	75,008	57,222	92,020
43	Copco 1		Restoration of Vegetation	Contractor overhead	1.00	LS	2,983,330.50	2,983,330	1,912,476	-36%	4,291,645	44%	3,530,879	2,244,456	5,103,293
43	Copco 2		Restoration of Vegetation	On-Site Pilot Growing Experiment	0.00	%	636,843.00	701	615	-12%	812	16%	708	622	821
43	Copco 2		Restoration of Vegetation	Seed Collection	0.00	%	1,167,800.00	1,285	974	-24%	1,598	24%	1,352	1,025	1,682
43	Copco 2		Restoration of Vegetation	Seed Propagation	0.00	%	2,803,989.00	3,084	1,159	-62%	3,964	29%	3,394	1,276	4,362
43	Copco 2		Restoration of Vegetation	Weed Eradication	0.00	%	3,049,095.15	3,354	2,648	-21%	4,060	21%	3,707	2,927	4,487
43	Copco 2		Restoration of Vegetation	Pioneer Seeding	0.00	%	2,150,000.00	2,365	1,540	-35%	3,630	53%	2,660	1,732	4,083
43	Copco 2		Restoration of Vegetation	Container Plant Growing	0.00	%	1,057,742.00	1,164	426	-63%	1,902	63%	1,327	485	2,168
43	Copco 2		Restoration of Vegetation	Establ. Prd. Maint. & Monitor'g	0.00	%	8,043,339.82	8,848	4,744	-46%	13,438	52%	10,765	5,772	16,350
43	Copco 2		Restoration of Vegetation	Long-Term Maint. & Monitor'g	0.00	%	8,189,100.00	9,008	4,085	-55%	15,236	69%	11,755	5,331	19,882
43	Copco 2		Restoration of Vegetation	Floodplain Riparian	0.81	AC	13,817.40	11,157	7,435	-33%	15,305	37%	12,844	8,560	17,619
43	Copco 2		Restoration of Vegetation	Disturbed Uplands above RWZ	1.19	AC	9,502.00	11,280	8,486	-25%	15,721	39%	13,097	9,853	18,253
43	Copco 2		Restoration of Vegetation	Undisturbed Uplands	0.00	AC	4,850.00	4	3	-24%	5	23%	4	3	5
43	Copco 2		Restoration of Vegetation	Contractor overhead	1.00	LS	9,894.21	9,894	6,468	-35%	14,234	44%	11,663	7,569	16,845
44			**YREKA WATER LINE REPLACEMENT**												
44	Project	6.001	Yreka Water Line Replacement	Microtunneling	612	LH	1,558.34	953,701	810,646	-20%	1,239,812	40%	1,052,154	894,331	1,367,800
44	Project	6.002	Yreka Water Line Replacement	Pile and Lagging Pre Drilling	458	LF	150.68	69,010	58,658	-20%	89,712	40%	76,134	64,714	98,974
44	Project	6.003	Yreka Water Line Replacement	Pile and Lagging Wall InstallatioN	13,715	SF	73.01	1,001,297	851,102	-20%	1,301,686	40%	1,104,663	938,963	1,436,062
44	Project	6.004	Yreka Water Line Replacement	Pipe Installation	2,106	LF	133.76	281,698	239,443	-20%	366,207	40%	310,778	264,161	404,012
44	Project	6.005	Yreka Water Line Replacement	Excavation and Backfill	3,653	CY	88.45	323,097	274,632	-20%	420,026	40%	356,451	302,983	463,386
45			**TRANSPORTATION (BRIDGES, CULVERTS, ROADS)**												
45	Project		Lakeview Bridge	Sheet Pile Coffer Dam For Center Footer	2,400	SF	38.40	92,161	73,729	-20%	119,809	30%	100,878	80,702	131,141
45	Project		Lakeview Bridge	Backfill, structural, common earth, 105 H.P. dozer, 50' haul,	89.00	CY	39.77	3,540	2,832	-20%	4,602	30%	3,875	3,100	5,037
45	Project		Lakeview Bridge	Earth Work Coffer Dam Construction for side footers	1,186	CY	15.26	18,097	14,478	-20%	23,526	30%	19,809	15,847	25,752
45	Project		Lakeview Bridge	Structure Excavation (Rock) Drilling and blasting rock,	107	CY	186.20	19,924	15,939	-20%	25,901	30%	21,808	17,447	28,351
45	Project		Lakeview Bridge	Structure Excavation (Type D)	1,122	CY	20.27	22,741	18,193	-20%	29,563	30%	24,892	19,913	32,359
45	Project		Lakeview Bridge	Structure Excavation (Bridge)	159	CY	58.08	9,234	7,387	-20%	12,004	30%	10,107	8,086	13,140
45	Project		Lakeview Bridge	Prestressed concrete piles, square, 40' long, 24" square,	480	LF	165.17	79,283	63,426	-20%	103,068	30%	86,781	69,425	112,816
45	Project		Lakeview Bridge	18" Diameter 40' Long Tie Down Anchor Installation	480	LF	101.95	48,937	39,149	-20%	63,618	30%	53,565	42,852	69,634
45	Project		Lakeview Bridge	Piling special costs, pre-augering for Pile and Tie Down	960	LF	311.56	299,101	239,281	-20%	388,831	30%	327,390	261,912	425,606
45	Project		Lakeview Bridge	Mobilization, 150 ton, set up and remove crane, with pile	2.00	EA	22,228.11	44,456	35,565	-20%	57,793	30%	48,661	38,929	63,259
45	Project		Lakeview Bridge	A736 Barrier Wall	536	LF	388.00	207,966	166,373	-20%	270,356	30%	227,635	182,108	295,926
45	Project		Lakeview Bridge	Expansion joint, neoprene, liquid, 1" x 2", cold applied	46.00	LF	44.09	2,028	1,623	-20%	2,637	30%	2,220	1,776	2,886
45	Project		Lakeview Bridge	Columns Structural Concrete includes forms, Grade 60 rebar,	172	CY	1,953.07	335,929	268,743	-20%	436,707	30%	367,701	294,161	478,011
45	Project		Lakeview Bridge	Deck Structural concrete, in place, includes forms, Grade 60	168	CY	1,143.38	192,088	153,670	-20%	249,714	30%	210,255	168,204	273,332
45	Project		Lakeview Bridge	Footer Structural concrete,footing, reinforced, includes	448	CY	421.72	188,929	151,143	-20%	245,608	30%	206,798	165,438	268,837
45	Project		Lakeview Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	17.00	CY	293.49	4,989	3,992	-20%	6,486	30%	5,461	4,369	7,100
45	Project		Lakeview Bridge	Precast 36" I-Girder 65'	8.00	EA	29,970.09	239,761	191,809	-20%	311,689	30%	262,437	209,950	341,168
45	Project		Lakeview Bridge	Precast 36" I-Girder 48'	8.00	EA	35,810.59	286,485	229,188	-20%	372,430	30%	313,580	250,864	407,654
45	Project		Lakeview Bridge	Bridge Demolition	3,917	SF	60.00	235,020	188,016	-20%	305,526	30%	257,248	205,798	334,422
45	Project		Lakeview Bridge - Paving	Roadway Excavation	510	CY	40.00	20,400	16,320	-20%	25,500	25%	22,329	17,864	27,912
45	Project		Lakeview Bridge - Paving	Imported Borrow	2,510	CY	45.00	112,950	90,360	-20%	141,188	25%	123,633	98,906	154,541
45	Project		Lakeview Bridge - Paving	Hot Mix Asphalt (Type A)	450	T	130.00	58,500	46,800	-20%	73,125	25%	64,033	51,226	80,041
45	Project		Lakeview Bridge - Paving	Class 2 Aggregate Base	330	CY	65.00	21,450	17,160	-20%	26,813	25%	23,479	18,783	29,348
45	Project		Lakeview Bridge - Paving	Midwest Guardrail System	200	LF	40.61	8,122	6,498	-20%	10,153	25%	8,890	7,112	11,113

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Lakeview Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Lakeview Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Lakeview Bridge - Paving	Temporary Reinforced Silt Fence	600	LF	7.58	4,548	3,638	-20%	5,685	25%	4,978	3,983	6,223
45	Project		Lakeview Bridge - Paving	Temporary Fence (Type ESA)	300	LF	5.03	1,509	1,207	-20%	1,886	25%	1,652	1,321	2,065
45	Project		Lakeview Bridge - Paving	Temporary Concrete Washout	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Lakeview Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Lakeview Bridge - Paving	Water Pollution Control	0.10	%	213,300.00	21,330	17,064	-20%	26,663	25%	23,347	18,678	29,184
45	Project		Lakeview Bridge - Paving	Roadside Sign - One Post	2.00	EA	270.00	540	432	-20%	675	25%	591	473	739
45	Project		Lakeview Bridge - Paving	Reset Roadside Sign	4.00	EA	300.00	1,200	960	-20%	1,500	25%	1,313	1,051	1,642
45	Project		Lakeview Bridge - Paving	Relocate Roadside Sign	2.00	EA	100.00	200	160	-20%	250	25%	219	175	274
45	Project		Lakeview Bridge - Paving	Construction Area Signs	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Lakeview Bridge - Paving	Thermoplastic Traffic Stripe	660	LF	0.86	568	454	-20%	710	25%	621	497	777
45	Project		Lakeview Bridge - Paving	Type III Barricade	4.00	EA	274.29	1,097	878	-20%	1,371	25%	1,201	961	1,501
45	Project		Lakeview Bridge - Paving	Traffic Control System	20.00	DA	1,000.00	20,000	16,000	-20%	25,000	25%	21,892	17,513	27,364
45	Project		Lakeview Bridge - Paving	Temporary Railing (Type K)	300	LF	47.00	14,100	11,280	-20%	17,625	25%	15,434	12,347	19,292
45	Project		Fall Creek Bridge	Structure Excavation (Bridge)	499	CY	58.08	28,980	23,184	-20%	37,674	30%	31,721	25,377	41,237
45	Project		Fall Creek Bridge	A736 Barrier Wall	100	LF	388.00	38,800	31,040	-20%	50,440	30%	42,469	33,975	55,210
45	Project		Fall Creek Bridge	Columns/Walls Structural Concrete includes forms, Grade 60	111	CY	1,953.07	216,791	173,433	-20%	281,829	30%	237,295	189,836	308,484
45	Project		Fall Creek Bridge	Deck Structural concrete, in place, includes forms, Grade 60	31.00	CY	1,143.38	35,445	28,356	-20%	46,078	30%	38,797	31,038	50,436
45	Project		Fall Creek Bridge	Footer Structural concrete,footing, reinforced, includes	86.00	CY	421.72	36,268	29,014	-20%	47,148	30%	39,698	31,758	51,607
45	Project		Fall Creek Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	22.00	CY	293.49	6,457	5,166	-20%	8,394	30%	7,068	5,654	9,188
45	Project		Fall Creek Bridge	Bridge Demolition	720	SF	60.00	43,200	34,560	-20%	56,160	30%	47,286	37,829	61,472
45	Project		Fall Creek Bridge - Paving	Roadway Excavation	720	CY	40.00	28,800	23,040	-20%	36,000	25%	31,524	25,219	39,405
45	Project		Fall Creek Bridge - Paving	Imported Borrow	2,380	CY	45.00	107,100	85,680	-20%	133,875	25%	117,229	93,784	146,537
45	Project		Fall Creek Bridge - Paving	Hot Mix Asphalt (Type A)	230	T	130.00	29,900	23,920	-20%	37,375	25%	32,728	26,182	40,910
45	Project		Fall Creek Bridge - Paving	Class 2 Aggregate Base	170	CY	65.00	11,050	8,840	-20%	13,813	25%	12,095	9,676	15,119
45	Project		Fall Creek Bridge - Paving	Midwest Guardrail System	100	LF	40.61	4,061	3,249	-20%	5,076	25%	4,445	3,556	5,556
45	Project		Fall Creek Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Fall Creek Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Fall Creek Bridge - Paving	Relocate Gate	1.00	EA	100.00	100	80	-20%	125	25%	109	88	137
45	Project		Fall Creek Bridge - Paving	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Fall Creek Bridge - Paving	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Fall Creek Bridge - Paving	Temporary Hydroseed	280	SY	9.22	2,582	2,065	-20%	3,227	25%	2,826	2,261	3,532
45	Project		Fall Creek Bridge - Paving	Rolled Erosion Control / Jute Mesh	280	SY	16.62	4,654	3,723	-20%	5,817	25%	5,094	4,075	6,367
45	Project		Fall Creek Bridge - Paving	Temporary Fiber Roll	375	LF	8.10	3,038	2,430	-20%	3,797	25%	3,325	2,660	4,156
45	Project		Fall Creek Bridge - Paving	Temporary Concrete Washout	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Fall Creek Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Fall Creek Bridge - Paving	Water Pollution Control	0.10	%	176,850.00	17,685	14,148	-20%	22,106	25%	19,358	15,486	24,197
45	Project		Fall Creek Bridge - Paving	Construction Area Signs	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Fall Creek Bridge - Paving	Temporary Traffic Stripe	500	LF	1.20	600	480	-20%	750	25%	657	525	821
45	Project		Fall Creek Bridge - Paving	Thermoplastic Traffic Stripe	275	LF	0.86	237	189	-20%	296	25%	259	207	324
45	Project		Fall Creek Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Fall Creek Bridge - Paving	Traffic Control System	50.00	DA	1,000.00	50,000	40,000	-20%	62,500	25%	54,729	43,783	68,411
45	Project		Fall Creek Bridge - Paving	Temporary Railing (Type K)	200	LF	47.00	9,400	7,520	-20%	11,750	25%	10,289	8,231	12,861
45	Project		Daggett Road Bridge	Sheet Pile Coffer Dam For Footers	7,200	SF	38.40	276,483	221,186	-20%	359,428	30%	302,633	242,106	393,422
45	Project		Daggett Road Bridge	Backfill, structural, common earth, 105 H.P. dozer, 50' haul,	91.00	CY	39.77	3,619	2,896	-20%	4,705	30%	3,962	3,169	5,150
45	Project		Daggett Road Bridge	Structure Excavation (Rock) Drilling and blasting rock,	107	CY	186.20	19,924	15,939	-20%	25,901	30%	21,808	17,447	28,351
45	Project		Daggett Road Bridge	Structure Excavation (Type D)	1,535	CY	20.27	31,112	24,889	-20%	40,445	30%	34,054	27,243	44,271
45	Project		Daggett Road Bridge	Structure Excavation (Bridge)	171	CY	58.08	9,931	7,945	-20%	12,910	30%	10,870	8,696	14,131
45	Project		Daggett Road Bridge	Prestressed concrete piles, square, 40' long, 24" square,	480	LF	165.17	79,283	63,426	-20%	103,068	30%	86,781	69,425	112,816
45	Project		Daggett Road Bridge	18" Diameter 40' Long Tie Down Anchor Installation	480	LF	101.95	48,937	39,149	-20%	63,618	30%	53,565	42,852	69,634
45	Project		Daggett Road Bridge	Piling special costs, pre-augering for Pile and Tie Down	960	LF	311.56	299,101	239,281	-20%	388,831	30%	327,390	261,912	425,606
45	Project		Daggett Road Bridge	Mobilization, 150 ton, set up and remove crane, with pile	2.00	EA	22,228.11	44,456	35,565	-20%	57,793	30%	48,661	38,929	63,259
45	Project		Daggett Road Bridge	A736 Barrier Wall	530	LF	388.00	205,638	164,510	-20%	267,330	30%	225,087	180,070	292,613
45	Project		Daggett Road Bridge	Expansion joint, neoprene, liquid, 1" x 2", cold applied	46.00	LF	44.09	2,028	1,623	-20%	2,637	30%	2,220	1,776	2,886
45	Project		Daggett Road Bridge	Columns Structural Concrete includes forms, Grade 60 rebar,	157	CY	1,953.07	306,633	245,306	-20%	398,622	30%	335,634	268,507	436,324
45	Project		Daggett Road Bridge	Deck Structural concrete, in place, includes forms, Grade 60	167	CY	1,143.38	190,944	152,755	-20%	248,228	30%	209,004	167,203	271,705
45	Project		Daggett Road Bridge	Footer Structural concrete,footing, reinforced, includes	448	CY	421.72	188,929	151,143	-20%	245,608	30%	206,798	165,438	268,837
45	Project		Daggett Road Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	17.00	CY	293.49	4,989	3,992	-20%	6,486	30%	5,461	4,369	7,100
45	Project		Daggett Road Bridge	Precast 36" I-Girder 65'	8.00	EA	29,970.09	239,761	191,809	-20%	311,689	30%	262,437	209,950	341,168
45	Project		Daggett Road Bridge	Precast 36" I-Girder 48'	8.00	EA	35,810.59	286,485	229,188	-20%	372,430	30%	313,580	250,864	407,654
45	Project		Daggett Road Bridge	Bridge Demolition	3,262	SF	60.00	195,720	156,576	-20%	254,436	30%	214,231	171,385	278,500
45	Project		Daggett Road Bridge - Paving	Roadway Excavation	1,500	CY	40.00	60,000	48,000	-20%	75,000	25%	65,675	52,540	82,093
45	Project		Daggett Road Bridge - Paving	Imported Borrow	5,500	CY	45.00	247,500	198,000	-20%	309,375	25%	270,908	216,727	338,635

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Daggett Road Bridge - Paving	Hot Mix Asphalt (Type A)	1,240	T	130.00	161,200	128,960	-20%	201,500	25%	176,446	141,157	220,558
45	Project		Daggett Road Bridge - Paving	Class 2 Aggregate Base	920	CY	65.00	59,800	47,840	-20%	74,750	25%	65,456	52,365	81,820
45	Project		Daggett Road Bridge - Paving	Remove Base and Surfacing	9,485	SF	6.00	56,910	45,528	-20%	71,138	25%	62,293	49,834	77,866
45	Project		Daggett Road Bridge - Paving	Midwest Guardrail System	200	LF	40.61	8,122	6,498	-20%	10,153	25%	8,890	7,112	11,113
45	Project		Daggett Road Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Daggett Road Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Daggett Road Bridge - Paving	Temporary Reinforced Silt Fence	1,000	LF	7.58	7,580	6,064	-20%	9,475	25%	8,297	6,638	10,371
45	Project		Daggett Road Bridge - Paving	Temporary Fence (Type ESA)	1,000	LF	5.03	5,030	4,024	-20%	6,288	25%	5,506	4,405	6,882
45	Project		Daggett Road Bridge - Paving	Temporary Hydroseed	1,200	SY	9.22	11,064	8,851	-20%	13,830	25%	12,110	9,688	15,138
45	Project		Daggett Road Bridge - Paving	Rolled Erosion Control / Jute Mesh	1,200	SY	16.62	19,944	15,955	-20%	24,930	25%	21,830	17,464	27,288
45	Project		Daggett Road Bridge - Paving	Temporary Fiber Roll	1,100	LF	8.10	8,910	7,128	-20%	11,138	25%	9,753	7,802	12,191
45	Project		Daggett Road Bridge - Paving	Temporary Construction Entrance	1.00	EA	4,303.25	4,303	3,443	-20%	5,379	25%	4,710	3,768	5,888
45	Project		Daggett Road Bridge - Paving	Water Pollution Control	0.10	%	585,410.00	58,541	46,833	-20%	73,176	25%	64,078	51,262	80,097
45	Project		Daggett Road Bridge - Paving	Roadside Sign - One Post	1.00	EA	270.00	270	216	-20%	338	25%	296	236	369
45	Project		Daggett Road Bridge - Paving	Remove Roadside Sign	2.00	EA	100.00	200	160	-20%	250	25%	219	175	274
45	Project		Daggett Road Bridge - Paving	Reset Roadside Sign	2.00	EA	300.00	600	480	-20%	750	25%	657	525	821
45	Project		Daggett Road Bridge - Paving	Construction Area Signs	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Daggett Road Bridge - Paving	Thermoplastic Traffic Stripe	2,020	LF	0.86	1,737	1,390	-20%	2,172	25%	1,902	1,521	2,377
45	Project		Daggett Road Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Daggett Road Bridge - Paving	Traffic Control System	15.00	DA	1,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Daggett Road Bridge - Paving	Temporary Railing (Type K)	120	LF	47.00	5,640	4,512	-20%	7,050	25%	6,173	4,939	7,717
45	Project		Dry Creek Bridge	Temporary Bridge	1,015	SF	210.00	213,150	170,520	-20%	277,095	30%	233,310	186,648	303,302
45	Project		Dry Creek Bridge - Paving	Roadway Excavation	700	CY	40.00	28,000	22,400	-20%	35,000	25%	30,648	24,519	38,310
45	Project		Dry Creek Bridge - Paving	Imported Borrow	1,000	CY	45.00	45,000	36,000	-20%	56,250	25%	49,256	39,405	61,570
45	Project		Dry Creek Bridge - Paving	Hot Mix Asphalt (Type A)	600	T	130.00	78,000	62,400	-20%	97,500	25%	85,377	68,302	106,721
45	Project		Dry Creek Bridge - Paving	Class 2 Aggregate Base	380	CY	65.00	24,700	19,760	-20%	30,875	25%	27,036	21,629	33,795
45	Project		Dry Creek Bridge - Paving	Midwest Guardrail System	100	LF	40.61	4,061	3,249	-20%	5,076	25%	4,445	3,556	5,556
45	Project		Dry Creek Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Dry Creek Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Dry Creek Bridge - Paving	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Dry Creek Bridge - Paving	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Dry Creek Bridge - Paving	Temporary Hydroseed	550	SY	9.22	5,071	4,057	-20%	6,339	25%	5,551	4,440	6,938
45	Project		Dry Creek Bridge - Paving	Rolled Erosion Control / Jute Mesh	550	SY	16.62	9,141	7,313	-20%	11,426	25%	10,006	8,004	12,507
45	Project		Dry Creek Bridge - Paving	Temporary Fiber Roll	1,000	LF	8.10	8,100	6,480	-20%	10,125	25%	8,866	7,093	11,083
45	Project		Dry Creek Bridge - Paving	Temporary Concrete Washout	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Dry Creek Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Dry Creek Bridge - Paving	Water Pollution Control	0.10	%	175,700.00	17,570	14,056	-20%	21,963	25%	19,232	15,385	24,040
45	Project		Dry Creek Bridge - Paving	Construction Area Signs	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Dry Creek Bridge - Paving	Thermoplastic Traffic Stripe	650	LF	0.86	559	447	-20%	699	25%	612	489	765
45	Project		Dry Creek Bridge - Paving	Portable Changeable Message Signs	2.00	EA	3,000.00	6,000	4,800	-20%	7,500	25%	6,567	5,254	8,209
45	Project		Dry Creek Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Dry Creek Bridge - Paving	Traffic Control System	20.00	DA	1,000.00	20,000	16,000	-20%	25,000	25%	21,892	17,513	27,364
45	Project		Dry Creek Bridge - Paving	Temporary Railing (Type K)	200	LF	47.00	9,400	7,520	-20%	11,750	25%	10,289	8,231	12,861
45	Project		Dry Creek Bridge - Temp Detour	Roadway Excavation	1,200	CY	40.00	48,000	38,400	-20%	60,000	25%	52,540	42,032	65,675
45	Project		Dry Creek Bridge - Temp Detour	Ditch Excavation	40.00	CY	35.00	1,400	1,120	-20%	1,750	25%	1,532	1,226	1,916
45	Project		Dry Creek Bridge - Temp Detour	Imported Borrow	1,620	CY	45.00	72,900	58,320	-20%	91,125	25%	79,795	63,836	99,744
45	Project		Dry Creek Bridge - Temp Detour	Hot Mix Asphalt (Type A)	530	T	130.00	68,900	55,120	-20%	86,125	25%	75,417	60,333	94,271
45	Project		Dry Creek Bridge - Temp Detour	Class 2 Aggregate Base	400	CY	65.00	26,000	20,800	-20%	32,500	25%	28,459	22,767	35,574
45	Project		Dry Creek Bridge - Temp Detour	Midwest Guardrail System	100	LF	40.61	4,061	3,249	-20%	5,076	25%	4,445	3,556	5,556
45	Project		Dry Creek Bridge - Temp Detour	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Dry Creek Bridge - Temp Detour	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Dry Creek Bridge - Temp Detour	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Dry Creek Bridge - Temp Detour	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Dry Creek Bridge - Temp Detour	Temporary Hydroseed	320	SY	9.22	2,950	2,360	-20%	3,688	25%	3,229	2,584	4,037
45	Project		Dry Creek Bridge - Temp Detour	Rolled Erosion Control / Jute Mesh	320	SY	16.62	5,318	4,255	-20%	6,648	25%	5,821	4,657	7,277
45	Project		Dry Creek Bridge - Temp Detour	Temporary Fiber Roll	400	LF	8.10	3,240	2,592	-20%	4,050	25%	3,546	2,837	4,433
45	Project		Dry Creek Bridge - Temp Detour	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Dry Creek Bridge - Temp Detour	Water Pollution Control	0.10	%	217,200.00	21,720	17,376	-20%	27,150	25%	23,774	19,019	29,718
45	Project		Dry Creek Bridge - Temp Detour	Construction Area Signs	1.00	LS	2,000.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Dry Creek Bridge - Temp Detour	Temporary Traffic Stripe	620	LF	0.78	486	389	-20%	608	25%	532	426	665
45	Project		Dry Creek Bridge - Temp Detour	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Dry Creek Bridge - Temp Detour	Traffic Control System	5.00	DA	1,000.00	5,000	4,000	-20%	6,250	25%	5,473	4,378	6,841
45	Project		Dry Creek Bridge - Temp Detour	Temporary Railing (Type K)	160	LF	47.00	7,520	6,016	-20%	9,400	25%	8,231	6,585	10,289
45	Project		Camp Creek Bridge	Backfill, structural, common earth, 105 H.P. dozer, 50' haul,	420	CY	39.77	16,705	13,364	-20%	21,717	30%	18,285	14,628	23,771

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Camp Creek Bridge	Earth Work Coffer Dam Construction for side footers	1,186	CY	15.26	18,097	14,478	-20%	23,526	30%	19,809	15,847	25,752
45	Project		Camp Creek Bridge	Structure Excavation (Bridge)	585	CY	58.08	33,975	27,180	-20%	44,167	30%	37,188	29,750	48,344
45	Project		Camp Creek Bridge	Steel piles, "H" Sections, 50' long, HP14 X 89, excludes	1,400	LF	86.12	120,571	96,457	-20%	156,742	30%	131,974	105,580	171,567
45	Project		Camp Creek Bridge	Piling special costs, pre-augering for Pile	1,400	LF	311.56	436,189	348,951	-20%	567,045	30%	477,443	381,955	620,676
45	Project		Camp Creek Bridge	Mobilization, 150 ton, set up and remove crane, with pile	2.00	EA	22,228.11	44,456	35,565	-20%	57,793	30%	48,661	38,929	63,259
45	Project		Camp Creek Bridge	A736 Barrier Wall	444	LF	388.00	172,270	137,816	-20%	223,952	30%	188,564	150,851	245,133
45	Project		Camp Creek Bridge	Expansion joint, neoprene, liquid, 1" x 2", cold applied	50.00	LF	44.09	2,205	1,764	-20%	2,866	30%	2,413	1,931	3,137
45	Project		Camp Creek Bridge	Columns Structural Concrete includes forms, Grade 60 rebar,	132	CY	1,953.07	257,806	206,245	-20%	335,148	30%	282,189	225,751	366,846
45	Project		Camp Creek Bridge	Deck Structural concrete, in place, includes forms, Grade 60	139	CY	1,143.38	158,930	127,144	-20%	206,609	30%	173,961	139,169	226,149
45	Project		Camp Creek Bridge	Footer Structural concrete,footing, reinforced, includes	162	CY	421.72	68,318	54,655	-20%	88,814	30%	74,780	59,824	97,214
45	Project		Camp Creek Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	19.00	CY	293.49	5,576	4,461	-20%	7,249	30%	6,104	4,883	7,935
45	Project		Camp Creek Bridge	Precast 36" I-Girder 67'	4.00	EA	29,970.09	119,880	95,904	-20%	155,844	30%	131,219	104,975	170,584
45	Project		Camp Creek Bridge	Precast 36" I-Girder 53'	8.00	EA	35,810.59	286,485	229,188	-20%	372,430	30%	313,580	250,864	407,654
45	Project		Camp Creek Bridge - Paving	Roadway Excavation	12,270	CY	40.00	490,800	392,640	-20%	613,500	25%	537,219	429,776	671,524
45	Project		Camp Creek Bridge - Paving	Ditch Excavation	200	CY	35.00	7,000	5,600	-20%	8,750	25%	7,662	6,130	9,578
45	Project		Camp Creek Bridge - Paving	Imported Borrow	12,550	CY	45.00	564,750	451,800	-20%	705,938	25%	618,164	494,531	772,705
45	Project		Camp Creek Bridge - Paving	Hot Mix Asphalt (Type A)	710	T	130.00	92,300	73,840	-20%	115,375	25%	101,030	80,824	126,287
45	Project		Camp Creek Bridge - Paving	Class 2 Aggregate Base	520	CY	65.00	33,800	27,040	-20%	42,250	25%	36,997	29,597	46,246
45	Project		Camp Creek Bridge - Paving	Midwest Guardrail System	400	LF	40.61	16,244	12,995	-20%	20,305	25%	17,780	14,224	22,225
45	Project		Camp Creek Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Camp Creek Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Camp Creek Bridge - Paving	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Camp Creek Bridge - Paving	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Camp Creek Bridge - Paving	Temporary Hydroseed	160	SY	9.22	1,475	1,180	-20%	1,844	25%	1,615	1,292	2,018
45	Project		Camp Creek Bridge - Paving	Rolled Erosion Control / Jute Mesh	160	SY	16.62	2,659	2,127	-20%	3,324	25%	2,911	2,329	3,638
45	Project		Camp Creek Bridge - Paving	Temporary Fiber Roll	225	LF	8.10	1,823	1,458	-20%	2,278	25%	1,995	1,596	2,494
45	Project		Camp Creek Bridge - Paving	Temporary Concrete Washout	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Camp Creek Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Camp Creek Bridge - Paving	Water Pollution Control	0.10	%	497,800.00	49,780	39,824	-20%	62,225	25%	54,488	43,591	68,110
45	Project		Camp Creek Bridge - Paving	Roadside Sign - One Post	8.00	EA	270.00	2,160	1,728	-20%	2,700	25%	2,364	1,891	2,955
45	Project		Camp Creek Bridge - Paving	Construction Area Signs	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Camp Creek Bridge - Paving	Thermoplastic Traffic Stripe	810	LF	0.86	697	557	-20%	871	25%	762	610	953
45	Project		Camp Creek Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Camp Creek Bridge - Paving	Traffic Control System	20.00	DA	1,000.00	20,000	16,000	-20%	25,000	25%	21,892	17,513	27,364
45	Project		Camp Creek Bridge - Paving	Temporary Railing (Type K)	300	LF	47.00	14,100	11,280	-20%	17,625	25%	15,434	12,347	19,292
45	Project		Camp Creek Bridge - Temporary Culvert	Roadway Excavation	100	CY	40.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Camp Creek Bridge - Temporary Culvert	Ditch Excavation	150	CY	35.00	5,250	4,200	-20%	6,563	25%	5,747	4,597	7,183
45	Project		Camp Creek Bridge - Temporary Culvert	Imported Borrow	3,500	CY	45.00	157,500	126,000	-20%	196,875	25%	172,396	137,917	215,495
45	Project		Camp Creek Bridge - Temporary Culvert	Clearing & Grubbing	5,000	LS	1.00	5,000	4,000	-20%	6,250	25%	5,473	4,378	6,841
45	Project		Camp Creek Bridge - Temporary Culvert	Hot Mix Asphalt (Type A)	470	T	130.00	61,100	48,880	-20%	76,375	25%	66,879	53,503	83,598
45	Project		Camp Creek Bridge - Temporary Culvert	Class 2 Aggregate Base	235	CY	65.00	15,275	12,220	-20%	19,094	25%	16,720	13,376	20,900
45	Project		Camp Creek Bridge - Temporary Culvert	Rock Slope Protection (Class?) Method B	15.00	CY	100.00	1,500	1,200	-20%	1,875	25%	1,642	1,313	2,052
45	Project		Camp Creek Bridge - Temporary Culvert	Rock Slope Protection Fabric Class 8	45.00	SY	10.13	456	365	-20%	570	25%	499	399	624
45	Project		Camp Creek Bridge - Temporary Culvert	36" Alternative Pipe Culvert	300	LF	261.42	78,426	62,741	-20%	98,033	25%	85,843	68,675	107,304
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Reinforced Silt Fence	600	LF	7.58	4,548	3,638	-20%	5,685	25%	4,978	3,983	6,223
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Fence (Type ESA)	600	LF	5.03	3,018	2,414	-20%	3,773	25%	3,303	2,643	4,129
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Hydroseed	630	SY	9.22	5,809	4,647	-20%	7,261	25%	6,358	5,086	7,947
45	Project		Camp Creek Bridge - Temporary Culvert	Rolled Erosion Control / Jute Mesh	630	SY	16.62	10,471	8,376	-20%	13,088	25%	11,461	9,169	14,326
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Fiber Roll	1,190	LF	8.10	9,639	7,711	-20%	12,049	25%	10,551	8,441	13,188
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Concrete Washout	2,000	LS	1.50	2,999	2,399	-20%	3,749	25%	3,283	2,626	4,104
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Camp Creek Bridge - Temporary Culvert	Water Pollution Control	0.10	%	328,506.85	32,851	26,281	-20%	41,063	25%	35,958	28,766	44,947
45	Project		Camp Creek Bridge - Temporary Culvert	Construction Area Signs	1.00	LS	2,000.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Traffic Stripe	650	LF	0.78	510	408	-20%	637	25%	558	446	698
45	Project		Camp Creek Bridge - Temporary Culvert	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Camp Creek Bridge - Temporary Culvert	Traffic Control System	10.00	DA	1,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Camp Creek Bridge - Temporary Culvert	Temporary Railing (Type K)	600	LF	47.00	28,200	22,560	-20%	35,250	25%	30,867	24,694	38,584
45	Project		Jenny Creek Bridge	Sheet Pile Coffer Dam For Center Footer	2,400	SF	38.40	92,161	73,729	-20%	119,809	30%	100,878	80,702	131,141
45	Project		Jenny Creek Bridge	Earth Work Coffer Dam Construction for side footers	1,186	CY	15.26	18,097	14,478	-20%	23,526	30%	19,809	15,847	25,752
45	Project		Jenny Creek Bridge	Backfill, structural, common earth, 105 H.P. dozer, 50' haul,	142	CY	39.77	5,648	4,518	-20%	7,342	30%	6,182	4,946	8,037
45	Project		Jenny Creek Bridge	Structure Excavation (Type D)	320	CY	20.27	6,486	5,189	-20%	8,432	30%	7,099	5,679	9,229
45	Project		Jenny Creek Bridge	Structure Excavation (Bridge)	209	CY	58.08	12,138	9,710	-20%	15,779	30%	13,286	10,629	17,272
45	Project		Jenny Creek Bridge	Steel piles, "H" Sections, 50' long, HP14 X 89, excludes	2,640	LF	86.12	227,362	181,890	-20%	295,571	30%	248,866	199,093	323,526
45	Project		Jenny Creek Bridge	Piling special costs, pre-augering for Pile and Tie Down	2,640	LF	311.56	822,527	658,022	-20%	1,069,286	30%	900,321	720,257	1,170,418
45	Project		Jenny Creek Bridge	Mobilization, 150 ton, set up and remove crane, with pile	2.00	EA	22,228.11	44,456	35,565	-20%	57,793	30%	48,661	38,929	63,259

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Jenny Creek Bridge	A736 Barrier Wall	776	LF	388.00	301,085	240,868	-20%	391,411	30%	329,562	263,649	428,430
45	Project		Jenny Creek Bridge	Expansion joint, neoprene, liquid, 1" x 2", cold applied	58.00	LF	44.09	2,557	2,046	-20%	3,325	30%	2,799	2,239	3,639
45	Project		Jenny Creek Bridge	Columns Structural Concrete includes forms, Grade 60 rebar,	174	CY	1,953.07	339,835	271,868	-20%	441,785	30%	371,976	297,581	483,569
45	Project		Jenny Creek Bridge	Deck Structural concrete, in place, includes forms, Grade 60	317	CY	1,143.38	362,451	289,961	-20%	471,186	30%	396,731	317,385	515,751
45	Project		Jenny Creek Bridge	Footer Structural concrete,footing, reinforced, includes	281	CY	421.72	118,503	94,802	-20%	154,053	30%	129,710	103,768	168,624
45	Project		Jenny Creek Bridge	Approach Slab Structural concrete, in place, 6" thick, includes	22.00	CY	293.49	6,457	5,166	-20%	8,394	30%	7,068	5,654	9,188
45	Project		Jenny Creek Bridge	Precast 61" Bulb Tee 73'	8.00	EA	49,373.69	394,990	315,992	-20%	513,486	30%	432,347	345,878	562,052
45	Project		Jenny Creek Bridge	Precast 61" Bulb Tee 100'	8.00	EA	78,816.06	630,528	504,423	-20%	819,687	30%	690,163	552,131	897,212
45	Project		Jenny Creek Bridge	Bridge Demolition	3,102	SF	60.00	186,120	148,896	-20%	241,956	30%	203,723	162,978	264,840
45	Project		Jenny Creek Bridge - Paving	Roadway Excavation	30,000	CY	40.00	1,200,000	960,000	-20%	1,500,000	25%	1,313,495	1,050,796	1,641,869
45	Project		Jenny Creek Bridge - Paving	Ditch Excavation	210	CY	35.00	7,350	5,880	-20%	9,188	25%	8,045	6,436	10,056
45	Project		Jenny Creek Bridge - Paving	Imported Borrow	35,000	CY	45.00	1,575,000	1,260,000	-20%	1,968,750	25%	1,723,962	1,379,170	2,154,953
45	Project		Jenny Creek Bridge - Paving	Hot Mix Asphalt (Type A)	600	T	130.00	78,000	62,400	-20%	97,500	25%	85,377	68,302	106,721
45	Project		Jenny Creek Bridge - Paving	Class 2 Aggregate Base	370	CY	65.00	24,050	19,240	-20%	30,063	25%	26,325	21,060	32,906
45	Project		Jenny Creek Bridge - Paving	Midwest Guardrail System	200	LF	40.61	8,122	6,498	-20%	10,153	25%	8,890	7,112	11,113
45	Project		Jenny Creek Bridge - Paving	Transition Railing (Type WB-31)	4.00	EA	4,000.00	16,000	12,800	-20%	20,000	25%	17,513	14,011	21,892
45	Project		Jenny Creek Bridge - Paving	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Jenny Creek Bridge - Paving	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Jenny Creek Bridge - Paving	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Jenny Creek Bridge - Paving	Temporary Hydroseed	1,770	SY	9.22	16,319	13,056	-20%	20,399	25%	17,863	14,290	22,329
45	Project		Jenny Creek Bridge - Paving	Rolled Erosion Control / Jute Mesh	1,770	SY	16.62	29,417	23,534	-20%	36,772	25%	32,200	25,760	40,250
45	Project		Jenny Creek Bridge - Paving	Temporary Fiber Roll	2,490	LF	8.10	20,169	16,135	-20%	25,211	25%	22,077	17,661	27,596
45	Project		Jenny Creek Bridge - Paving	Temporary Concrete Washout	2,000	LS	1.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Jenny Creek Bridge - Paving	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Jenny Creek Bridge - Paving	Water Pollution Control	0.10	%	2,884,400.00	288,440	230,752	-20%	360,550	25%	315,720	252,576	394,651
45	Project		Jenny Creek Bridge - Paving	Roadside Sign - One Post	8.00	EA	270.00	2,160	1,728	-20%	2,700	25%	2,364	1,891	2,955
45	Project		Jenny Creek Bridge - Paving	Construction Area Signs	2,000	LS	1.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Jenny Creek Bridge - Paving	Thermoplastic Traffic Stripe	1,000	LF	0.86	860	688	-20%	1,075	25%	941	753	1,177
45	Project		Jenny Creek Bridge - Paving	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Jenny Creek Bridge - Paving	Traffic Control System	20.00	DA	1,000.00	20,000	16,000	-20%	25,000	25%	21,892	17,513	27,364
45	Project		Jenny Creek Bridge - Paving	Temporary Railing (Type K)	300	LF	47.00	14,100	11,280	-20%	17,625	25%	15,434	12,347	19,292
45	Project		Other Structures	Pedestrian Bridge Total	800	SF	60.00	48,000	43,200	-10%	62,400	30%	52,540	47,286	68,302
45	Project		Other Structures	Bridge Demolition Ped Bridge Campground	800	SF	60.00	48,000	43,200	-10%	62,400	30%	52,540	47,286	68,302
45	Project		Other Structures	Bridge Demolition Timber JC Boyle	1,800	SF	60.00	108,000	97,200	-10%	140,400	30%	118,215	106,393	153,679
45	Project		Scotch Creek - Temporary Culvert	Roadway Excavation	550	CY	40.00	22,000	17,600	-20%	27,500	25%	24,081	19,265	30,101
45	Project		Scotch Creek - Temporary Culvert	Ditch Excavation	10.00	CY	35.00	350	280	-20%	438	25%	383	306	479
45	Project		Scotch Creek - Temporary Culvert	Imported Borrow	2,300	CY	45.00	103,500	82,800	-20%	129,375	25%	113,289	90,631	141,611
45	Project		Scotch Creek - Temporary Culvert	Clearing & Grubbing	1.00	LS	1.00	-	1	-20%	1	25%	-	-	-
45	Project		Scotch Creek - Temporary Culvert	Hot Mix Asphalt (Type A)	510	T	130.00	66,300	53,040	-20%	82,875	25%	72,571	58,056	90,713
45	Project		Scotch Creek - Temporary Culvert	Class 2 Aggregate Base	380	CY	65.00	24,700	19,760	-20%	30,875	25%	27,036	21,629	33,795
45	Project		Scotch Creek - Temporary Culvert	Rock Slope Protection (Class?) Method B	10.00	CY	100.00	1,000	800	-20%	1,250	25%	1,095	876	1,368
45	Project		Scotch Creek - Temporary Culvert	Rock Slope Protection Fabric Class 8	30.00	SY	10.13	304	243	-20%	380	25%	333	266	416
45	Project		Scotch Creek - Temporary Culvert	36" Alternative Pipe Culvert	250	LF	261.42	65,355	52,284	-20%	81,694	25%	71,536	57,229	89,420
45	Project		Scotch Creek - Temporary Culvert	Temporary Reinforced Silt Fence	300	LF	7.58	2,274	1,819	-20%	2,843	25%	2,489	1,991	3,111
45	Project		Scotch Creek - Temporary Culvert	Temporary Fence (Type ESA)	300	LF	5.03	1,509	1,207	-20%	1,886	25%	1,652	1,321	2,065
45	Project		Scotch Creek - Temporary Culvert	Temporary Hydroseed	590	SY	9.22	5,440	4,352	-20%	6,800	25%	5,954	4,763	7,443
45	Project		Scotch Creek - Temporary Culvert	Rolled Erosion Control / Jute Mesh	590	SY	16.62	9,806	7,845	-20%	12,257	25%	10,733	8,587	13,417
45	Project		Scotch Creek - Temporary Culvert	Temporary Fiber Roll	450	LF	8.10	3,645	2,916	-20%	4,556	25%	3,990	3,192	4,987
45	Project		Scotch Creek - Temporary Culvert	Temporary Concrete Washout	2,000	LS	1.50	2,999	2,399	-20%	3,749	25%	3,283	2,626	4,104
45	Project		Scotch Creek - Temporary Culvert	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Scotch Creek - Temporary Culvert	Water Pollution Control	0.10	%	283,509.90	28,351	22,681	-20%	35,439	25%	31,032	24,826	38,791
45	Project		Scotch Creek - Temporary Culvert	Construction Area Signs	1.00	LS	2,000.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Scotch Creek - Temporary Culvert	Temporary Traffic Stripe	520	LF	0.78	408	326	-20%	510	25%	446	357	558
45	Project		Scotch Creek - Temporary Culvert	Type III Barricade	2.00	EA	274.29	549	439	-20%	686	25%	600	480	751
45	Project		Scotch Creek - Temporary Culvert	Traffic Control System	10.00	DA	1,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Scotch Creek - Temporary Culvert	Temporary Railing (Type K)	500	LF	47.00	23,500	18,800	-20%	29,375	25%	25,723	20,578	32,153
45	Project		Scotch Creek - Culvert	Roadway Excavation	3,000	CY	40.00	120,000	96,000	-20%	150,000	25%	131,350	105,080	164,187
45	Project		Scotch Creek - Culvert	Ditch Excavation	10.00	CY	35.00	350	280	-20%	438	25%	383	306	479
45	Project		Scotch Creek - Culvert	Imported Borrow	3,000	CY	45.00	135,000	108,000	-20%	168,750	25%	147,768	118,215	184,710
45	Project		Scotch Creek - Culvert	Hot Mix Asphalt (Type A)	170	T	130.00	22,100	17,680	-20%	27,625	25%	24,190	19,352	30,238
45	Project		Scotch Creek - Culvert	Class 2 Aggregate Base	120	CY	65.00	7,800	6,240	-20%	9,750	25%	8,538	6,830	10,672
45	Project		Scotch Creek - Culvert	Rock Slope Protection Class III, Method B	5.00	CY	100.00	500	400	-20%	625	25%	547	438	684
45	Project		Scotch Creek - Culvert	Rock Slope Protection Fabric Class 8	12.00	SY	10.13	122	97	-20%	152	25%	133	106	166
45	Project		Scotch Creek - Culvert	Structural Concrete, Box Culvert	10.00	CY	4,835.00	48,350	38,680	-20%	60,438	25%	52,923	42,338	66,154

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Scotch Creek - Culvert	Midwest Guardrail System	400	LF	34.19	13,676	10,941	-20%	17,095	25%	14,969	11,976	18,712
45	Project		Scotch Creek - Culvert	Alternative Flared Terminal System	2.00	EA	2,000.00	4,000	3,200	-20%	5,000	25%	4,378	3,503	5,473
45	Project		Scotch Creek - Culvert	Temporary Reinforced Silt Fence	400	LF	7.58	3,032	2,426	-20%	3,790	25%	3,319	2,655	4,148
45	Project		Scotch Creek - Culvert	Temporary Fence (Type ESA)	400	LF	5.03	2,012	1,610	-20%	2,515	25%	2,202	1,762	2,753
45	Project		Scotch Creek - Culvert	Temporary Hydroseed	220	SY	9.22	2,028	1,623	-20%	2,536	25%	2,220	1,776	2,775
45	Project		Scotch Creek - Culvert	Rolled Erosion Control / Jute Mesh	220	SY	16.62	3,656	2,925	-20%	4,571	25%	4,002	3,202	5,003
45	Project		Scotch Creek - Culvert	Temporary Fiber Roll	450	LF	8.10	3,645	2,916	-20%	4,556	25%	3,990	3,192	4,987
45	Project		Scotch Creek - Culvert	Temporary Construction Entrance	2.00	EA	4,303.25	8,607	6,885	-20%	10,758	25%	9,420	7,536	11,776
45	Project		Scotch Creek - Culvert	Water Pollution Control	0.10	%	334,221.56	33,422	26,738	-20%	41,778	25%	36,583	29,267	45,729
45	Project		Scotch Creek - Culvert	Construction Area Signs	1.00	LS	2,500.00	2,500	2,000	-20%	3,125	25%	2,736	2,189	3,421
45	Project		Scotch Creek - Culvert	Thermoplastic Traffic Stripe	200	LF	0.86	172	138	-20%	215	25%	188	151	235
45	Project		Scotch Creek - Culvert	Traffic Control System	1.00	LS	10,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Scotch Creek - Culvert	Temporary Railing (Type K)	200	LF	33.57	6,714	5,371	-20%	8,393	25%	7,349	5,879	9,187
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Roadway Excavation	3,000	CY	40.00	120,000	96,000	-20%	150,000	25%	131,350	105,080	164,187
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Imported Borrow	2,500	CY	45.00	112,500	90,000	-20%	140,625	25%	123,140	98,512	153,925
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Rock Slope Protection Class III, Method B	250	CY	100.00	25,000	20,000	-20%	31,250	25%	27,364	21,892	34,206
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Rock Slope Protection Fabric Class 8	700	SY	10.13	7,091	5,673	-20%	8,864	25%	7,762	6,209	9,702
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	60" CORRUGATED STEEL PIPE (.138" THICK)	80.00	LF	270.00	21,600	17,280	-20%	27,000	25%	23,643	18,914	29,554
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Temporary Reinforced Silt Fence	600	LF	7.58	4,548	3,638	-20%	5,685	25%	4,978	3,983	6,223
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Temporary Fence (Type ESA)	600	LF	5.03	3,018	2,414	-20%	3,773	25%	3,303	2,643	4,129
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Water Pollution Control	0.10	%	286,191.00	28,619	22,895	-20%	35,774	25%	31,326	25,061	39,157
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Construction Area Signs	1.00	LS	600.00	600	480	-20%	750	25%	657	525	821
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Traffic Control System	1.00	LS	10,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Temporary Railing (Type K)	80.00	LF	33.57	2,686	2,149	-20%	3,357	25%	2,940	2,352	3,675
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Replace and Reconstruct 60-inch Culvert No.1 at Beaver	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Copco Rd at Beaver Creek Culvert (60 in dia)	Replace and Reconstruct 60-inch Culvert No.2 at Beaver	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Copco Rd at Raymond Gulch Culvert	Rock Slope Protection Class III, Method B	150	CY	100.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Copco Rd at Raymond Gulch Culvert	Rock Slope Protection Fabric Class 8	400	SY	10.13	4,052	3,242	-20%	5,065	25%	4,435	3,548	5,544
45	Project		Copco Rd at Raymond Gulch Culvert	Temporary Reinforced Silt Fence	600	LF	7.58	4,548	3,638	-20%	5,685	25%	4,978	3,983	6,223
45	Project		Copco Rd at Raymond Gulch Culvert	Temporary Fence (Type ESA)	600	LF	5.03	3,018	2,414	-20%	3,773	25%	3,303	2,643	4,129
45	Project		Copco Rd at Raymond Gulch Culvert	Water Pollution Control	1.00	LS	19,052.00	19,052	15,242	-20%	23,815	25%	20,854	16,683	26,067
45	Project		Copco Rd at Raymond Gulch Culvert	Traffic Control System	1.00	LS	1,000.00	1,000	800	-20%	1,250	25%	1,095	876	1,368
45	Project		Copco Rd at Raymond Gulch Culvert	60-inch Culvert at Raymond Gulch	1.00	LS	10,000.00	10,000	8,000	-20%	12,500	25%	10,946	8,757	13,682
45	Project		Patricia Avenue Culverts	Rock Slope Protection Class III, Method B	150	CY	100.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Patricia Avenue Culverts	Rock Slope Protection Fabric Class 8	400	SY	10.13	4,052	3,242	-20%	5,065	25%	4,435	3,548	5,544
45	Project		Patricia Avenue Culverts	Water Pollution Control	0.10	%	19,052.00	1,905	1,524	-20%	2,382	25%	2,085	1,668	2,607
45	Project		Patricia Avenue Culverts	Traffic Control System	1.00	LS	1,000.00	1,000	800	-20%	1,250	25%	1,095	876	1,368
45	Project		Topsy Grade Culverts	Trench Excavation	275	CY	40.00	11,000	8,800	-20%	13,750	25%	12,040	9,632	15,050
45	Project		Topsy Grade Culverts	Clearing & Grubbing	1.00	LS	2,000.00	2,000	1,600	-20%	2,500	25%	2,189	1,751	2,736
45	Project		Topsy Grade Culverts	Rock Slope Protection Class III, Method B	800	CY	100.00	80,000	64,000	-20%	100,000	25%	87,566	70,053	109,458
45	Project		Topsy Grade Culverts	Rock Slope Protection Fabric Class 8	2,350	SY	10.13	23,806	19,044	-20%	29,757	25%	26,057	20,846	32,571
45	Project		Topsy Grade Culverts	24" corrugated steel pipe (.138" thick)	200	LF	137.50	27,500	22,000	-20%	34,375	25%	30,101	24,081	37,626
45	Project		Topsy Grade Culverts	Temporary Reinforced Silt Fence	1,000	LF	7.58	7,580	6,064	-20%	9,475	25%	8,297	6,638	10,371
45	Project		Topsy Grade Culverts	Temporary Fence (Type ESA)	1,000	LF	5.03	5,030	4,024	-20%	6,288	25%	5,506	4,405	6,882
45	Project		Topsy Grade Culverts	Water Pollution Control	0.10	%	144,305.50	14,431	11,544	-20%	18,038	25%	15,795	12,636	19,744
45	Project		Topsy Grade Culverts	Traffic Control System	1.00	LS	5,000.00	5,000	4,000	-20%	6,250	25%	5,473	4,378	6,841
45	Project		JC Boyle Unnamed Culverts	Rock Slope Protection Class III, Method B	115	CY	100.00	11,500	9,200	-20%	14,375	25%	12,588	10,070	15,735
45	Project		JC Boyle Unnamed Culverts	Rock Slope Protection Fabric Class 8	350	SY	10.13	3,546	2,836	-20%	4,432	25%	3,881	3,105	4,851
45	Project		JC Boyle Unnamed Culverts	Water Pollution Control	0.10	%	15,045.50	1,505	1,204	-20%	1,881	25%	1,647	1,317	2,059
45	Project		JC Boyle Unnamed Culverts	Traffic Control System	1.00	LS	1,000.00	1,000	800	-20%	1,250	25%	1,095	876	1,368
45	Project		Copco Road at Unnamed Creek Culvert No. 1	Copco Road at Unnamed Creek Culvert No. 1	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Copco Road at Unnamed Creek Culvert No. 2	Copco Road at Unnamed Creek Culvert No. 2	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		6'x6'x34' Box Culvert installation	6'x6'x34' Box Culvert installation	1.00	LS	15,000.00	15,000	12,000	-20%	18,750	25%	16,419	13,135	20,523
45	Project		Paving - Lakeview Disposal Access Road	Pre: none; Post: 0.7 miles 6" AB overlay (no drainage	1.00	EA	170,000.00	170,000	-	-20%	340,000	25%	191,227	-	382,454
45	Project		Paving - Copco 1 Dam Access	Pre: 2500CY roadway excavation, 0.9 miles 9" AB overlay (no	1.00	EA	250,000.00	250,000	190,000	-20%	370,000	25%	270,400	205,504	400,192
45	Project		Paving - Copco Rd from Copco 1 access to Copco Bridge	Pre: 1 mile 9" AB repair; Post: 1 mile 9" AB repair, 0.2 mile	1.00	EA	318,000.00	318,000	208,000	-20%	585,000	25%	352,204	230,372	647,922
45	Project		Paving - Copco 1 Ager Beswick Rd Barge Access	Pre: minor excavation and 9"' AB section; Post: none	1.00	EA	60,000.00	60,000	-	-20%	120,000	25%	64,896	-	129,792
45	Project		Paving - US 97 Dalles CA Hwy	Pre: none; Post: none (high only)	1.00	EA	966,000.00	-	-	-20%	966,000	25%	-	-	1,086,619
45	Project		Paving - OR 66 Green Springs hwy	Pre: none; Post: none (high only)	1.00	EA	-	-	-	-20%	988,000	25%	-	-	1,111,366
45	Project		Paving - JC Boyle Keno Worden	Pre: none; Post: none (high only)	1.00	EA	-	-	-	-20%	988,000	25%	-	-	1,111,366
45	Project		Paving - Topsy Grade Rd	Pre: 0.9 mile 9" AB repair; Post: 0.9 mile 9" AB repair	1.00	EA	880,000.00	880,000	440,000	-20%	1,320,000	25%	970,844	485,422	1,456,266

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
45	Project		Paving - JC Boyle Dam Access Rd (2,940 ft to dam toe)	Pre: minor excavation; 0.25 mile new 9" AB, 0.7 mile 9" AB	1.00	EA	335,000.00	335,000	212,000	-20%	374,000	25%	368,133	232,968	410,991
45	Project		Paving - JC Boyle Power Canal Access Rd	Pre: 1.5 mile 9" AB repair; post: 1.5 mile 9" AB repair; no	1.00	EA	432,000.00	432,000	216,000	-20%	744,000	25%	476,596	238,298	820,805
45	Project		Paving - JC Boyle Powerhouse Access Rd	Pre: none; Post: none (high only)	1.00	EA	-	-	-	-20%	216,000	25%	-	-	242,971
45	Project		Paving - Copco Rd I5 to Ager Rd	Pre: none; Post: 1 mile new asphalt overlay	1.00	EA	1,090,000.00	1,090,000	545,000	-20%	2,100,000	25%	1,226,102	613,051	2,362,214
45	Project		Paving - Copco Rd Ager Rd to Lakeview Rd	Pre: 0.5 miles crack sealer, 0.75 miles new asphalt; Post: 1	1.00	EA	1,625,000.00	1,625,000	1,185,000	-20%	5,235,000	25%	1,799,782	1,312,457	5,798,068
45	Project		Paving - Copco Rd to Lakeview Rd to Dagget Rd	Pre: 1 mile crack sealer, 1.5 miles new asphalt; Post: 2 miles	1.00	EA	2,980,000.00	2,980,000	2,370,000	-20%	10,470,000	25%	3,300,524	2,624,913	11,596,136
45	Project		Paving - Copco Rd Daggett Rd to Copco 1 Access Rd	Pre: 1.5 mile 9" AB repair; Post: 1.5 mile 9" AB repair, no	1.00	EA	432,000.00	432,000	216,000	-20%	744,000	25%	476,596	238,298	820,805
46			**RECREATION IMPROVEMENTS**												
46	Project		Campground - Jenny Creek expansion & upgrade	Picnic table	7.00	EA	2,363.80	16,547	10,500	-37%	21,000	27%	18,112	11,493	22,986
46	Project		Campground - Jenny Creek expansion & upgrade	Fire grate	7.00	EA	675.37	4,728	3,000	-37%	6,000	27%	5,175	3,284	6,567
46	Project		Campground - Jenny Creek expansion & upgrade	Trash bins	7.00	EA	1,000.00	7,000	5,000	-29%	10,000	43%	7,662	5,473	10,946
46	Project		Campground - Jenny Creek expansion & upgrade	Parking	7.00	EA	562.81	3,940	2,500	-37%	5,000	27%	4,312	2,736	5,473
46	Project		Campground - Jenny Creek expansion & upgrade	Shade structure	3.00	EA	14,633.07	43,899	26,000	-41%	65,000	48%	48,051	28,459	71,148
46	Project		Campground - Jenny Creek expansion & upgrade	Restroom (single vault toilet)	2.00	EA	57,406.66	114,813	102,000	-11%	204,000	78%	125,672	111,647	223,294
46	Project		Campground - Jenny Creek expansion & upgrade	Assumed earthwork	450	CY	9.00	4,052	2,400	-41%	4,800	18%	4,435	2,627	5,254
46	Project		Campground - Jenny Creek expansion & upgrade	Signage	2.00	EA	5,000.00	10,000	5,000	-50%	15,000	50%	10,946	5,473	16,419
46	Project		Campground - Jenny Creek expansion & upgrade	Operations and maintenance	5.00	YR	33,768.63	168,843	-	0%	600,000	255%	184,812	-	656,748
46	Project		Campground - Topsy upgrade	boat ramp	1.00	EA	10,000.00	10,000	10,000	0%	10,000	0%	10,946	10,946	10,946
46	Project		Campground - Topsy upgrade	trash bins	1.00	EA	1,000.00	1,000	1,000	0%	1,000	0%	1,095	1,095	1,095
46	Project		Campground - Topsy upgrade	Operations and maintenance	5.00	YR	11,256.21	56,281	-	0%	200,000	255%	61,604	-	218,916
46	Project		Campgrounds - New campgrounds	picnic table	20.00	EA	2,363.80	47,276	47,276	0%	47,276	0%	51,747	51,747	51,747
46	Project		Campgrounds - New campgrounds	fire grate	20.00	EA	675.37	13,507	13,507	0%	13,507	0%	14,785	14,785	14,785
46	Project		Campgrounds - New campgrounds	trash bins	20.00	EA	1,000.00	20,000	20,000	0%	20,000	0%	21,892	21,892	21,892
46	Project		Campgrounds - New campgrounds	restroom (single vault toilet)	6.00	EA	57,406.66	344,440	344,440	0%	344,440	0%	377,017	377,017	377,017
46	Project		Campgrounds - New campgrounds	parking	20.00	EA	562.81	11,256	11,256	0%	11,256	0%	12,321	12,321	12,321
46	Project		Campgrounds - New campgrounds	boat ramp	2.00	EA	11,256.21	22,512	14,633	-35%	22,512	0%	24,642	16,017	24,642
46	Project		Campgrounds - New campgrounds	trash bins	2.00	EA	1,000.00	2,000	1,300	-35%	2,000	0%	2,189	1,423	2,189
46	Project		Campgrounds - New campgrounds	picnic table	2.00	EA	2,363.80	4,728	4,255	-10%	4,728	0%	5,175	4,657	5,175
46	Project		Campgrounds - New campgrounds	fire grate	2.00	EA	675.37	1,351	1,216	-10%	1,351	0%	1,478	1,331	1,478
46	Project		Campgrounds - New campgrounds	trash bins	2.00	EA	1,000.00	2,000	2,000	0%	2,000	0%	2,189	2,189	2,189
46	Project		Campgrounds - New campgrounds	assumed earthwork	1,200	CY	9.00	10,806	9,725	-10%	10,806	0%	11,828	10,645	11,828
46	Project		Campgrounds - New campgrounds	signage	4.00	EA	5,000.00	20,000	10,000	-50%	30,000	50%	21,892	10,946	32,837
46	Project		Campgrounds - New campgrounds	Operations and maintenance	5.00	YR	67,537.25	337,686	-	0%	1,200,000	255%	369,624	-	1,313,495
46	Project		Recreation area - Fall Creek upgrade	restroom (single vault toilet)	1.00	EA	57,406.66	57,407	51,666	-10%	103,332	80%	62,836	56,553	113,105
46	Project		Recreation area - Fall Creek upgrade	picnic table	5.00	EA	2,363.80	11,819	8,400	-29%	12,600	7%	12,937	9,194	13,792
46	Project		Recreation area - Fall Creek upgrade	shade structure	2.00	EA	14,633.07	29,266	26,340	-10%	43,899	50%	32,034	28,831	48,051
46	Project		Recreation area - Fall Creek upgrade	fire grate	4.00	EA	675.37	2,701	1,800	-33%	3,000	11%	2,957	1,970	3,284
46	Project		Recreation area - Fall Creek upgrade	trash bins	5.00	EA	1,000.00	5,000	4,000	-20%	6,000	20%	5,473	4,378	6,567
46	Project		Recreation area - Fall Creek upgrade	parking	6.00	EA	562.81	3,377	2,000	-41%	4,000	18%	3,696	2,189	4,378
46	Project		Recreation area - Fall Creek upgrade	reconstructed trail	0.50	MI	35,659.67	17,830	7,920	-56%	31,680	78%	19,516	8,669	34,676
46	Project		Recreation area - Fall Creek upgrade	assumed earthwork	300	CY	9.00	2,701	1,600	-41%	3,200	18%	2,957	1,751	3,503
46	Project		Recreation area - Fall Creek upgrade	signage	2.00	EA	5,000.00	10,000	5,000	-50%	15,000	50%	10,946	5,473	16,419
46	Project		Recreation area - Fall Creek upgrade	Operations and maintenance	5.00	YR	16,884.31	84,422	-	0%	300,000	255%	92,406	-	328,374
46	Project		Recreation area - Iron Gate Hatchery day use site	shade structure	3.00	EA	14,633.07	43,899	26,000	-41%	52,000	18%	48,051	28,459	56,918
46	Project		Recreation area - Iron Gate Hatchery day use site	picnic table	6.00	EA	2,363.80	14,183	8,400	-41%	16,800	18%	15,524	9,194	18,389
46	Project		Recreation area - Iron Gate Hatchery day use site	trash bins	7.00	EA	1,000.00	7,000	5,000	-29%	9,000	29%	7,662	5,473	9,851
46	Project		Recreation area - Iron Gate Hatchery day use site	parking	6.00	EA	562.81	3,377	2,000	-41%	4,000	18%	3,696	2,189	4,378
46	Project		Recreation area - Iron Gate Hatchery day use site	fire grate	6.00	EA	675.37	4,052	2,400	-41%	4,800	18%	4,435	2,627	5,254
46	Project		Recreation area - Iron Gate Hatchery day use site	restroom (single vault toilet)	2.00	EA	57,406.66	114,813	102,000	-11%	204,000	78%	125,672	111,647	223,294
46	Project		Recreation area - Iron Gate Hatchery day use site	boat ramp	1.00	EA	11,256.21	11,256	11,256	0%	11,256	0%	12,321	12,321	12,321
46	Project		Recreation area - Iron Gate Hatchery day use site	assumed earthwork	450	CY	9.00	4,052	2,400	-41%	4,800	18%	4,435	2,627	5,254
46	Project		Recreation area - Iron Gate Hatchery day use site	signage	2.00	EA	5,000.00	10,000	5,000	-50%	15,000	50%	10,946	5,473	16,419
46	Project		Recreation area - Iron Gate Hatchery day use site	Operations and maintenance	5.00	YR	16,884.31	84,422	-	0%	300,000	255%	92,406	-	328,374
46	Project		Recreation area - River fishing access sites	parking	18.00	EA	562.81	10,131	-	0%	12,000	18%	11,089	-	13,135
46	Project		Recreation area - River fishing access sites	portable toilet	6.00	EA	787.93	4,728	4,200	-11%	5,600	18%	5,175	4,597	6,130
46	Project		Recreation area - River fishing access sites	trash bins	6.00	EA	1,000.00	6,000	6,000	0%	8,000	33%	6,567	6,567	8,757
46	Project		Recreation area - River fishing access sites	signage	6.00	EA	5,000.00	30,000	30,000	0%	40,000	33%	32,837	32,837	43,783
46	Project		Recreation area - River fishing access sites	trail refurbishment	7,920	LF	6.75	53,490	47,520	-11%	63,360	18%	58,548	52,014	69,353
46	Project		Recreation area - River fishing access sites	Operations and maintenance	5.00	YR	11,256.21	56,281	-	0%	200,000	255%	61,604	-	218,916
46	Project		Recreation area - New day use sites	picnic table	4.00	EA	2,363.80	9,455	-	0%	12,600	33%	10,349	-	13,792
46	Project		Recreation area - New day use sites	fire grate	4.00	EA	675.37	2,701	-	0%	3,600	33%	2,957	-	3,940

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
46	Project		Recreation area - New day use sites	trash bins	4.00	EA	1,000.00	4,000	-	0%	6,000	50%	4,378	-	6,567
46	Project		Recreation area - New day use sites	shade structure	2.00	EA	14,633.07	29,266	-	0%	39,000	33%	32,034	-	42,689
46	Project		Recreation area - New day use sites	assumed earthwork	200	CY	9.00	1,801	-	0%	2,400	33%	1,971	-	2,627
46	Project		Recreation area - New day use sites	signage	2.00	EA	5,000.00	10,000	-	0%	15,000	50%	10,946	-	16,419
46	Project		Recreation area - New day use sites	Operations and maintenance	5.00	YR	22,512.42	112,562	-	0%	400,000	255%	123,208	-	437,832
46	Project		Recreation area - New boat ramps	New boat ramps	4.00	EA	11,256.21	45,025	20,000	-56%	80,000	78%	49,283	21,892	87,566
46	Project		Non-motorized rec trails - JC Boyle to Iron Gate	Trail	20.00	MI	35,659.67	713,193	-	0%	1,267,200	78%	780,647	-	1,387,051
46	Project		Non-motorized rec trails - JC Boyle to Iron Gate	Signage	2.00	EA	5,000.00	10,000	-	0%	15,000	50%	10,946	-	16,419
46	Project		Non-motorized rec trails	Walking trails for recreation access to river	7.00	MI	35,659.67	249,618	158,400	-37%	316,800	27%	273,226	173,381	346,763
46	Project		Non-motorized rec trails - Walking/wildlife viewing/interpretive	Trail Grading	5.00	MI	35,659.67	178,298	-	0%	316,800	78%	195,162	-	346,763
46	Project		Non-motorized rec trails - Walking/wildlife viewing/interpretive	trash bins	1.00	EA	1,000.00	1,000	-	#####	1,000	0%	1,095	-	1,095
46	Project		Non-motorized rec trails - Walking/wildlife viewing/interpretive	Signage	2.00	EA	5,000.00	10,000	-	0%	15,000	0%	10,946	-	16,419
46	Project		General Conditions	Contractor overhead	15%	%	3,337,792.01	500,669	450,772	-10%	651,114	30%	548,022	493,405	712,696
46	Project		General Conditions	Contractor profit	8%	%	3,337,792.01	267,023	240,411	-10%	347,261	30%	292,278	263,149	380,105
46	Project		General Conditions	Insurance	1%	%	4,105,484.17	41,055	36,963	-10%	53,391	30%	44,938	40,459	58,441
46	Project		General Conditions	Bond	1%	%	4,105,484.17	41,055	36,963	-10%	53,391	30%	44,938	40,459	58,441
47			**FLOOD PROOFING**												
47	Project	10.010	Raise homes	Cost to raise homes and add 2 stairs	45.00	EA	30,187.71	1,358,447	1,086,758	-20%	1,765,981	30%	1,498,682	1,198,946	1,948,287
48			**PUBLIC HEALTH AND SAFETY**												
48	Project		Public Health and Safety	Cattle exclusion fencing	182,160	LF	11.90	2,167,704	2,489,116	15%	3,042,253	40%	2,363,345	2,713,766	3,316,825
50			**MITIGATION MEASURES**												
51			**GROUNDWATER IMPROVEMENTS**												
51	Project		Groundwater improvements	Outreach to well owners	1.00	SUM	55,000.00	55,000	55,000	0%	55,000	0%	59,488	59,488	59,488
51	Project		Groundwater improvements	Drill and install new monitoring wells	5.00	EA	16,000.00	80,000	48,000	-40%	80,000	0%	88,259	52,955	88,259
51	Project		Groundwater improvements	Sentinel water level monitoring of new wells and landowner	36.00	MO	2,800.00	100,800	86,400	-14%	115,200	14%	115,743	99,208	132,278
51	Project		Groundwater improvements	WQ laboratory analytical testing	1.00	SUM	37,500.00	37,500	15,000	-60%	60,000	60%	41,371	16,548	66,194
51	Project		Groundwater improvements	Well replacements	20.00	EA	63,375.00	1,267,500	810,000	-36%	1,725,000	36%	1,483,366	947,950	2,018,782
51	Project		Groundwater improvements	Well abandonment	20.00	EA	2,625.00	52,500	30,000	-43%	75,000	43%	58,488	33,421	83,554
51	Project		Groundwater improvements	Temporary water supply	16.00	EA	3,406.25	54,500	36,000	-34%	73,000	34%	60,716	40,106	81,326
51	Project		Groundwater improvements	Permitting and Reporting	1.00	SUM	66,500.00	66,500	37,000	-44%	96,000	44%	74,084	41,220	106,949
52			**WATER SUPPLY/RIGHTS**												
52	Project		Water supply rights	Hay production	3,379	T	175.00	591,357	506,877	-14%	675,836	14%	652,403	559,203	745,604
52	Project		Water supply rights	Water supply for domestic use for water rights	1.00	LS	28.01	8,666	8,436	-3%	9,053	4%	9,561	9,306	9,988
52	Project		Water supply rights	Sediment removal at intakes	254	CY	500.00	126,999	63,500	-50%	190,499	50%	140,110	70,055	210,164
52	Project		Water supply rights	Groundwater wells - domestic	9.00	EA	10,000.00	90,000	40,000	-56%	100,000	11%	99,291	44,129	110,323
52	Project		Water supply rights	Groundwater wells - municipal	1.00	EA	100,000.00	100,000	-	#####	100,000	0%	110,323	-	110,323
52	Project		Water supply rights	Sediment basin	39.00	EA	1,851.85	72,222	72,222	0%	72,222	0%	79,678	79,678	79,678
53			**CULTURAL RESOURCES**												
53			**2017/18 Support**												
53	Project		Cultural Resources Tasks	Generally	12.00	MO	168,958.33	2,027,500	1,824,750	-10%	2,230,250	10%	2,027,500	1,824,750	2,230,250
53			**2018/19 Support**												
53	Project		Cultural Resources Tasks	Generally	12.00	MO	168,958.33	2,027,500	1,824,750	-10%	2,230,250	10%	2,068,050	1,861,245	2,274,855
			2019 H2 Support												
53	Project		Task management	Principal Scientist/Planner	208	HR	900.00	187,200	168,480	-10%	205,920	10%	194,688	175,219	214,157
53	Project		Task 1.2A Agency consultation	Principal Scientist/Planner	83.20	HR	180.00	14,976	13,478	-10%	16,474	10%	15,575	14,018	17,133
53	Project		Task 1.2A Agency consultation	Senior Scientist/Planner	41.60	HR	160.00	6,656	5,990	-10%	7,322	10%	6,922	6,230	7,614
53	Project		Task 1.2B Tribal consultation and work plans	Principal Scientist/Planner	256	HR	180.00	46,080	41,472	-10%	50,688	10%	47,923	43,131	52,716
53	Project		Task 1.2B Tribal consultation and work plans	Senior Scientist/Planner	128	HR	160.00	20,480	18,432	-10%	22,528	10%	21,299	19,169	23,429
53	Project		Task 1.2B Tribal consultation and work plans	Technical Editor	16.00	HR	105.00	1,680	1,512	-10%	1,848	10%	1,747	1,572	1,922
53	Project		Task 1.2B Tribal consultation and work plans	GIS/CADD/Graphics	24.00	HR	90.00	2,160	1,944	-10%	2,376	10%	2,246	2,022	2,471
			2020-2024 Support												
53	Project		Task management	Principal Scientist/Planner	1,040	HR	180.00	187,200	168,480	-10%	205,920	10%	210,795	189,715	231,874
53	Project		Task 1.2A Agency consultation	Principal Scientist/Planner	416	HR	180.00	74,880	67,392	-10%	82,368	10%	84,318	75,886	92,750

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
53	Project		Task 1.2A Agency consultation	Senior Scientist/Planner	208	HR	160.00	33,280	29,952	-10%	36,608	10%	37,475	33,727	41,222
53	Project		Task 1.2B Tribal consultation and work plans	Principal Scientist/Planner	1,280	HR	180.00	230,400	207,360	-10%	253,440	10%	259,440	233,496	285,384
53	Project		Task 1.2B Tribal consultation and work plans	Senior Scientist/Planner	640	HR	160.00	102,400	92,160	-10%	112,640	10%	115,307	103,776	126,837
53	Project		Task 1.2B Tribal consultation and work plans	Technical Editor	80.00	HR	105.00	8,400	7,560	-10%	9,240	10%	9,459	8,513	10,405
53	Project		Task 1.2B Tribal consultation and work plans	GIS/CADD/Graphics	120	HR	90.00	10,800	9,720	-10%	11,880	10%	12,161	10,945	13,377
53	Project		Task 2.6L Curation	Principal Scientist/Planner	80.00	HR	180.00	14,400	12,960	-10%	15,840	10%	16,110	14,499	17,721
53	Project		Task 2.6L Curation	Scientist/Planner	1,640	HR	120.00	196,800	177,120	-10%	216,480	10%	220,165	198,148	242,181
53	Project		Task 2.6L Curation	Curation	410	EA	500.00	205,000	184,500	-10%	225,500	10%	229,338	206,405	252,272
53	Project		Task 2.6L Curation	Other direct costs	1.00	SUM	5,000.00	5,000	4,500	-10%	5,500	10%	5,594	5,034	6,153
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Principal Scientist/Planner	200	HR	180.00	36,000	32,400	-10%	39,600	10%	38,938	35,044	42,831
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Senior Scientist/Planner	290	HR	160.00	46,400	41,760	-10%	51,040	10%	50,186	45,168	55,205
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Scientist/Planner	1,180	HR	120.00	141,600	127,440	-10%	155,760	10%	153,155	137,839	168,470
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Technical Editor	40.00	HR	105.00	4,200	3,780	-10%	4,620	10%	4,543	4,088	4,997
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Junior Scientist/Planner	10.00	HR	95.00	950	855	-10%	1,045	10%	1,028	925	1,130
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	GIS/CADD/Graphics	100	HR	90.00	9,000	8,100	-10%	9,900	10%	9,734	8,761	10,708
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Tribal monitor subcontract	149	DA	617.00	91,933	82,740	-10%	101,126	10%	99,435	89,491	109,378
53	Project		Task 2.6M Arch fieldwork - Drawdown shoreline survey	Travel and perdiem	1.00	SUM	35,858.00	35,858	32,272	-10%	39,444	10%	38,784	34,906	42,662
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Principal Scientist/Planner	200	HR	180.00	36,000	32,400	-10%	39,600	10%	40,495	36,446	44,545
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Senior Scientist/Planner	98.00	HR	160.00	15,680	14,112	-10%	17,248	10%	17,638	15,874	19,402
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Scientist/Planner	972	HR	120.00	116,640	104,976	-10%	128,304	10%	131,204	118,084	144,325
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Technical Editor	40.00	HR	105.00	4,200	3,780	-10%	4,620	10%	4,724	4,252	5,197
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Junior Scientist/Planner	20.00	HR	95.00	1,900	1,710	-10%	2,090	10%	2,137	1,924	2,351
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	GIS/CADD/Graphics	120	HR	90.00	10,800	9,720	-10%	11,880	10%	12,149	10,934	13,363
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Field Technician	768	HR	75.00	57,600	51,840	-10%	63,360	10%	64,792	58,313	71,271
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Tribal monitor subcontract	77.00	DA	647.85	49,884	44,896	-10%	54,873	10%	56,113	50,502	61,725
53	Project		Task 2.6M Arch fieldwork - Post drawdown survey	Travel and perdiem	1.00	SUM	30,900.00	30,900	27,810	-10%	33,990	10%	34,758	31,282	38,234
53	Project		Task 2.6N Discoveries - Burial recovery	Human remains	100	EA	15,000.00	1,500,000	1,350,000	-10%	1,650,000	10%	1,689,061	1,520,155	1,857,968
53	Project		Task 2.6N Discoveries - Burial recovery	Other direct costs	1.00	SUM	500.00	500	450	-10%	550	10%	563	507	619
53	Project		Task 2.6N Discoveries - Arch resources	Archaeological unit cost	60.00	EA	30,000.00	1,800,000	1,620,000	-10%	1,980,000	10%	2,026,874	1,824,186	2,229,561
53	Project		Task 2.6N Discoveries - Arch resources	Other direct costs	1.00	SUM	500.00	500	450	-10%	550	10%	563	507	619
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Principal Scientist/Planner	240	HR	180.00	43,200	38,880	-10%	47,520	10%	47,660	42,894	52,426
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Senior Scientist/Planner	1,808	HR	160.00	289,280	260,352	-10%	318,208	10%	319,143	287,229	351,057
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Scientist/Planner	1,928	HR	120.00	231,360	208,224	-10%	254,496	10%	255,244	229,719	280,768
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Technical Editor	40.00	HR	105.00	4,200	3,780	-10%	4,620	10%	4,634	4,170	5,097
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Junior Scientist/Planner	40.00	HR	95.00	3,800	3,420	-10%	4,180	10%	4,192	3,773	4,612
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	GIS/CADD/Graphics	120	HR	90.00	10,800	9,720	-10%	11,880	10%	11,915	10,723	13,106
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Field Technician	7,680	HR	75.00	576,000	518,400	-10%	633,600	10%	635,462	571,915	699,008
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Tribal monitor subcontract	452	EA	617.00	278,884	250,996	-10%	306,772	10%	307,674	276,906	338,441
53	Project		Task 2.6O Short-term monitoring FY 2021-2022	Other direct costs	1.00	SUM	127,984.00	127,984	115,186	-10%	140,782	10%	141,196	127,076	155,316
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Principal Scientist/Planner	240	HR	180.00	43,200	38,880	-10%	47,520	10%	52,586	47,328	57,845
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Senior Scientist/Planner	1,176	HR	160.00	188,160	169,344	-10%	206,976	10%	229,043	206,139	251,947
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Scientist/Planner	1,536	HR	120.00	184,320	165,888	-10%	202,752	10%	224,368	201,932	246,805
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Technical Editor	40.00	HR	105.00	4,200	3,780	-10%	4,620	10%	5,113	4,601	5,624
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Junior Scientist/Planner	40.00	HR	95.00	3,800	3,420	-10%	4,180	10%	4,626	4,163	5,088
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	GIS/CADD/Graphics	230	HR	90.00	20,700	18,630	-10%	22,770	10%	25,198	22,678	27,717
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Field Technician	7,680	HR	75.00	576,000	518,400	-10%	633,600	10%	701,151	631,036	771,267
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Tribal monitor subcontract	294	EA	647.85	190,468	171,421	-10%	209,515	10%	231,852	208,667	255,037
53	Project		Task 2.6O Short-term monitoring FY 2023-2025	Other direct costs	1.00	SUM	57,448.00	57,448	51,703	-10%	63,193	10%	69,930	62,937	76,923
53	Project		TCP Project allowance	TCP Project allowance	1.00	SUM	1,000,000.00	1,000,000	1,000,000	0%	1,000,000	0%	1,000,000	1,000,000	1,000,000
53	Project		Cultural resources allowance	Allowance for additional discoveries (reconciled with risk log)	1.00	SUM	1,000,000.00	1,000,000	1,000,000	0%	1,000,000	0%	1,000,000	1,000,000	1,000,000
60			**MONITORING AND OTHER COSTS**												
61			**AQUATIC RESOURCES**												
61	Project		Mainstem spawning (AR-1)	Tributory confluence monitoring (passage)	960	HR	46.13	44,280	39,852	-10%	66,420	50%	48,866	43,980	73,299
61	Project		Mainstem spawning (AR-1)	Confluence Area Maintenance (downstream tribs)	900	HR	46.13	41,513	37,361	-10%	62,269	50%	45,812	41,231	68,718
61	Project		Mainstem spawning (AR-1)	Confluence Area Maintenance (upstream tribs)	400	HR	102.50	41,000	36,900	-10%	61,500	50%	45,246	40,722	67,870
61	Project		Mainstem spawning (AR-1)	Mainstem Spawning Gravel Survey (45.3 miles)	100	HR	148.63	14,863	13,376	-10%	22,294	50%	16,402	14,762	24,603
61	Project		Mainstem spawning (AR-1)	Tributary Spawning Gravel Survey (13.9 miles)	200	HR	102.50	20,500	18,450	-10%	30,750	50%	22,623	20,361	33,935
61	Project		Mainstem spawning (AR-1)	Reporting and Coordination	1,280	HR	102.50	131,200	118,080	-10%	196,800	50%	144,789	130,310	217,183
61	Project		Mainstem spawning (AR-1)	Spawning Gravel Augmentation	16,132	CY	256.25	4,133,825	3,720,443	-10%	6,200,738	50%	4,561,971	4,105,774	6,842,957
61	Project		Mainstem spawning (AR-1)	Laborer (30 days)	240	HR	35.88	8,610	7,749	-10%	12,915	50%	9,502	8,552	14,253
61	Project		Mainstem spawning (AR-1)	200 Class Excavator (30 days)	240	HR	256.25	61,500	55,350	-10%	92,250	50%	67,870	61,083	101,804

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
61	Project		Juvenile outmigration (AR-2)	Tributary Confluence Monitoring (Passage)	960	HR	46.13	44,280	39,852	-10%	66,420	50%	48,866	43,980	73,299
61	Project		Juvenile outmigration (AR-2)	Tributary Confluence Monitoring (WQ)	960	HR	46.13	44,280	39,852	-10%	66,420	50%	48,866	43,980	73,299
61	Project		Juvenile outmigration (AR-2)	2018 Mainstem Winter Seining Recon	400	HR	107.63	43,050	38,745	-10%	64,575	50%	47,509	42,758	71,263
61	Project		Juvenile outmigration (AR-2)	2019 Mainstem Winter Seining	400	HR	153.75	61,500	55,350	-10%	92,250	50%	67,870	61,083	101,804
61	Project		Juvenile outmigration (AR-2)	Fish Transport (1 Truck)	400	HR	46.13	18,450	16,605	-10%	27,675	50%	20,361	18,325	30,541
61	Project		Juvenile outmigration (AR-2)	Fish Rescue and Relocation Crew	1,120	HR	153.75	172,200	154,980	-10%	258,300	50%	190,035	171,032	285,053
61	Project		Juvenile outmigration (AR-2)	Fish Transport (2 Trucks)	3,360	HR	46.13	154,980	139,482	-10%	232,470	50%	171,032	153,928	256,547
61	Project		Juvenile outmigration (AR-2)	Reporting and Coordination	1,280	HR	102.50	131,200	118,080	-10%	196,800	50%	144,789	130,310	217,183
61	Project		Juvenile outmigration (AR-2)	Miscellaneous Equipment	5.00	EA	6,150.00	30,750	27,675	-10%	46,125	50%	33,935	30,541	50,902
61	Project		Juvenile outmigration (AR-2)	H2O Monitoring Equipment	5.00	EA	30,750.00	153,750	138,375	-10%	230,625	50%	169,674	152,707	254,511
61	Project		Juvenile outmigration (AR-2)	H2O Monitoring Equipment	26.00	EA	307.50	7,995	7,196	-10%	11,993	50%	8,823	7,941	13,235
61	Project		Juvenile outmigration (AR-2)	Technician Equipment	14.00	EA	1,230.00	17,220	15,498	-10%	25,830	50%	19,004	17,103	28,505
61	Project		Juvenile outmigration (AR-2)	Transport Vehicle Rental ($300/day for 21 days)	672	HR	46.13	30,996	27,896	-10%	46,494	50%	34,206	30,786	51,309
61	Project		Juvenile outmigration (AR-2)	Transport Vehicle Operational Cost ($0.75/mi)	53,760	MI	0.92	49,594	44,634	-10%	74,390	50%	54,730	49,257	82,095
61	Project		Sucker rescue and relocation plan (AR-6)	Sucker Recapture Study (Spring and Fall)	280	HR	307.50	86,100	77,490	-10%	129,150	50%	95,018	85,516	142,526
61	Project		Sucker rescue and relocation plan (AR-6)	Sucker Salvage	280	HR	307.50	86,100	77,490	-10%	129,150	50%	95,018	85,516	142,526
61	Project		Sucker rescue and relocation plan (AR-6)	Sucker Transport (1 Truck)	140	HR	46.13	6,458	5,812	-10%	9,686	50%	7,126	6,414	10,689
61	Project		Sucker rescue and relocation plan (AR-6)	Reporting and Coordination	960	HR	102.50	98,400	88,560	-10%	147,600	50%	108,591	97,732	162,887
61	Project		Sucker rescue and relocation plan (AR-6)	Boat Electrofisher	300	HR	36.90	11,070	9,963	-10%	16,605	50%	12,217	10,995	18,325
61	Project		Sucker rescue and relocation plan (AR-6)	Boats (2 boats)	224	HR	92.25	20,664	18,598	-10%	30,996	50%	22,804	20,524	34,206
61	Project		Sucker rescue and relocation plan (AR-6)	Technician Equipment	12.00	EA	1,230.00	14,760	13,284	-10%	22,140	50%	16,289	14,660	24,433
61	Project		Sucker rescue and relocation plan (AR-6)	Tagging Equipment	1.00	EA	12,300.00	12,300	11,070	-10%	18,450	50%	13,574	12,217	20,361
61	Project		Sucker rescue and relocation plan (AR-6)	Transport Vehicle Rental ($300/day)	168	HR	46.13	7,749	6,974	-10%	11,624	50%	8,552	7,696	12,827
61	Project		Sucker rescue and relocation plan (AR-6)	Transport Vehicle Operational Cost ($0.75/mi)	7,200	MI	0.92	6,642	5,978	-10%	9,963	50%	7,330	6,597	10,995
61	Project		Freshwater mussel relocation (AR-7)	Freshwater Mussel Reconnaissance	280	HR	107.63	30,135	27,122	-10%	45,203	50%	33,256	29,931	49,884
61	Project		Freshwater mussel relocation (AR-7)	Mussel Salvage and Relocation	700	HR	107.63	75,338	67,804	-10%	113,006	50%	83,140	74,826	124,710
61	Project		Freshwater mussel relocation (AR-7)	Mussel Transport (1 Truck)	140	HR	46.13	6,458	5,812	-10%	9,686	50%	7,126	6,414	10,689
61	Project		Freshwater mussel relocation (AR-7)	Reporting and Coordination	960	HR	102.50	98,400	88,560	-10%	147,600	50%	108,591	97,732	162,887
61	Project		Freshwater mussel relocation (AR-7)	Miscellaneous Equipment	1.00	EA	6,150.00	6,150	5,535	-10%	9,225	50%	6,787	6,108	10,180
61	Project		Freshwater mussel relocation (AR-7)	Diving Gear	5.00	EA	1,230.00	6,150	5,535	-10%	9,225	50%	6,787	6,108	10,180
61	Project		Freshwater mussel relocation (AR-7)	Technician Equipment	10.00	EA	1,230.00	12,300	11,070	-10%	18,450	50%	13,574	12,217	20,361
61	Project		Freshwater mussel relocation (AR-7)	Transport Vehicle Rental ($300/day)	8.00	HR	922.50	7,380	6,642	-10%	11,070	50%	8,144	7,330	12,217
61	Project		Freshwater mussel relocation (AR-7)	Transport Vehicle Operational Cost ($0.75/mi)	14,000	MI	0.92	12,915	11,624	-10%	19,373	50%	14,253	12,827	21,379
62			**TERRESTRIAL RESOURCES MEASURES**												
62	Project		Habitat restoration plan (TER-1)	Annual maintenance and monitoring	3.00	EA	68,019.00	204,057	122,434	-40%	269,496	32%	248,394	149,036	328,051
62	Project		Habitat restoration plan (TER-1)	Annual reporting	3.00	EA	9,840.00	29,520	17,712	-40%	37,800	28%	35,934	21,560	46,013
62	Project		Habitat restoration plan (TER-1)	Post construction regulatory compliance and reporting	1.00	EA	14,760.00	14,760	8,856	-40%	18,900	28%	18,676	11,206	23,915
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Remove all nest platforms near construction, year 1	1.00	EA	53,640.30	53,640	-	0%	67,848	26%	58,017	-	73,384
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Nest exclusion monitoring, year 1	1.00	EA	110,896.80	110,897	-	0%	188,048	70%	119,946	-	203,393
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Remove all nest platforms near construction, year 2	1.00	EA	33,333.00	33,333	-	0%	46,632	40%	37,495	-	52,455
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Nest exclusion monitoring, year 2	1.00	EA	110,896.80	110,897	-	0%	188,048	70%	124,744	-	211,528
62	Project		Nesting Bird Surveys (TER-2); Osprey nests	Regulatory compliance and reporting, permitting	1.00	EA	9,840.00	9,840	-	0%	12,600	28%	11,069	-	14,173
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Remove nests near construction, year 1	1.00	EA	28,019.40	28,019	-	0%	55,048	96%	30,306	-	59,540
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Nest exclusion monitoring, year 1	1.00	EA	68,839.00	68,839	-	0%	146,600	113%	74,456	-	158,563
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Remove nests near construction, year 2	1.00	EA	22,463.90	22,464	-	0%	27,320	22%	25,269	-	30,731
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Nest exclusion monitoring, year 2	1.00	EA	68,839.00	68,839	-	0%	146,600	113%	77,435	-	164,905
62	Project		Nesting Bird Surveys (TER-2); Cliff swallow nests	Regulatory compliance and reporting, permitting	1.00	EA	7,380.00	7,380	-	0%	12,600	71%	8,301	-	14,173
62	Project		Nesting Bird Surveys (TER-2); Biological monitoring	Nesting bird surveys prior to vegetation clearing	1.00	EA	59,741.10	59,741	-	0%	212,568	256%	65,908	-	234,512
62	Project		Nesting Bird Surveys (TER-2); Biological monitoring	Daily biological monitoring throughout construction	3,114	HR	109.47	340,882	-	0%	540,568	59%	376,072	-	596,372
62	Project		Nesting Bird Surveys (TER-2); Biological monitoring	Regulatory compliance and reporting during construction	1.00	EA	63,960.00	63,960	63,960	0%	63,960	0%	70,563	70,563	70,563
62	Project		Nesting Bird Surveys (TER-2); Biological monitoring	Special status wildlife and habitat monitoring	1.00	EA	61,008.00	61,008	-	0%	107,520	76%	71,371	-	125,783
62	Project		Wetlands at Reservoirs (TER-5)	Wetland Project	10.00	AC	35,875.00	358,750	-	0%	700,000	95%	454,632	-	887,086
62	Project		Wetlands at Reservoirs (TER-5)	Monitoring	960	HR	64.79	62,197	-	0%	73,920	19%	78,820	-	93,676
62	Project		Special Status Bats (TER-6)	Pre-Demolition Exclusion	1.00	SUM	74,536.36	74,536	74,536	0%	74,536	0%	79,068	79,068	79,068
62	Project		Special Status Bats (TER-6)	Bat Exclusion Plan (Draft/Final)	1.00	SUM	8,171.51	8,172	8,172	0%	8,172	0%	8,668	8,668	8,668
62	Project		Special Status Bats (TER-6)	Field Prep/Health and Safety	1.00	SUM	2,882.20	2,882	2,882	0%	2,882	0%	3,057	3,057	3,057
62	Project		Special Status Bats (TER-6)	Biological Monitoring During Demolition	1.00	SUM	96,129.83	96,130	96,130	0%	96,130	0%	106,469	106,469	106,469
62	Project		Special Status Bats (TER-6)	Agency Coordination/Meetings	1.00	SUM	11,233.18	11,233	11,233	0%	11,233	0%	12,109	12,109	12,109
62	Project		Special Status Bats (TER-6)	Design Replacement Roosts	1.00	SUM	11,697.71	11,698	11,698	0%	11,698	0%	12,411	12,411	12,411
62	Project		Special Status Bats (TER-6)	Construct/Install Replacement Roosts	1.00	SUM	14,481.82	14,482	-	0%	25,643	77%	15,611	-	27,642
62	Project		Special Status Bats (TER-6)	Monitor Replacement Roosts (3 years)	1.00	SUM	145,169.93	145,170	-	0%	239,027	65%	170,090	-	280,058

Est Ref	Element	Cost Sheet	Heading	Description	Estimate at 2018 Rates and Prices								Escalated to Year of Construction		
					Qty	Unit	Rate	Estimate	Low	%	High	%	Estimate	Est Low	Est High
63			**WATER QUALITY MONITORING**												
63	Project		Field installation & equipment	Keno	1.00	SUM	60,900.00	60,900	38,000	-38%	79,170	30%	63,336	39,520	82,337
63	Project		Field installation & equipment	JC Boyle	1.00	SUM	158,550.00	158,550	120,000	-24%	206,115	30%	171,488	129,792	222,934
63	Project		Field installation & equipment	Copco	1.00	SUM	90,300.00	90,300	-	0%	117,390	30%	97,668	-	126,969
63	Project		Field installation & equipment	Iron Gate	1.00	SUM	77,700.00	77,700	74,000	-5%	101,010	30%	80,808	76,960	105,050
63	Project		Field installation & equipment	Walker Bridge	1.00	SUM	80,850.00	80,850	77,000	-5%	105,105	30%	87,447	83,283	113,682
63	Project		Field installation & equipment	Seiad Valley	1.00	SUM	65,100.00	65,100	42,000	-35%	84,630	30%	70,412	45,427	91,536
63	Project		Field installation & equipment	Orleans	1.00	SUM	67,200.00	67,200	44,000	-35%	87,360	30%	69,888	45,760	90,854
63	Project		Field installation & equipment	Klamath	1.00	SUM	61,950.00	61,950	59,000	-5%	80,535	30%	64,428	61,360	83,756
63	Project		Field installation & equipment	Shasta	1.00	SUM	68,250.00	68,250	45,000	-34%	88,725	30%	76,772	50,619	99,804
63	Project		Field installation & equipment	Scott	1.00	SUM	68,250.00	68,250	45,000	-34%	88,725	30%	76,772	50,619	99,804
63	Project		Field installation & equipment	Salmon	0.00	SUM	-	-	-	0%	-	0%	-	-	-
63	Project		Field installation & equipment	Trinity	0.00	SUM	-	-	-	0%	-	0%	-	-	-
63	Project		Field installation & equipment	Equipment replacement	1.00	SUM	315,000.00	315,000	200,000	-37%	500,000	59%	388,654	246,765	616,912
63	Project		Operation & Maintenance	Keno	17.00	QTR	16,800.00	285,600	130,000	-54%	464,000	62%	326,120	148,444	529,831
63	Project		Operation & Maintenance	JC Boyle	21.00	QTR	16,800.00	352,800	170,000	-52%	400,000	13%	427,595	206,041	484,802
63	Project		Operation & Maintenance	Copco	13.00	QTR	16,800.00	218,400	-	0%	400,000	83%	254,135	-	465,449
63	Project		Operation & Maintenance	Iron Gate	25.00	QTR	4,200.00	105,000	92,000	-12%	116,000	10%	124,895	109,432	137,979
63	Project		Operation & Maintenance	Walker Bridge	13.00	QTR	11,550.00	150,150	132,000	-12%	275,000	83%	174,718	153,598	319,996
63	Project		Operation & Maintenance	Seiad Valley	21.00	QTR	4,200.00	88,200	36,000	-59%	100,000	13%	106,899	43,632	121,201
63	Project		Operation & Maintenance	Orleans	25.00	QTR	4,200.00	105,000	42,000	-60%	116,000	10%	124,895	49,958	137,979
63	Project		Operation & Maintenance	Klamath	25.00	QTR	4,200.00	105,000	36,000	-66%	116,000	10%	124,895	42,821	137,979
63	Project		Operation & Maintenance	Shasta	9.00	QTR	5,250.00	47,250	27,000	-43%	105,000	122%	56,022	32,013	124,494
63	Project		Operation & Maintenance	Scott	9.00	QTR	5,250.00	47,250	27,000	-43%	105,000	122%	56,022	32,013	124,494
63	Project		Operation & Maintenance	Salmon	0.00	SUM	-	-	-	0%	45,000	0%	-	-	50,619
63	Project		Operation & Maintenance	Trinity	0.00	SUM	-	-	-	0%	45,000	0%	-	-	50,619
63	Project		Sediment, Sampling & Recording	Keno	17.00	QTR	12,600.00	214,200	1,040,000	386%	348,000	62%	244,590	1,187,552	397,373
63	Project		Sediment, Sampling & Recording	JC Boyle	21.00	QTR	15,750.00	330,750	170,000	-49%	375,000	13%	400,871	206,041	454,502
63	Project		Sediment, Sampling & Recording	Copco	13.00	QTR	15,750.00	204,750	-	0%	375,000	83%	238,252	-	436,359
63	Project		Sediment, Sampling & Recording	Iron Gate	25.00	QTR	25,200.00	630,000	552,000	-12%	696,000	10%	749,370	656,591	827,875
63	Project		Sediment, Sampling & Recording	Walker Bridge	13.00	QTR	25,200.00	327,600	288,000	-12%	600,000	83%	381,203	335,123	698,174
63	Project		Sediment, Sampling & Recording	Seiad Valley	21.00	QTR	25,200.00	529,200	216,000	-59%	600,000	13%	641,393	261,793	727,203
63	Project		Sediment, Sampling & Recording	Orleans	25.00	QTR	25,200.00	630,000	252,000	-60%	696,000	10%	749,370	299,748	827,875
63	Project		Sediment, Sampling & Recording	Klamath	25.00	QTR	16,800.00	420,000	288,000	-31%	464,000	10%	499,580	342,569	551,917
63	Project		Sediment, Sampling & Recording	Shasta	9.00	QTR	23,100.00	207,900	99,000	-52%	462,000	122%	246,498	117,380	547,773
63	Project		Sediment, Sampling & Recording	Scott	9.00	QTR	23,100.00	207,900	99,000	-52%	462,000	122%	246,498	117,380	547,773
63	Project		Sediment, Sampling & Recording	Salmon	0.00	SUM	-	-	-	0%	198,000	0%	-	-	222,723
63	Project		Sediment, Sampling & Recording	Trinity	0.00	SUM	-	-	-	0%	198,000	0%	-	-	222,723
63	Project		Sediment, Sampling & Recording	Data Management	1.00	SUM	462,000.00	462,000	293,000	-37%	600,600	30%	567,821	360,112	738,168
63	Project		Sediment, Sampling & Recording	ODCs	1.00	SUM	163,800.00	163,800	115,000	-30%	372,000	127%	190,635	133,840	432,943
63	Project		Sediment, Sampling & Recording	Esturary and river sampling for toxins	4.00	SUM	52,500.00	210,000	200,000	-5%	273,000	30%	234,041	222,896	304,253
63	Project		Sediment, Sampling & Recording	TSS and NTU laboratory relationship study by USGS	1.00	SUM	157,500.00	157,500	150,000	-5%	204,750	30%	175,531	167,172	228,190
63	Project		Aerial photos & LiDAR	Annual aircraft surveys + 1 after 5 year gap	5.00	EA	63,000.00	315,000	283,500	-10%	472,500	50%	379,026	341,123	568,539
63	Project		Volitional fish passage monitoring	Annual field survey; 2 wk field survey + study.	5.00	EA	26,250.00	131,250	118,125	-10%	196,875	50%	157,928	142,135	236,891
63	Project		Drone LiDAR in site specific locations, analysis & reporting	Drone LiDAR in site specific locations, analysis & reporting	4.00	EA	21,000.00	84,000	75,600	-10%	126,000	50%	96,452	86,807	144,679
63	Project		Surface comparison and analysis of sediment erosion	Surface comparison and analysis of sediment erosion	4.00	EA	21,000.00	84,000	75,600	-10%	126,000	50%	96,452	86,807	144,679

Attachment B Pay Item Cost Detail Worksheets

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PAY ITEM INFORMATION

PAY ITEM NUMBER :	1.001	Project :	JC Boyle			
Description :	Removal of Diversion Conduit Bulkheads					
Quantity :	14.00 CY					
Daily Production :	7.00 CY per 8 hour shift	Project # :	1			
Work Days :	2.0 Days	Estimator :	Eric Jones	CY per	Total Cost	Unit Price Per CY
Unit Price :	$1,323.00 per CY	Probable Low Cost Parameter		7.35	$17,596	$1,256.85
Total Cost :	$18,522	Probable High Cost Parameter		6.65	$19,448	$1,389.15

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Diver, Wet	Active	1.00	2.0	8	16.00	L	$124.57	incl. in rate	incl. in rate	$1,993.12
Diver, Tender	Active	1.00	2.0	8	16.00	L	$79.22	incl. in rate	incl. in rate	$1,267.52
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	incl. in rate	incl. in rate	$1,094.56
Truck Driver (heavy)	Active	1.00	***1.0***	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Barge Operator	Active	1.00	2.0	8	16.00	L	$40.30	incl. in rate	incl. in rate	$644.80
Crawler Crane (130tn)	Active	1.00	2.0	8	16.00	E	$258.66	incl. in rate	incl. in rate	$4,138.56
Barge (400T)	Active	1.00	2.0	8	16.00	E	$99.50	incl. in rate	incl. in rate	$1,592.00
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	***1.0***	8	8.00	E	$70.35	incl. in rate	incl. in rate	$562.80
Air Compressor 600 cfm	Active	1.00	2.0	8	16.00	E	$21.74	incl. in rate	incl. in rate	$347.82
0	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
Air Track Drill 4"	Active	1.00	***1.0***	8	8.00	E	$145.14	incl. in rate	incl. in rate	$1,161.12
Air Hose 100'	Active	1.00	***1.0***	8	8.00	E	$2.13	incl. in rate	incl. in rate	$17.04
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
				Labor Hours	**88**				**TOTAL LABOR**	**$6,201.04**
				Equipment Hours	**72**				**TOTAL EQUIPMENT**	**$7,819.34**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Blasting Explosives and Caps	10.00	EA	1.000	10.00	$12.70	$127.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$127.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$6,201.04	Labor Burden @	0.0%			$6,201.04
Material Cost	$127.00	Material Tax @	7.75%	$9.84		$136.84
Equipment Cost	$7,819.34	Equipment Tax @	7.75%	$606.00		$8,425.34
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$14,147**			**$616**	**DIRECT COST SUBTOTALS**	**$14,763**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$14,763.22	$2,214.48
Installing Contractors Profit@	8.0%				$14,763.22	$1,181.06
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$3,395.54**
General Contractors Insurance @	1.0%			on	$18,158.77	$182
Bond @	1.0%			on	$18,158.77	$182
Contingency @	0.0%			on	$18,521.94	$0
					TOTAL COST for pay item	**$18,522**

Additional Pay Item Notes :

Crew make up is based on using a diver to drill and set explosive caps to demolish bulkhead. Crane on Barge will then be used to scoop material from water using the diver to guide bucket. Crane will then load material from water into dump truck. Figuring 2 days to set up and blast, remove, and dump debris in scour hole. Trucks will only be used one day.

PAY ITEM INFORMATION

PAY ITEM NUMBER :	1.002	Project : JC Boyle				
Description :	Remove Water from behind Tailrace Cofferdam					
Quantity :	500,000.00 GAL					
Daily Production :	153,120.00 GAL per 8 hour shift	Project # : 1				
Work Days :	3.3 Days	Estimator : Eric Jones		GAL per	Total Cost	Unit Price Per GAL
Unit Price :	$0.01 per GAL	Probable Low Cost Parameter		168432	$4,778	$0.01
Total Cost :	$5,309	Probable High Cost Parameter		130152	$6,105	$0.01

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.3	8	26.40	L	$46.27	incl. in rate	incl. in rate	$1,221.53
Laborer	Active	2.00	3.3	8	52.80	L	$45.80	incl. in rate	incl. in rate	$2,418.24
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	3.3	8	26.40	E	$3.87	incl. in rate	incl. in rate	$102.17
Truck, Pickup (4x4, 3/4tn)	Active	1.00	3.3	8	26.40	E	$16.94	incl. in rate	incl. in rate	$447.22
0		1.00	3.3	8	26.40	0	$0.00	$0.00		$0.00
0		1.00	3.3	8	26.40	0	$0.00	$0.00		$0.00
0		2.00	3.3	8	52.80	0	$0.00	$0.00		$0.00
0		1.00	3.3	8	26.40	0	$0.00	$0.00		$0.00
0		1.00	3.3	8	26.40	0	$0.00	$0.00		$0.00
		1.00	3.3	8	26.40	0	$0.00	$0.00		$0.00
		1.00	3.3	8	26.40	0	$0.00	$0.00		$0.00
		1.00	3.3	8	26.40	0	$0.00	$0.00		$0.00
			3.3	8	0.00					$0.00
			3.3	8	0.00					$0.00
			3.3	8	0.00					$0.00
			3.3	8	0.00					$0.00
			3.3	8	0.00					$0.00
				Labor Hours	79.2				TOTAL LABOR	$3,639.77
				Equipment Hours	52.8				TOTAL EQUIPMENT	$549.38

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$3,639.77	Labor Burden @	0.0%			$3,639.77
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$549.38	Equipment Tax @	7.75%	$42.58		$591.96
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$4,189			$43	DIRECT COST SUBTOTALS	$4,232

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,231.73	$634.76
Installing Contractors Profit@	8.0%				$4,231.73	$338.54
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$973.30

General Contractors Insurance @	1.0%	on	$5,205.03	$52
Bond @	1.0%	on	$5,205.03	$52
Contingency @	0.0%	on	$5,309.13	$0
			TOTAL COST for pay item	$5,309

Additional Pay Item Notes :

3" pump can pump 19,140 gallons per hour, 153,120 gallons per 8 hour shift, rough 1.5 days to remove water. 1 foreman to run operation, 2 laborer to tend to pump during the day, 1 laborer to tend pump at night.

PAY ITEM COST DETAIL WORKSHEET

1.003 Provide Dewatering behind Tailrace Cofferdam

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.003		Project	: JC Boyle		
Description	:	Provide Dewatering behind Tailrace Cofferdam					
Quantity	:	1.00 LS					
Daily Production	:	1.00 LS per 8 hour shift		Project #	: 1		
Work Days	:	1.0 Days		Estimator	: Eric Jones	LS per	Total Cost
Unit Price	:	$61,036.38 per LS		Probable Low Cost Parameter		1.1	$54,933
Total Cost	:	$61,036		Probable High Cost Parameter		0.85	$70,192

	Unit Price Per LS
Probable Low Cost Parameter	$54,932.74
Probable High Cost Parameter	$70,191.83

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	***23.0***	8	184.00	L	$46.27	incl. in rate	incl. in rate	$8,513.68
Laborer	Active	2.00	***46.0***	8	736.00	L	$45.80	incl. in rate	incl. in rate	$33,708.80
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	***92.0***	8	736.00	E	$3.87	incl. in rate	incl. in rate	$2,848.32
Truck, Pickup (4x4, 3/4tn)	Active	1.00	***23.0***	8	184.00	E	$16.94	incl. in rate	incl. in rate	$3,116.96
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0		2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**920**				**TOTAL LABOR**	**$42,222.48**
				Equipment Hours	**920**				**TOTAL EQUIPMENT**	**$5,965.28**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$42,222.48	Labor Burden @	0.0%			$42,222.48
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$5,965.28	Equipment Tax @	7.75%	$462.31		$6,427.59
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$48,188**			**$462**	**DIRECT COST SUBTOTALS**	**$48,650**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$48,650.07		$7,297.51
Installing Contractors Profit@	8.0%				$48,650.07		$3,892.01
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$11,189.52**
General Contractors Insurance @	1.0%		on		$59,839.59		$598
Bond @	1.0%		on		$59,839.59		$598
Contingency @	0.0%		on		$61,036.38		$0
						TOTAL COST for pay item	**$61,036**

Additional Pay Item Notes :

Pump will be running for 3 months or 92 days (day and night), 1 laborer to maintain (refuel, adjust houses) during the day, 1 laborer to maintain (refuel, adjust houses) during the night, 1 foreman on activity .25 of the time to oversee operation.

PAY ITEM COST DETAIL WORKSHEET

1.004 Construct Embankment Cofferdam in Tailrace around Powerhouse

PAY ITEM INFORMATION

PAY ITEM NUMBER :	1.004		Project : JC Boyle			
Description :	Construct Embankment Cofferdam in Tailrace around Powerhouse					
Quantity :	2,000.00	cy				
Daily Production :	200.00	cy per 8 hour shift	Project # : 1			
Work Days :	10.0	Days	Estimator : Michael Barba	cy per	Total Cost	Unit Price Per cy
Unit Price :	$108.78	per cy	Probable Low Cost Parameter	220	$195,799	$97.90
Total Cost :	$217,554		Probable High Cost Parameter	160	$261,065	$130.53

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (310hp)(CATD8)	Active	1.00	10.0	8	80.00	E	$197.60	$197.60		$15,808.00
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	10.0	8	160.00	E	$111.64	$111.64		$17,862.40
Equipment Operator (medium)	Active	1.00	10.0	8	80.00	L	$66.28	$0.00		$5,302.40
Truck Driver (heavy)	Active	2.00	10.0	8	160.00	L	$57.59	$0.00		$9,214.40
Laborer	Active	4.00	10.0	8	320.00	L	$45.80	$0.00		$14,656.00
Labor Foreman (out)	Active	1.00	10.0	8	80.00	L	$46.27	$0.00		$3,701.60
Truck, Pickup (4x4, 3/4tn)	Active	1.00	10.0	8	80.00	E	$16.94	$16.94		$1,355.20
	Active	1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
	Active	1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
				Labor Hours	640				TOTAL LABOR	$32,874.40
				Equipment Hours	320				TOTAL EQUIPMENT	$35,025.60

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		SF	1.300	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ls	1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Cofferdam Sheet Piling Drive and Extract	4,830	SF	RSMs Data	$24.93	$120,411.90
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$120,411.90

SUMMARY OF COSTS

Labor Cost	$32,874.40	Labor Burden @	49.7%	$0.00		$32,874.40
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$35,025.60	Equipment Tax @	7.75%	$2,714.48		$37,740.08
Subcontractors	$120,411.90					$120,411.90
DIRECT COST SUBTOTALS	$188,312			$2,714	DIRECT COST SUBTOTALS	$191,026

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$70,614.48	$10,592.17
Installing Contractors Profit@	8.0%				$70,614.48	$5,649.16
GC Markup on Subs @	5.0%				$120,411.90	$6,020.60
					TOTAL MARKUP COSTS	$22,261.93
General Contractors Insurance @	1.0%			on	$213,288.31	$2,133
Bond @	1.0%			on	$213,288.31	$2,133
Contingency @	0.0%			on	$217,554.08	$0
					TOTAL COST for pay item	$217,554

Additional Pay Item Notes :

Sheetpile will be 35' and expected to be driven acrosss tailrace to demolishPowerhouse concrete

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.006		Project	: JCBOYLE			
Description	:	Remove Monorail Structural Steel Components						
Quantity	:	15,000.00	LBS					
Daily Production	:	18,500.00	LBS per 8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	0.8	Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.64	per LBS	Probable Low Cost Parameter		20350	$8,613	$0.57
Total Cost	:	$9,570		Probable High Cost Parameter		12025	$12,919	$0.86

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.8	8	6.40	L	$47.23	incl. in rate	incl. in rate	$302.27
Electrician	Active	1.00	0.8	8	6.40	L	$45.23	incl. in rate	incl. in rate	$289.47
Steelworker	Active	4.00	0.8	8	25.60	L	$65.52	incl. in rate	incl. in rate	$1,677.31
Laborer	Active	4.00	0.8	8	25.60	L	$45.80	incl. in rate	incl. in rate	$1,172.48
Truck Driver (heavy)	Active	1.00	0.8	8	6.40	L	$57.59	incl. in rate	incl. in rate	$368.58
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.8	8	6.40	E	$111.64	incl. in rate	incl. in rate	$714.50
Hydraulic Crane (120tn)	Active	1.00	0.8	8	6.40	E	$239.06	incl. in rate	incl. in rate	$1,529.98
Welder	Active	1.00	0.8	8	6.40	L	$7.84	incl. in rate	incl. in rate	$50.16
Gas Welding Machine	Active	1.00	0.8	8	6.40	E	$2.88	incl. in rate	incl. in rate	$18.41
Equipment Operator (crane)	Active	1.00	0.8	8	6.40	L	$68.41	incl. in rate	incl. in rate	$437.82
Vibratory Hammer & Extractor	Active	1.00	0.8	8	6.40	E	$94.34	incl. in rate	incl. in rate	$603.78
				Labor Hours	83.2				TOTAL LABOR	$4,298.10
				Equipment Hours	25.6				TOTAL EQUIPMENT	$2,866.67

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$429.81	$429.81
					TOTAL MATERIAL	$429.81

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$4,298.10	Labor Burden @	49.7%	$0.00		$4,298.10
Material Cost	$429.81	Material Tax @	7.8%	$33.31		$463.12
Equipment Cost	$2,866.67	Equipment Tax @	0.0%	$0.00		$2,866.67
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$7,595			$33	DIRECT COST SUBTOTALS	$7,628

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$7,627.88	$1,144.18
Installing Contractors Profit@	8.0%				$7,627.88	$610.23
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,754.41

General Contractors Insurance @	1.0%	on	$9,382.30	$94
Bond @	1.0%	on	$9,382.30	$94
Contingency @	0.0%	on	$9,569.94	$0
			TOTAL COST for pay item	$9,570

Additional Pay Item Notes :

Includes structure to install steel stop logs in spillway, radial gate opening. Crews: E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. by 13-men crew (4 steelworkers, 4 laborer, 1 electrician, 1 welder and 3 equipment operators). Based on the current production rate 15000lbs= 8.89 cy rmeans we will use 1 truck.

PAY ITEM COST DETAIL WORKSHEET

1.005 Remove Spillway Concrete

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.005		**Project**	: JC Boyle		
Description	:	Remove Spillway Concrete					
Quantity	:	2,100.00	cy				
Daily Production	:	45.00	cy per 8 hour shift	**Project #**	: 1		
Work Days	:	46.7	Days	**Estimator**	: Felipe Poletto	**cy per**	**Total Cost** / **Unit Price Per cy**
Unit Price	:	$330.13	per cy	**Probable Low Cost Parameter**		**51.75**	**$589,274** / **$280.61**
Total Cost	:	$693,263		**Probable High Cost Parameter**		**36**	**$831,916** / **$396.15**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	46.7	8	747.20	L	$48.27	incl. in rate	incl. in rate	$36,067.34
Laborer	Active	8.00	46.7	8	2,988.80	L	$45.80	incl. in rate	incl. in rate	$136,887.04
Equipment Operator (medium)	Active	2.00	46.7	8	747.20	L	$66.28	incl. in rate	incl. in rate	$49,524.42
Truck Driver (heavy)	Active	1.00	46.7	8	373.60	L	$57.59	incl. in rate	incl. in rate	$21,515.62
Air Compressor 900 cfm	Active	1.00	46.7	8	373.60	E	$38.87	incl. in rate	incl. in rate	$14,521.43
Air Compressor 600 cfm	Active	1.00	46.7	8	373.60	E	$21.74	incl. in rate	incl. in rate	$8,121.66
Air Tool, Chipping Hammer	Active	5.00	46.7	8	1,868.00	E	$1.64	incl. in rate	incl. in rate	$3,061.72
Generator, Small Generator, 10 - 15 kW	Active	2.00	46.7	8	747.20	E	$7.04	incl. in rate	incl. in rate	$5,260.29
Hydraulic Excavator (2.5cy)	Active	2.00	46.7	8	747.20	E	$203.63	incl. in rate	incl. in rate	$152,152.34
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	46.7	8	373.60	E	$62.72	incl. in rate	incl. in rate	$23,432.19
Hydraulic Thumbs/Shear Attachment	Active	1.00	46.7	8	373.60	E	$16.39	incl. in rate	incl. in rate	$6,123.30
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	46.7	8	373.60	E	$111.64	incl. in rate	incl. in rate	$41,708.70
			46.7	8	0.00					$0.00
			46.7	8	0.00					$0.00
			46.7	8	0.00					$0.00
			46.7	8	0.00					$0.00
			46.7	8	0.00					$0.00
				Labor Hours	**4,857**				**TOTAL LABOR**	**$243,994.42**
				Equipment Hours	**5,230**				**TOTAL EQUIPMENT**	**$254,381.63**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$12,199.72	$12,199.72
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$12,199.72**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	10	EA	**Cost per Mob**	$2,500.00	$25,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$25,000.00**

SUMMARY OF COSTS

Labor Cost	$243,994.42	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$243,994.42
Material Cost	$12,199.72	Material Tax @	7.75%	$945.48		$13,145.20
Equipment Cost	$254,381.63	Equipment Tax @	7.75%	$19,714.58		$274,096.21
Subcontractors	$25,000.00					$25,000.00
DIRECT COST SUBTOTALS	**$535,576**			**$20,660**	**DIRECT COST SUBTOTALS**	**$556,236**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$531,235.83	$79,685.37
Installing Contractors Profit@	8.0%				$531,235.83	$42,498.87
GC Markup on Subs @	5.0%				$25,000.00	$1,250.00
					TOTAL MARKUP COSTS	**$123,434.24**
General Contractors Insurance @	1.0%			on	$679,670.07	$6,797
Bond @	1.0%			on	$679,670.07	$6,797
Contingency @	0.0%			on	$693,263.47	$0
					TOTAL COST for pay item	**$693,263**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to scour hole is also included - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.007		**Project**	: JC Boyle		
Description	: Remove Fish Ladder Concrete					
Quantity	: 1,820.00 cy					
Daily Production	: 28.00 cy per 8 hour shift		**Project #**	: 1		
Work Days	: 65.0 Days		**Estimator**	: Felipe Poletto		
				cy per	**Total Cost**	**Unit Price Per cy**
Unit Price	: $333.49 per cy		**Probable Low Cost Parameter**	**30.8**	**$546,257**	**$300.14**
Total Cost	: $606,952		**Probable High Cost Parameter**	**25.2**	**$667,647**	**$366.84**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	65.0	8	520.00	L	$48.27	incl. in rate	incl. in rate	$25,100.40
Laborer	Active	4.00	65.0	8	2,080.00	L	$45.80	incl. in rate	incl. in rate	$95,264.00
Equipment Operator (medium)	Active	1.00	65.0	8	520.00	L	$66.28	incl. in rate	incl. in rate	$34,465.60
Truck Driver (heavy)	Active	1.00	65.0	8	520.00	L	$57.59	incl. in rate	incl. in rate	$29,946.80
Air Compressor 600 cfm	Active	1.00	65.0	8	520.00	E	$21.74	incl. in rate	incl. in rate	$11,304.24
Air Compressor 900 cfm	Active	1.00	65.0	8	520.00	E	$38.87	incl. in rate	incl. in rate	$20,211.84
Air Tool, Chipping Hammer	Active	3.00	65.0	8	1,560.00	E	$1.64	incl. in rate	incl. in rate	$2,556.89
Generator, Small Generator, 10 - 15 kW	Active	2.00	65.0	8	1,040.00	E	$7.04	incl. in rate	incl. in rate	$7,321.60
Hydraulic Excavator (2.5cy)	Active	1.00	65.0	8	520.00	E	$203.63	incl. in rate	incl. in rate	$105,887.60
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	65.0	8	520.00	E	$62.72	incl. in rate	incl. in rate	$32,614.40
Hydraulic Thumbs/Shear Attachment	Active	1.00	65.0	8	520.00	E	$16.39	incl. in rate	incl. in rate	$8,522.80
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	65.0	8	520.00	E	$111.64	incl. in rate	incl. in rate	$58,052.80
			65.0	8	0.00					$0.00
			65.0	8	0.00					$0.00
			65.0	8	0.00					$0.00
			65.0	8	0.00					$0.00
			65.0	8	0.00					$0.00
				Labor Hours	**3,640**				**TOTAL LABOR**	**$184,776.80**
				Equipment Hours	**5,720**				**TOTAL EQUIPMENT**	**$246,472.17**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$9,238.84	$9,238.84
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$9,238.84**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	11	EA	**Cost per Mob**	$2,500.00	$27,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$27,500.00**

SUMMARY OF COSTS

Labor Cost	$184,776.80	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.		$184,776.80
Material Cost	$9,238.84	Material Tax @	7.75%	$716.01			$9,954.85
Equipment Cost	$246,472.17	Equipment Tax @	7.75%	$19,101.59			$265,573.76
Subcontractors	$27,500.00						$27,500.00
DIRECT COST SUBTOTALS	**$467,988**			**$19,818**		**DIRECT COST SUBTOTALS**	**$487,805**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$460,305.41	$69,045.81
Installing Contractors Profit@	8.0%				$460,305.41	$36,824.43
GC Markup on Subs @	5.0%				$27,500.00	$1,375.00
					TOTAL MARKUP COSTS	**$107,245.25**
General Contractors Insurance @	1.0%			on	$595,050.66	$5,951
Bond @	1.0%			on	$595,050.66	$5,951
Contingency @	0.0%			on	$606,951.67	$0
					TOTAL COST for pay item	**$606,952**

Additional Pay Item Notes :

The work is done by one 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to scour hole is also included - based on the current production rate only 3 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. This productivity is considerably slower than flume demolition due to access. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET

1.008 Remove Gravity Dam Section Concrete

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.008		**Project** : JC Boyle			
Description	: Remove Gravity Dam Section Concrete					
Quantity	: 600.00 cy					
Daily Production	: 30.00 cy per 8 hour shift		**Project #** : 1			
Work Days	: 20.0 Days		**Estimator** : Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	: $339.60 per cy		**Probable Low Cost Parameter**	**34.5**	**$173,195**	**$288.66**
Total Cost	: $203,759		**Probable High Cost Parameter**	**24**	**$244,511**	**$407.52**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	20.0	8	160.00	L	$48.27	incl. in rate	incl. in rate	$7,723.20
Laborer	Active	4.00	20.0	8	640.00	L	$45.80	incl. in rate	incl. in rate	$29,312.00
Equipment Operator (medium)	Active	1.00	20.0	8	160.00	L	$66.28	incl. in rate	incl. in rate	$10,604.80
Truck Driver (heavy)	Active	1.00	20.0	8	160.00	L	$57.59	incl. in rate	incl. in rate	$9,214.40
Air Compressor 600 cfm	Active	1.00	20.0	8	160.00	E	$21.74	incl. in rate	incl. in rate	$3,478.23
Air Compressor 900 cfm	Active	1.00	20.0	8	160.00	E	$38.87	incl. in rate	incl. in rate	$6,219.03
Air Tool, Chipping Hammer	Active	3.00	20.0	8	480.00	E	$1.64	incl. in rate	incl. in rate	$786.74
Generator, Small Generator, 10 - 15 kW	Active	2.00	20.0	8	320.00	E	$7.04	incl. in rate	incl. in rate	$2,252.80
Hydraulic Excavator (5.0cy)	Active	1.00	20.0	8	160.00	E	$274.63	incl. in rate	incl. in rate	$43,940.80
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	20.0	8	160.00	E	$62.72	incl. in rate	incl. in rate	$10,035.20
Hydraulic Thumbs/Shear Attachment	Active	1.00	20.0	8	160.00	E	$16.39	incl. in rate	incl. in rate	$2,622.40
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	20.0	8	160.00	E	$111.64	incl. in rate	incl. in rate	$17,862.40
			20.0	8	0.00					$0.00
			20.0	8	0.00					$0.00
			20.0	8	0.00					$0.00
			20.0	8	0.00					$0.00
			20.0	8	0.00					$0.00
				Labor Hours	**1,120**				**TOTAL LABOR**	**$56,854.40**
				Equipment Hours	**1,760**				**TOTAL EQUIPMENT**	**$87,197.59**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$2,842.72	$2,842.72
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$2,842.72**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	4	EA	Cost per Mob	$2,500.00	$10,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$10,000.00**

SUMMARY OF COSTS

Labor Cost	$56,854.40	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$56,854.40
Material Cost	$2,842.72	Material Tax @	7.75%	$220.31		$3,063.03
Equipment Cost	$87,197.59	Equipment Tax @	7.75%	$6,757.81		$93,955.40
Subcontractors	$10,000.00					$10,000.00
DIRECT COST SUBTOTALS	**$156,895**			**$6,978**	**DIRECT COST SUBTOTALS**	**$163,873**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$153,872.84	$23,080.93
Installing Contractors Profit@	8.0%				$153,872.84	$12,309.83
GC Markup on Subs @	5.0%				$10,000.00	$500.00
					TOTAL MARKUP COSTS	**$35,890.75**
General Contractors Insurance @	1.0%			on	$199,763.59	$1,998
Bond @	1.0%			on	$199,763.59	$1,998
Contingency @	0.0%			on	$203,758.86	$0
					TOTAL COST for pay item	**$203,759**

Additional Pay Item Notes :

The work is done by one 6-men crew (foreman, 4 laborers, and 2 equipment operators). Concrete hauling to scour hole is also included - based on the current production rate only 3 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. This productivity is considerably slower than flume demolition due to access. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER :	1.009	Project :	JCBOYLE
Description :	Remove Timber Equipment Ramp on left side of Dam		
Quantity :	10,500.00 LBS		
Daily Production :	15,000.00 LBS per 8 hour shift	Project # :	Klamath Dams Removal
Work Days :	0.7 Days	Estimator :	Mihaela Tomulescu
Unit Price :	$0.66 per LBS		
Total Cost :	$6,969		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	17250	$5,924	$0.56
Probable High Cost Parameter	9750	$9,409	$0.90

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.7	8	5.60	L	$47.23	incl. in rate	incl. in rate	$264.49
Electrician	Active	1.00	0.7	8	5.60	L	$45.23	incl. in rate	incl. in rate	$253.29
Carpenters, Journeyman	Active	4.00	0.7	8	22.40	L	$65.37	incl. in rate	incl. in rate	$1,464.29
Laborer	Active	4.00	0.7	8	22.40	L	$45.80	incl. in rate	incl. in rate	$1,025.92
Truck Driver (heavy)	Active	1.00	0.7	8	5.60	L	$57.59	incl. in rate	incl. in rate	$322.50
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.7	8	5.60	E	$111.64	incl. in rate	incl. in rate	$625.18
Hydraulic Crane (17tn)	Active	1.00	0.7	8	5.60	E	$81.52	incl. in rate	incl. in rate	$456.51
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.7	8	5.60	E	$64.23	incl. in rate	incl. in rate	$359.69
Equipment Operator (crane)	Active	1.00	0.7	8	5.60	L	$68.41	incl. in rate	incl. in rate	$383.10

Labor Hours	67.2	TOTAL LABOR	$3,713.58
Equipment Hours	16.8	TOTAL EQUIPMENT	$1,441.38

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$371.36	$371.36
					TOTAL MATERIAL	$371.36

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$3,713.58	Labor Burden @	49.7%	$0.00		$3,713.58
Material Cost	$371.36	Material Tax @	7.8%	$28.78		$400.14
Equipment Cost	$1,441.38	Equipment Tax @	0.0%	$0.00		$1,441.38
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$5,526			$29	DIRECT COST SUBTOTALS	$5,555

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,555.11	$833.27
Installing Contractors Profit@	8.0%				$5,555.11	$444.41
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,277.67
General Contractors Insurance @	1.0%		on		$6,832.78	$68
Bond @	1.0%		on		$6,832.78	$68
Contingency @	0.0%		on		$6,969.44	$0
					TOTAL COST for pay item	$6,969

Additional Pay Item Notes :

Includes structure to install steel stop logs in spillway, radial gate opening. Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. by one 13-men crew (4 steelworkers, 4 laborer, 1 electrician, 1 welder and 3 equipment operators). Based on the current production rate 15000lbs= 8.89 cy rmeans we will use 1 truck.

PAY ITEM COST DETAIL WORKSHEET — **1.010 Remove Pressure-Treated Lumber from Footbridge around Intake Structure**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.010	Project	: JC Boyle			
Description	:	Remove Pressure-Treated Lumber from Footbridge around Intake Structure					
Quantity	:	3,600.00 SF					
Daily Production	:	900.00 SF per 8 hour shift	Project #	: 1			
Work Days	:	4.0 Days	Estimator	: Eric Jones	SF per	Total Cost	Unit Price Per SF
Unit Price	:	$7.19 per SF	Probable Low Cost Parameter		990	$23,298	$6.47
Total Cost	:	$25,886	Probable High Cost Parameter		765	$29,769	$8.27

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (50tn)	Active	1.00	4.0	8	32.00	E	$134.32	incl. in rate	incl. in rate	$4,298.24
Truck, Pickup (4x4, 3/4tn)	Active	1.00	4.0	8	32.00	E	$16.94	incl. in rate	incl. in rate	$542.08
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	4.0	8	64.00	E	$31.90	incl. in rate	incl. in rate	$2,041.60
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Equipment Operator (crane)	Active	1.00	4.0	8	32.00	L	$68.41	incl. in rate	incl. in rate	$2,189.12
Truck Driver (heavy)	Active	2.00	4.0	8	64.00	L	$57.59	incl. in rate	incl. in rate	$3,685.76
Laborer	Active	4.00	4.0	8	128.00	L	$45.80	incl. in rate	incl. in rate	$5,862.40
0		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
				Labor Hours	256				TOTAL LABOR	$13,217.92
				Equipment Hours	128				TOTAL EQUIPMENT	$6,881.92

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$13,217.92	Labor Burden @		0.0%			$13,217.92
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$6,881.92	Equipment Tax @		7.75%	$533.35		$7,415.27
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$20,100				$533	DIRECT COST SUBTOTALS	$20,633
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$20,633.19		$3,094.98
Installing Contractors Profit@	8.0%				$20,633.19		$1,650.66
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$4,745.63
General Contractors Insurance @	1.0%			on	$25,378.82		$254
Bond @	1.0%			on	$25,378.82		$254
Contingency @	0.0%			on	$25,886.40		$0
						TOTAL COST for pay item	$25,886

Additional Pay Item Notes :

Expecting complete operation will take 4 days, Crane used to fly material out of demolition area and load on to 2 trucks, 4 laborers will demo the foot bridge lumber and back up trucks, foreman to oversee operation, 2 trucks used to make sure there is always a place to load demolition materials.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.011		Project	: JC Boyle		
Description	:	Remove Storage Shed located on access road					
Quantity	:	4,480.00 SF					
Daily Production	:	900.00 SF per	8 hour shift	Project #	: 1		
Work Days	:	5.0 Days		Estimator	: Eric Jones	SF per	Total Cost	Unit Price Per SF
Unit Price	:	$27.79 per SF		Probable Low Cost Parameter	945	$118,293	$26.40
Total Cost	:	$124,519		Probable High Cost Parameter	810	$136,970	$30.57

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	5.0	8	40.00	L	$48.27	incl. in rate	incl. in rate	$1,930.80
Laborer	Active	4.00	5.0	8	160.00	L	$45.80	incl. in rate	incl. in rate	$7,328.00
Truck Driver (heavy)	Active	5.00	5.0	8	200.00	L	$57.59	incl. in rate	incl. in rate	$11,518.00
Equipment Operator (medium)	Active	4.00	5.0	8	160.00	L	$66.28	incl. in rate	incl. in rate	$10,604.80
Equipment Operator (crane)	Active	1.00	5.0	8	40.00	L	$68.41	incl. in rate	incl. in rate	$2,736.40
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	5.0	8	80.00	E	$31.90	incl. in rate	incl. in rate	$2,552.00
Truck, On-Highway Dump (6x4, 12cy)	Active	3.00	5.0	8	120.00	E	$70.35	incl. in rate	incl. in rate	$8,442.00
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	5.0	8	40.00	E	$54.70	incl. in rate	incl. in rate	$2,188.00
Hydraulic Excavator (5.0cy)	Active	2.00	5.0	8	80.00	E	$274.63	incl. in rate	incl. in rate	$21,970.40
Loader, FE Rubber Tire (5.25cy)	Active	2.00	5.0	8	80.00	E	$75.42	incl. in rate	incl. in rate	$6,033.60
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
				Labor Hours	600				TOTAL LABOR	$34,118.00
				Equipment Hours	400				TOTAL EQUIPMENT	$41,186.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	657	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	328.53	tons	**Klamath County LandFill**	$74.00	$24,311.47
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$24,311.47

SUMMARY OF COSTS

Labor Cost	$34,118.00	Labor Burden @	0.0%			$34,118.00
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$41,186.00	Equipment Tax @	7.75%	$3,191.92		$44,377.92
Subcontractors	$24,311.47					$24,311.47
DIRECT COST SUBTOTALS	**$99,615**			**$3,192**	**DIRECT COST SUBTOTALS**	**$102,807**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$78,495.92	$11,774.39
Installing Contractors Profit@	8.0%				$78,495.92	$6,279.67
GC Markup on Subs @	5.0%				$24,311.47	$1,215.57
					TOTAL MARKUP COSTS	$19,269.63
General Contractors Insurance @	1.0%		on		$122,077.02	$1,221
Bond @	1.0%		on		$122,077.02	$1,221
Contingency @	0.0%		on		$124,518.56	$0
					TOTAL COST for pay item	**$124,519**

Additional Pay Item Notes :

It will take 1 week to complete the demolition of the storage shed. This includes disassembly and material removal. Using 2 excavators to demolish building, using 1 FE loader to keep area clean and maintain haul path for trucks, 1 forklift to load trucks with demo material, Laborers will be used to guide trucks and assist equipment with demolition operation, Foreman will oversee operation.

PAY ITEM COST DETAIL WORKSHEET — **1.012 Remove Warehouse located on access road**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.012		**Project**	: JC Boyle		
Description	: Remove Warehouse located on access road					
Quantity	: 2,580.00 SF					
Daily Production	: 550.00 SF per 8 hour shift		**Project #**	: 1		
Work Days	: 4.7 Days		**Estimator**	: Eric Jones	**SF per**	**Total Cost** / **Unit Price Per SF**
Unit Price	: $36.49 per SF		**Probable Low Cost Parameter**		577.5	$89,441 / $34.67
Total Cost	: $94,149		**Probable High Cost Parameter**		495	$103,564 / $40.14

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	4.7	8	37.60	L	$48.27	incl. in rate	incl. in rate	$1,814.95
Laborer	Active	4.00	4.7	8	150.40	L	$45.80	incl. in rate	incl. in rate	$6,888.32
Truck Driver (heavy)	Active	4.00	4.7	8	150.40	L	$57.59	incl. in rate	incl. in rate	$8,661.54
Equipment Operator (medium)	Active	3.00	4.7	8	112.80	L	$66.28	incl. in rate	incl. in rate	$7,476.38
Equipment Operator (light)	Active	1.00	4.7	8	37.60	L	$64.90	incl. in rate	incl. in rate	$2,440.24
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	4.7	8	75.20	E	$31.90	incl. in rate	incl. in rate	$2,398.88
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	4.7	8	75.20	E	$70.35	incl. in rate	incl. in rate	$5,290.32
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	4.7	8	37.60	E	$54.70	incl. in rate	incl. in rate	$2,056.72
Hydraulic Excavator (5.0cy)	Active	2.00	4.7	8	75.20	E	$274.63	incl. in rate	incl. in rate	$20,652.18
Loader, FE Rubber Tire (5.25cy)	Active	1.00	4.7	8	37.60	E	$75.42	incl. in rate	incl. in rate	$2,835.79
		1.00	4.7	8	37.60	0	$0.00	$0.00		$0.00
		1.00	4.7	8	37.60	0	$0.00	$0.00		$0.00
			4.7	8	0.00					$0.00
			4.7	8	0.00					$0.00
			4.7	8	0.00					$0.00
			4.7	8	0.00					$0.00
			4.7	8	0.00					$0.00
				Labor Hours	**488.8**				**TOTAL LABOR**	**$27,281.43**
				Equipment Hours	**300.8**				**TOTAL EQUIPMENT**	**$33,233.89**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	378	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	189.20	tons	**Klamath County LandFill**	$74.00	$14,000.80
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$14,000.80**

SUMMARY OF COSTS

Labor Cost	$27,281.43	Labor Burden @	0.0%			$27,281.43
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$33,233.89	Equipment Tax @	7.75%	$2,575.63		$35,809.51
Subcontractors	$14,000.80					$14,000.80
DIRECT COST SUBTOTALS	**$74,516**			**$2,576**	**DIRECT COST SUBTOTALS**	**$77,092**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$63,090.95	$9,463.64
Installing Contractors Profit@	8.0%				$63,090.95	$5,047.28
GC Markup on Subs @	5.0%				$14,000.80	$700.04
					TOTAL MARKUP COSTS	**$15,210.96**
General Contractors Insurance @	1.0%			on	$92,302.70	$923
Bond @	1.0%			on	$92,302.70	$923
Contingency @	0.0%			on	$94,148.76	$0
					TOTAL COST for pay item	**$94,149**

Additional Pay Item Notes :

It will take 1 week to complete the demolition of the warehouse. This includes disassembly and material removal. Using 2 excavators to demolition building, using 1 FE loader to keep area clean and maintain haul path for trucks, 1 forklift to load trucks with demo material, Laborers will be used to guide trucks and assist equipment with demolition operation, Foreman will oversee operation.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.013	Project	: JC Boyle			
Description	: Remove Fire System Control Bldg. on left abutment					
Quantity	: 520.00 SF					
Daily Production	: 520.00 SF per 8 hour shift	Project #	: 1			
Work Days	: 1.0 Days	Estimator	: Eric Jones	SF per	Total Cost	Unit Price Per SF
Unit Price	: $26.00 per SF	Probable Low Cost Parameter		546	$12,845	$24.70
Total Cost	: $13,521	Probable High Cost Parameter		468	$14,873	$28.60

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	incl. in rate	incl. in rate	$386.16
Laborer	Active	3.00	1.0	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Truck Driver (heavy)	Active	2.00	1.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	1.0	8	8.00	E	$70.35	incl. in rate	incl. in rate	$562.80
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	1.0	8	8.00	E	$54.70	incl. in rate	incl. in rate	$437.60
Hydraulic Excavator (5.0cy)	Active	1.00	1.0	8	8.00	E	$274.63	incl. in rate	incl. in rate	$2,197.04
Loader, FE Rubber Tire (5.25cy)	Active	1.00	1.0	8	8.00	E	$75.42	incl. in rate	incl. in rate	$603.36
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	72				TOTAL LABOR	$3,997.52
				Equipment Hours	40				TOTAL EQUIPMENT	$4,056.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	76	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	38.13	tons	Klamath County LandFill	$74.00	$2,821.87
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$2,821.87

SUMMARY OF COSTS

Labor Cost	$3,997.52	Labor Burden @		0.0%			$3,997.52
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$4,056.00	Equipment Tax @		7.75%	$314.34		$4,370.34
Subcontractors	$2,821.87						$2,821.87
DIRECT COST SUBTOTALS	$10,875				$314	DIRECT COST SUBTOTALS	$11,190
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,367.86		$1,255.18
Installing Contractors Profit@	8.0%				$8,367.86		$669.43
GC Markup on Subs @	5.0%				$2,821.87		$141.09
						TOTAL MARKUP COSTS	$2,065.70
General Contractors Insurance @	1.0%			on	$13,255.43		$133
Bond @	1.0%			on	$13,255.43		$133
Contingency @	0.0%			on	$13,520.54		$0
						TOTAL COST for pay item	$13,521

Additional Pay Item Notes :

It will take 1 day to complete the demolition of the fire control building. This includes disassembly and material removal. Using 1 excavator to demolish building, 1 FE loader to keep area clean and maintain haul path for trucks, 1 forklift to load trucks with demo material, 1 flatbed truck and 1 dump truck to haul off materials, laborers will be used to direct trucks and assist operators with the demolition activity.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.014		Project	: JC Boyle		
Description	:	Remove Dam Communication Bldg. on left abutment					
Quantity	:	490.00	SF				
Daily Production	:	490.00	SF per 8 hour shift	Project #	: 1		
Work Days	:	1.0	Days	Estimator	: Eric Jones		
					SF per	Total Cost	Unit Price Per SF
Unit Price	:	$27.21	per SF	Probable Low Cost Parameter	514.5	$12,666	$25.85
Total Cost	:	$13,332		Probable High Cost Parameter	441	$14,666	$29.93

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	incl. in rate	incl. in rate	$386.16
Laborer	Active	3.00	1.0	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Truck Driver (heavy)	Active	2.00	1.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Equipment Operator (light)	Active	1.00	1.0	8	8.00	L	$64.90	incl. in rate	incl. in rate	$519.20
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	1.0	8	8.00	E	$70.35	incl. in rate	incl. in rate	$562.80
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	1.0	8	8.00	E	$54.70	incl. in rate	incl. in rate	$437.60
Hydraulic Excavator (5.0cy)	Active	1.00	1.0	8	8.00	E	$274.63	incl. in rate	incl. in rate	$2,197.04
Loader, FE Rubber Tire (5.25cy)	Active	1.00	1.0	8	8.00	E	$75.42	incl. in rate	incl. in rate	$603.36
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	72				TOTAL LABOR	$3,986.48
				Equipment Hours	40				TOTAL EQUIPMENT	$4,056.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	72	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	35.93	tons	**Klamath County LandFill**	$74.00	$2,659.07
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$2,659.07

SUMMARY OF COSTS

Labor Cost	$3,986.48	Labor Burden @		0.0%			$3,986.48
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$4,056.00	Equipment Tax @		7.75%	$314.34		$4,370.34
Subcontractors	$2,659.07						$2,659.07
DIRECT COST SUBTOTALS	**$10,702**				**$314**	**DIRECT COST SUBTOTALS**	**$11,016**
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,356.82		$1,253.52
Installing Contractors Profit@	8.0%				$8,356.82		$668.55
GC Markup on Subs @	5.0%				$2,659.07		$132.95
						TOTAL MARKUP COSTS	**$2,055.02**
General Contractors Insurance @	1.0%		on		$13,070.91		$131
Bond @	1.0%		on		$13,070.91		$131
Contingency @	0.0%		on		$13,332.33		$0
						TOTAL COST for pay item	**$13,332**

Additional Pay Item Notes :

It will take 1 day to complete the demolition of the fire control building. This includes disassembly and material removal. Using 1 excavator to demolish building, 1 FE loader to keep area clean and maintain haul path for trucks, 1 forklift to load trucks with demo material, 1 flatbed truck and 1 dump truck to haul off materials, laborers will be used to direct trucks and assist operators with the demolition activity.

PAY ITEM COST DETAIL WORKSHEET — **1.015 Remove Concrete Slab on left abutment for former Control House**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.015	**Project**	: JC Boyle		
Description	:	Remove Concrete Slab on left abutment for former Control House				
Quantity	:	6.00 CY				
Daily Production	:	6.00 CY per 8 hour shift	**Project #**	: 1		
Work Days	:	1.0 Days	**Estimator**	: Eric Jones	**CY per**	**Total Cost** / **Unit Price Per CY**
Unit Price	:	$1,778.57 per CY	**Probable Low Cost Parameter**		**6.6**	**$9,604** / **$1,600.71**
Total Cost	:	$10,671	**Probable High Cost Parameter**		**5.1**	**$12,272** / **$2,045.36**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Hydraulic Excavator (5.0cy)	Active	2.00	1.0	8	16.00	E	$274.63	incl. in rate	incl. in rate	$4,394.08
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	1.0	8	8.00	E	$70.35	incl. in rate	incl. in rate	$562.80
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	1.0	8	8.00	E	$62.72	incl. in rate	incl. in rate	$501.76
	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**48**				**TOTAL LABOR**	**$2,624.16**
				Equipment Hours	**32**				**TOTAL EQUIPMENT**	**$5,458.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,624.16	Labor Burden @	0.0%				$2,624.16
Material Cost	$0.00	Material Tax @	7.75%	$0.00			$0.00
Equipment Cost	$5,458.64	Equipment Tax @	7.75%	$423.04			$5,881.68
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	**$8,083**			**$423**		**DIRECT COST SUBTOTALS**	**$8,506**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,505.84		$1,275.88
Installing Contractors Profit@	8.0%				$8,505.84		$680.47
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$1,956.34**
General Contractors Insurance @	1.0%		on		$10,462.19		$105
Bond @	1.0%		on		$10,462.19		$105
Contingency @	0.0%		on		$10,671.43		$0
						TOTAL COST for pay item	**$10,671**

Additional Pay Item Notes :

1 day to demolish and removal all concrete material, 1 excavator with breaker, 1 excavator loading materials in to dump truck, 2 laborers to direct trucks and assist equipment with demolition operation, 1 foreman to oversee operation.

PAY ITEM COST DETAIL WORKSHEET — **1.016 Remove 4'x5' Metal Hatch on top of Concrete Pull Box on left abutment**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.016	**Project**	: JC Boyle		
Description	:	Remove 4'x5' Metal Hatch on top of Concrete Pull Box on left abutment				
Quantity	:	1.00 CY				
Daily Production	:	3.00 CY per 8 hour shift	**Project #**	: 1		
Work Days	:	0.3 Days	**Estimator**	: Eric Jones	**CY per**	**Total Cost** / **Unit Price Per CY**
Unit Price	:	$1,769.46 per CY	**Probable Low Cost Parameter**		**3.3**	**$1,593** / **$1,592.51**
Total Cost	:	$1,769	**Probable High Cost Parameter**		**2.7**	**$1,946** / **$1,946.40**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	0.3	8	2.40	L	$46.27	incl. in rate	incl. in rate	$111.05
Laborer	Active	1.00	0.3	8	2.40	L	$45.80	incl. in rate	incl. in rate	$109.92
Truck Driver (heavy)	Active	1.00	0.3	8	2.40	L	$57.59	incl. in rate	incl. in rate	$138.22
Equipment Operator (medium)	Active	1.00	0.3	8	2.40	L	$66.28	incl. in rate	incl. in rate	$159.07
Hydraulic Excavator (5.0cy)	Active	1.00	0.3	8	2.40	E	$274.63	incl. in rate	incl. in rate	$659.11
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	0.3	8	2.40	E	$70.35	incl. in rate	incl. in rate	$168.84
0		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
				Labor Hours	**9.6**				**TOTAL LABOR**	**$518.26**
				Equipment Hours	**4.8**				**TOTAL EQUIPMENT**	**$827.95**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$518.26	Labor Burden @	0.0%			$518.26
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$827.95	Equipment Tax @	7.75%	$64.17		$892.12
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,346**			**$64**	**DIRECT COST SUBTOTALS**	**$1,410**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,410.37	$211.56
Installing Contractors Profit@	8.0%				$1,410.37	$112.83
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$324.39**
General Contractors Insurance @	1.0%		on		$1,734.76	$17
Bond @	1.0%		on		$1,734.76	$17
Contingency @	0.0%		on		$1,769.46	$0
					TOTAL COST for pay item	**$1,769**

Additional Pay Item Notes :

2.5 hours to complete operation, using 1 excavator to demo and load material, laborer to support equipment, dump truck to haul material to scour haul, foreman to oversee operation.

PAY ITEM COST DETAIL WORKSHEET — **1.017 Remove Reservoir Level Gauge House on Dam Crest**

PAY ITEM INFORMATION

PAY ITEM NUMBER :	1.017		**Project** : JC Boyle			
Description :	Remove Reservoir Level Gauge House on Dam Crest					
Quantity :	24.00 SF					
Daily Production :	48.00 SF per	8 hour shift	**Project #** : 1			
Work Days :	0.5 Days		**Estimator** : Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price :	$138.69 per SF		**Probable Low Cost Parameter**	**50.4**	**$3,162**	**$131.75**
Total Cost :	$3,328		**Probable High Cost Parameter**	**43.2**	**$3,661**	**$152.55**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.5	8	4.00	L	$48.27	incl. in rate	incl. in rate	$193.08
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
Equipment Operator (medium)	Active	1.00	0.5	8	4.00	L	$66.28	incl. in rate	incl. in rate	$265.12
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	0.5	8	4.00	E	$70.35	incl. in rate	incl. in rate	$281.40
Hydraulic Excavator (5.0cy)	Active	1.00	0.5	8	4.00	E	$274.63	incl. in rate	incl. in rate	$1,098.52
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
				Labor Hours	**20**				**TOTAL LABOR**	**$1,054.96**
				Equipment Hours	**8**				**TOTAL EQUIPMENT**	**$1,379.92**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	4	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	1.76	tons	**Klamath County LandFill**	$74.00	$130.24
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$130.24**

SUMMARY OF COSTS

Labor Cost	$1,054.96	Labor Burden @		0.0%			$1,054.96
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$1,379.92	Equipment Tax @		7.75%	$106.94		$1,486.86
Subcontractors	$130.24						$130.24
DIRECT COST SUBTOTALS	**$2,565**				**$107**	**DIRECT COST SUBTOTALS**	**$2,672**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$2,541.82		$381.27
Installing Contractors Profit@	8.0%				$2,541.82		$203.35
GC Markup on Subs @	5.0%				$130.24		$6.51
						TOTAL MARKUP COSTS	**$591.13**
General Contractors Insurance @	1.0%		on		$3,263.20		$33
Bond @	1.0%		on		$3,263.20		$33
Contingency @	0.0%		on		$3,328.46		$0
						TOTAL COST for pay item	**$3,328**

Additional Pay Item Notes :

Operation will take 1/2 of a day to complete including mobilizing to area, excavator will be used to demolish and load material, truck will haul off material, to dump location, laborer to support equipment and truck coordination, foreman to oversee operation.

PAY ITEM COST DETAIL WORKSHEET

1.018 Downstream Riprap

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.018		**Project**	: JC Boyle		
Description	: Downstream Riprap					
Quantity	: 2,200.00 CY					
Daily Production	: 325.00 CY per 8 hour shift		**Project #**	: 1		
Work Days	: 6.8 Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	: $93.45 per CY		**Probable Low Cost Parameter**	**357.5**	**$185,023**	**$84.10**
Total Cost	: $205,581		**Probable High Cost Parameter**	**292.5**	**$226,139**	**$102.79**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	4.00	6.8	8	217.60	E	$274.63	incl. in rate	incl. in rate	$59,759.49
Truck, On-Highway Dump (6x4, 12cy)	Active	10.00	6.8	8	544.00	E	$70.35	incl. in rate	incl. in rate	$38,270.40
Equipment Operator (medium)	Active	4.00	6.8	8	217.60	L	$66.28	incl. in rate	incl. in rate	$14,422.53
Truck Driver (heavy)	Active	10.00	6.8	8	544.00	L	$57.59	incl. in rate	incl. in rate	$31,328.96
Labor Foreman (out)	Active	1.00	6.8	8	54.40	L	$46.27	incl. in rate	incl. in rate	$2,517.09
Laborer	Active	4.00	6.8	8	217.60	L	$45.80	incl. in rate	incl. in rate	$9,966.08
0		1.00	6.8	8	54.40	0	$0.00	$0.00		$0.00
		1.00	6.8	8	54.40	0	$0.00	$0.00		$0.00
		1.00	6.8	8	54.40	0	$0.00	$0.00		$0.00
0		1.00	6.8	8	54.40	0	$0.00	$0.00		$0.00
		1.00	6.8	8	54.40	0	$0.00	$0.00		$0.00
		1.00	6.8	8	54.40	0	$0.00	$0.00		$0.00
			6.8	8	0.00					$0.00
			6.8	8	0.00					$0.00
			6.8	8	0.00					$0.00
			6.8	8	0.00					$0.00
			6.8	8	0.00					$0.00
				Labor Hours	**1033.6**				**TOTAL LABOR**	**$58,234.66**
				Equipment Hours	**761.6**				**TOTAL EQUIPMENT**	**$98,029.89**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$58,234.66	Labor Burden @	0.0%			$58,234.66
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$98,029.89	Equipment Tax @	7.75%	$7,597.32		$105,627.20
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$156,265**			**$7,597**	**DIRECT COST SUBTOTALS**	**$163,862**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$163,861.86	$24,579.28
Installing Contractors Profit@	8.0%				$163,861.86	$13,108.95
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$37,688.23**
General Contractors Insurance @	1.0%		on		$201,550.09	$2,016
Bond @	1.0%		on		$201,550.09	$2,016
Contingency @	0.0%		on		$205,581.09	$0
					TOTAL COST for pay item	**$205,581**

Additional Pay Item Notes :

Trucks will be hauling 10 CY of material at a time, 10 trucks will be 13 loads per truck, truck will be hauling roughly 4 loads per day due to time it takes to load material and potential void space from material. Trucks to haul material to disposal site, 2 excavators used to place material at loading stock pile, 2 excavators used to load trucks, laborers will be used to direct truck traffic, foreman to oversee operation.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.019	**Project**	: JC Boyle		
Description	:	Upstream Riprap				
Quantity	:	1,300.00 CY				
Daily Production	:	325.00 CY per 8 hour shift	**Project #**	: 1		
Work Days	:	4.0 Days	**Estimator**	: Eric Jones	**CY per**	**Total Cost**
Unit Price	:	$93.02 per CY	**Probable Low Cost Parameter**	357.5	$108,837	$83.72
Total Cost	:	$120,930	**Probable High Cost Parameter**	292.5	$133,023	$102.33

(Unit Price Per CY: $83.72 low; $102.33 high)

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	4.00	4.0	8	128.00	E	$274.63	incl. in rate	incl. in rate	$35,152.64
Truck, On-Highway Dump (6x4, 12cy)	Active	10.00	4.0	8	320.00	E	$70.35	incl. in rate	incl. in rate	$22,512.00
Equipment Operator (medium)	Active	4.00	4.0	8	128.00	L	$66.28	incl. in rate	incl. in rate	$8,483.84
Truck Driver (heavy)	Active	10.00	4.0	8	320.00	L	$57.59	incl. in rate	incl. in rate	$18,428.80
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Laborer	Active	4.00	4.0	8	128.00	L	$45.80	incl. in rate	incl. in rate	$5,862.40
0		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
0		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
				Labor Hours	**608**				**TOTAL LABOR**	**$34,255.68**
				Equipment Hours	**448**				**TOTAL EQUIPMENT**	**$57,664.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$34,255.68	Labor Burden @	0.0%		$34,255.68
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$57,664.64	Equipment Tax @	7.75%	$4,469.01	$62,133.65
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$91,920**			**$4,469**	**DIRECT COST SUBTOTALS** **$96,389**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$96,389.33	$14,458.40
Installing Contractors Profit@	8.0%				$96,389.33	$7,711.15
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$22,169.55**
General Contractors Insurance @	1.0%		on		$118,558.88	$1,186
Bond @	1.0%		on		$118,558.88	$1,186
Contingency @	0.0%		on		$120,930.05	$0
					TOTAL COST for pay item	**$120,930**

Additional Pay Item Notes :

Trucks will be hauling 10 CY of material at a time, 10 trucks will be 22 loads per truck, truck will be hauling roughly 4 loads per day due to time it takes to load material and potential void space from material. Trucks to haul material to scour site, 2 excavators used to place material at loading stock pile, 2 excavators used to load trucks, laborers will be used to direct truck traffic, foreman to oversee operation.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.02		**Project**	: JC Boyle		
Description	:	Miscellaneous Excavation (Dam Earth Section)					
Quantity	:	132,500.00	cy				
Daily Production	:	3,000.00	cy per 8 hour shift	**Project #**	: 1		
Work Days	:	44.2	Days	**Estimator**	: Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$10.42	per cy	**Probable Low Cost Parameter**	**3450**	**$1,173,107**	**$8.85**
Total Cost	:	$1,380,126		**Probable High Cost Parameter**	**2400**	**$1,656,151**	**$12.50**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (6.0cy)	Active	3.00	44.2	8	1,060.80	E	$322.48	$322.48		$342,086.78
Loader, FE Rubber Tire (8.6cy)	Active	3.00	44.2	8	1,060.80	E	$221.50	$221.50		$234,967.20
Truck, Off-Road, Articulated Rear, 20cy	Active	3.00	44.2	8	1,060.80	E	$111.64	$111.64		$118,427.71
Equipment Operator (medium)	Active	6.00	44.2	8	2,121.60	L	$66.28	$0.00		$140,619.65
Truck Driver (heavy)	Active	3.00	44.2	8	1,060.80	L	$57.59	$0.00		$61,091.47
Laborer		1.00	44.2	8	353.60	L	$45.80	$0.00		$16,194.88
		0.00	44.2	8	0.00	0	$0.00	$0.00		$0.00
			44.2	8	0.00					$0.00
			44.2	8	0.00					$0.00
			44.2	8	0.00					$0.00
			44.2	8	0.00					$0.00
			44.2	8	0.00					$0.00
				Labor Hours	**3536**				**TOTAL LABOR**	**$217,906.00**
				Equipment Hours	**3182.4**				**TOTAL EQUIPMENT**	**$695,481.70**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
	0.00	lf	1.000	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ls	1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$217,906.00	Labor Burden @	49.7%	$0.00		$217,906.00
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$695,481.70	Equipment Tax @	7.75%	$53,899.83		$749,381.53
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$913,388**			**$53,900**	**DIRECT COST SUBTOTALS**	**$967,288**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$967,287.53	$145,093.13
Installing Contractors Profit@	8.0%				$967,287.53	$77,383.00
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$222,476.13**
General Contractors Insurance @	15.0%		on		$1,189,763.66	$178,465
Bond @	1.0%		on		$1,189,763.66	$11,898
Contingency @	0.0%		on		$1,380,125.84	$0
					TOTAL COST for pay item	**$1,380,126**

Additional Pay Item Notes :

Used excavators for removal of material figuring 3000 CY per shift

PAY ITEM COST DETAIL WORKSHEET

1.021 Cutoff Wall Concrete Demolition

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.021		Project	: JC Boyle		
Description	: Cutoff Wall Concrete Demolition					
Quantity	: 70.00 CY					
Daily Production	: 20.00 CY per 8 hour shift		Project #	: 1		
Work Days	: 3.5 Days		Estimator	: Eric Jones		
				CY per	Total Cost	Unit Price Per CY
Unit Price	: $655.64 per CY		Probable Low Cost Parameter	21	$43,600	$622.86
Total Cost	: $45,895		Probable High Cost Parameter	17	$52,779	$753.99

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	2.00	3.5	8	56.00	E	$274.63	incl. in rate	incl. in rate	$15,379.28
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	3.5	8	56.00	E	$70.35	incl. in rate	incl. in rate	$3,939.60
Truck, Pickup (4x4, 3/4tn)	Active	1.00	3.5	8	28.00	E	$16.94	incl. in rate	incl. in rate	$474.32
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	3.5	8	28.00	E	$62.72	incl. in rate	incl. in rate	$1,756.16
Labor Foreman (out)	Active	1.00	3.5	8	28.00	L	$46.27	incl. in rate	incl. in rate	$1,295.56
Laborer	Active	4.00	3.5	8	112.00	L	$45.80	incl. in rate	incl. in rate	$5,129.60
Equipment Operator (medium)	Active	2.00	3.5	8	56.00	L	$66.28	incl. in rate	incl. in rate	$3,711.68
Truck Driver (heavy)	Active	2.00	3.5	8	56.00	L	$57.59	incl. in rate	incl. in rate	$3,225.04
		1.00	3.5	8	28.00	0	$0.00	$0.00		$0.00
0		1.00	3.5	8	28.00	0	$0.00	$0.00		$0.00
		1.00	3.5	8	28.00	0	$0.00	$0.00		$0.00
		1.00	3.5	8	28.00	0	$0.00	$0.00		$0.00
			3.5	8	0.00					$0.00
			3.5	8	0.00					$0.00
			3.5	8	0.00					$0.00
			3.5	8	0.00					$0.00
			3.5	8	0.00					$0.00
				Labor Hours	252				TOTAL LABOR	$13,361.88
				Equipment Hours	168				TOTAL EQUIPMENT	$21,549.36

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$13,361.88	Labor Burden @		0.0%			$13,361.88
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$21,549.36	Equipment Tax @		7.75%	$1,670.08		$23,219.44
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$34,911				$1,670	DIRECT COST SUBTOTALS	$36,581
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$36,581.32		$5,487.20
Installing Contractors Profit@	8.0%				$36,581.32		$2,926.51
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$8,413.70
General Contractors Insurance @	1.0%		on		$44,995.02		$450
Bond @	1.0%		on		$44,995.02		$450
Contingency @	0.0%		on		$45,894.92		$0
						TOTAL COST for pay item	$45,895

Additional Pay Item Notes :

1 excavator with breaker will be used to demolish material, 1 excavator will be used to load trucks, 1 truck will haul 7 loads total roughly 2 load per day, overall duration accounts for setup and break down time, Laborers will be used to direct trucks and assist equipment operations, foreman will oversee the operation. Expect that the demolition operation is going to slow down the down the production of the dump trucks and the second excavator.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.022		Project	: JCBOYLE		
Description	: Cuttoff Wall Anchors					
Quantity	: 285.00 EA					
Daily Production	: 285.00 EA per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 1.0 Days		Estimator	: Mihaela Tomulescu		
				EA per	Total Cost	Unit Price Per EA
Unit Price	: $12.86 per EA		Probable Low Cost Parameter	299.25	$3,481	$12.21
Total Cost	: $3,664		Probable High Cost Parameter	256.5	$4,030	$14.14

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	incl. in rate	incl. in rate	$1,048.32
Carpenters, Journeyman	Active	1.00	1.0	8	8.00	L	$65.37	incl. in rate	incl. in rate	$522.96
Equipment Operator (medium)	Active	1.00	0.5	8	4.00	L	$66.28	incl. in rate	incl. in rate	$265.12
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.5	8	4.00	E	$221.50	incl. in rate	incl. in rate	$886.00

Labor Hours	28	TOTAL LABOR	$1,836.40
Equipment Hours	4	TOTAL EQUIPMENT	$886.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$183.64	$183.64
					TOTAL MATERIAL	$183.64

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,836.40	Labor Burden @	49.7%	$0.00		$1,836.40
Material Cost	$183.64	Material Tax @	7.8%	$14.23		$197.87
Equipment Cost	$886.00	Equipment Tax @	0.0%	$0.00		$886.00
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$2,906			$14	DIRECT COST SUBTOTALS	$2,920

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,920.27	$438.04
Installing Contractors Profit@	8.0%				$2,920.27	$233.62
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$671.66
General Contractors Insurance @	1.0%		on		$3,591.93	$36
Bond @	1.0%		on		$3,591.93	$36
Contingency @	0.0%		on		$3,663.77	$0
					TOTAL COST for pay item	$3,664

Additional Pay Item Notes :

Assumed 1 day work and includes cutting anchors at top of bedrock.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.023	Project	: JCBOYLE
Description	: Remove & Dispose Hand Rails and Light Poles		
Quantity	: 5,000.00 LBS		
Daily Production	: 18,500.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 0.3 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $0.85 per LBS		
Total Cost	: $4,227		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	19425	$4,016	$0.80
Probable High Cost Parameter	15725	$4,861	$0.97

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (80tn)	Active	1.00	0.3	8	2.40	E	$190.46	incl. in rate	incl. in rate	$457.10
Millwright	Active	6.00	0.3	8	14.40	L	$69.46	incl. in rate	incl. in rate	$1,000.22
Equipment Operator (crane)	Active	1.00	0.3	8	2.40	L	$68.41	incl. in rate	incl. in rate	$164.18
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.3	8	2.40	E	$221.50	incl. in rate	incl. in rate	$531.60
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.3	8	2.40	E	$111.64	incl. in rate	incl. in rate	$267.94
Truck Driver (heavy)	Active	1.00	0.3	8	2.40	L	$57.59	incl. in rate	incl. in rate	$138.22
Electrician	Active	1.00	0.3	8	2.40	L	$45.23	incl. in rate	incl. in rate	$108.55
Labor Foreman (out)	Active	2.00	0.3	8	4.80	L	$46.27	incl. in rate	incl. in rate	$222.10
Equipment Operator (medium)	Active	1.00	0.3	8	2.40	L	$66.28	incl. in rate	incl. in rate	$159.07

Labor Hours	28.8	TOTAL LABOR	$1,792.34
Equipment Hours	7.2	TOTAL EQUIPMENT	$1,256.64

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$179.23	$179.23
					TOTAL MATERIAL	$179.23

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	0.25	ton	1.000	0.25	$595.00	$148.75
					TOTAL SUBCONTRACTS	$148.75

SUMMARY OF COSTS

Labor Cost	$1,792.34	Labor Burden @	49.7%	$0.00	$1,792.34
Material Cost	$179.23	Material Tax @	7.8%	$13.89	$193.13
Equipment Cost	$1,256.64	Equipment Tax @	0.0%	$0.00	$1,256.64
Subcontractors	$148.75				$148.75
DIRECT COST SUBTOTALS	$3,377			$14	DIRECT COST SUBTOTALS $3,391

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,242.11	$486.32
Installing Contractors Profit@	8.0%				$3,242.11	$259.37
GC Markup on Subs @	5.0%				$148.75	$7.44
					TOTAL MARKUP COSTS	$753.12

General Contractors Insurance @	1.0%	on	$4,143.98	$41
Bond @	1.0%	on	$4,143.98	$41
Contingency @	0.0%	on	$4,226.86	$0
			TOTAL COST for pay item	$4,227

Additional Pay Item Notes :

Assumed 2.40 hours work for a crew formed of 1 Forman, 5 millwright for the handrails and 1 electrician to assure power for tools, etc. Assumed hazardous waste 10% of the total lbs, calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.024	Project	: JCBOYLE
Description	: Remove & Dispose Spillway Radial Gates and Hoists		
Quantity	: 124,000.00 LBS		
Daily Production	: 8,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 15.5 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $2.14 per LBS		
Total Cost	: $264,891		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	8800	$238,402	$1.92
Probable High Cost Parameter	5200	$357,603	$2.88

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	15.5	8	124.00	L	$47.23	$0.00		$5,856.52
Electrician	Active	1.00	15.5	8	124.00	L	$45.23	$0.00		$5,608.52
Steelworker	Active	5.00	15.5	8	620.00	L	$65.52	$0.00		$40,622.40
Loader, FE Rubber Tire (8.6cy)	Active	1.00	15.5	8	124.00	E	$221.50	$221.50		$27,466.00
Truck Driver (heavy)	Active	1.00	15.5	8	124.00	L	$57.59	$0.00		$7,141.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	15.5	8	124.00	E	$111.64	$111.64		$13,843.36
Hydraulic Crane (120tn)	Active	1.00	15.5	8	124.00	E	$239.06	$239.06		$29,643.44
Welder	Active	1.00	15.5	8	124.00	L	$7.84	$0.00		$971.85
Gas Welding Machine	Active	1.00	15.5	8	124.00	E	$2.88	$2.88		$356.75
Equipment Operator (medium)	Active	1.00	15.5	8	124.00	L	$66.28	$0.00		$8,218.72
Equipment Operator (crane)	Active	1.00	15.5	8	124.00	L	$68.41	$0.00		$8,482.84
Laborer	Active	4.00	15.5	8	496.00	L	$45.80	$0.00		$22,716.80

Labor Hours	1860	TOTAL LABOR	$99,618.81
Equipment Hours	496	TOTAL EQUIPMENT	$71,309.55

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$4,980.94	$4,980.94
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	2,500.00	LF	1.000	2,500.00	$0.85	$2,125.00
TOTAL MATERIAL						$7,105.94

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	62.00	ton	1.000	62.00	$595.00	$36,890.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	171.20	mile	1.000	171.20	$7.25	$1,241.20
TOTAL SUBCONTRACTS						$38,131.20

SUMMARY OF COSTS

Labor Cost	$99,618.81	Labor Burden @	49.7%	$0.00	$99,618.81
Material Cost	$7,105.94	Material Tax @	7.8%	$550.71	$7,656.65
Equipment Cost	$71,309.55	Equipment Tax @	0.0%	$0.00	$71,309.55
Subcontractors	$38,131.20				$38,131.20
DIRECT COST SUBTOTALS	$216,165			$551	DIRECT COST SUBTOTALS $216,716

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$178,585.01	$26,787.75
Installing Contractors Profit@	8.0%				$178,585.01	$14,286.80
GC Markup on Subs @	5.0%				$38,131.20	$1,906.56
TOTAL MARKUP COSTS						$42,981.11

General Contractors Insurance @	1.0%	on	$259,697.32	$2,597
Bond @	1.0%	on	$259,697.32	$2,597
Contingency @	0.0%	on	$264,891.27	$0
TOTAL COST for pay item				$264,891

Additional Pay Item Notes :

Production based on crew 1 Forman, 5 Steelworkers and 1 Welder to cut and attach hooks to the gate for disposal, 4 Laborers to rigging wire rope slings, 1 Electrician to provide power for tools, 1 Truck for disposal to Yreka facility. Production has been reduced due to activity occuring during the winter months.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.025		Project	: JCBOYLE		
Description	: Remove & Dispose Stop Logs and Slots (steel)					
Quantity	: 92,000.00 LBS					
Daily Production	: 30,000.00 LBS per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 3.1 Days		Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $0.94 per LBS		Probable Low Cost Parameter		33000	$78,053	$0.85
Total Cost	: $86,725		Probable High Cost Parameter		24000	$104,070	$1.13

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	3.1	8	24.80	L	$47.23	$0.00		$1,171.30
Electrician	Active	1.00	3.1	8	24.80	L	$45.23	$0.00		$1,121.70
Ironworkers	Active	10.00	3.1	8	248.00	L	$63.95	$0.00		$15,859.60
Vibratory Hammer & Extractor	Active	1.00	3.1	8	24.80	E	$94.34	$94.34		$2,339.63
Truck Driver (heavy)	Active	2.00	3.1	8	49.60	L	$57.59	$0.00		$2,856.46
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	3.1	8	49.60	E	$111.64	$111.64		$5,537.34
Hydraulic Crane (120tn)	Active	2.00	3.1	8	49.60	E	$239.06	$239.06		$11,857.38
Welder	Active	2.00	3.1	8	49.60	L	$7.84	$0.00		$388.74
Gas Welding Machine	Active	2.00	3.1	8	49.60	E	$2.88	$2.88		$142.70
Equipment Operator (medium)	Active	2.00	3.1	8	49.60	L	$66.28	$0.00		$3,287.49
Equipment Operator (crane)	Active	1.00	3.1	8	24.80	L	$68.41	$0.00		$1,696.57
Laborer	Active	10.00	3.1	8	248.00	L	$45.80	$0.00		$11,358.40
				Labor Hours	719.2				TOTAL LABOR	$37,740.27
				Equipment Hours	173.6				TOTAL EQUIPMENT	$19,877.05

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,887.01	$1,887.01
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	5,000.00	LF	1.000	5,000.00	$0.85	$4,250.00
					TOTAL MATERIAL	$6,137.01

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (20%)	9.20	ton	1.000	9.20	$595.00	$5,474.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	36.00	mile	1.000	36.00	$7.25	$261.00
					TOTAL SUBCONTRACTS	$5,735.00

SUMMARY OF COSTS

Labor Cost	$37,740.27	Labor Burden @	49.7%	$0.00	$37,740.27
Material Cost	$6,137.01	Material Tax @	7.8%	$475.62	$6,612.63
Equipment Cost	$19,877.05	Equipment Tax @	0.0%	$0.00	$19,877.05
Subcontractors	$5,735.00				$5,735.00
DIRECT COST SUBTOTALS	$69,489			$476	DIRECT COST SUBTOTALS $69,965

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$64,229.95	$9,634.49
Installing Contractors Profit@	8.0%				$64,229.95	$5,138.40
GC Markup on Subs @	5.0%				$5,735.00	$286.75
					TOTAL MARKUP COSTS	$15,059.64
General Contractors Insurance @	1.0%		on		$85,024.59	$850
Bond @	1.0%		on		$85,024.59	$850
Contingency @	0.0%		on		$86,725.08	$0
					TOTAL COST for pay item	$86,725

Additional Pay Item Notes :

Production based on crew 1 Forman, 5 Ironworkers and 1 Welder to cut and attach hooks to the gate for disposal, 4 Laborers to rigging wire rope slings. Electrical crew to provide power for tools, 1 Truck for disposal to Yreka facility. Assuming using a Vibratory Hammer & Extractor for attachments in concrete and 2 cranes for balance when the gates are discharged.

PAY ITEM COST DETAIL WORKSHEET

1.026 Remove & Dispose of 24" Slide Gate at Entrance to Fish Ladder Structure

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.026		Project	: JCBOYLE		
Description	:	Remove & Dispose of 24" Slide Gate at Entrance to Fish Ladder Structure					
Quantity	:	4,200.00 LBS					
Daily Production	:	30,000.00 LBS per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	:	0.1 Days		Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.70 per LBS		Probable Low Cost Parameter		31500	$2,773	$0.66
Total Cost	:	$2,919		Probable High Cost Parameter		16500	$4,233	$1.01

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.1	8	0.80	L	$47.23	$0.00		$37.78
Electrician	Active	1.00	0.1	8	0.80	L	$45.23	$0.00		$36.18
Steelworker	Active	5.00	0.1	8	4.00	L	$65.52	$0.00		$262.08
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.1	8	0.80	E	$221.50	$221.50		$177.20
Truck Driver (heavy)	Active	1.00	0.1	8	0.80	L	$57.59	$0.00		$46.07
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.1	8	0.80	E	$111.64	$111.64		$89.31
Hydraulic Crane (120tn)	Active	1.00	0.1	8	0.80	E	$239.06	$239.06		$191.25
Welder	Active	1.00	0.1	8	0.80	L	$7.84	$0.00		$6.27
Gas Welding Machine	Active	1.00	0.1	8	0.80	E	$2.88	$2.88		$2.30
Equipment Operator (medium)	Active	1.00	0.1	8	0.80	L	$66.28	$0.00		$53.02
Equipment Operator (crane)	Active	1.00	0.1	8	0.80	L	$68.41	$0.00		$54.73
Laborer	Active	4.00	0.1	8	3.20	L	$45.80	$0.00		$146.56
				Labor Hours	12				TOTAL LABOR	$642.70
				Equipment Hours	3.2				TOTAL EQUIPMENT	$460.06

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$32.14	$32.14
					TOTAL MATERIAL	$32.14

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	2.10	ton	1.000	2.10	$595.00	$1,249.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	19.83	mile	1.000	19.83	$7.25	$143.79
					TOTAL SUBCONTRACTS	$1,393.29

SUMMARY OF COSTS

Labor Cost	$642.70	Labor Burden @		49.7%	$0.00		$642.70
Material Cost	$32.14	Material Tax @		7.8%	$2.49		$34.63
Equipment Cost	$460.06	Equipment Tax @		0.0%	$0.00		$460.06
Subcontractors	$1,393.29						$1,393.29
DIRECT COST SUBTOTALS	$2,528				$2	DIRECT COST SUBTOTALS	$2,531
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,137.39		$170.61
Installing Contractors Profit@	8.0%				$1,137.39		$90.99
GC Markup on Subs @	5.0%				$1,393.29		$69.66
						TOTAL MARKUP COSTS	$331.26
General Contractors Insurance @	1.0%		on		$2,861.94		$29
Bond @	1.0%		on		$2,861.94		$29
Contingency @	0.0%		on		$2,919.18		$0
						TOTAL COST for pay item	$2,919

Additional Pay Item Notes :

Production based on crew 1 Forman, 5 Steelworkers and 1 Welder to cut and attach hooks to the gate for disposal, 4 Laborers to rigging wire rope slings, 1 Electrician to provide power for tools, 1 Truck for disposal to Yreka facility. Assuming 1 hour of work.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.026a	Project	: JCBOYLE		
Description	:	Remove petroleum products from Red Bam Area				
Quantity	:	1,600.00 GAL				
Daily Production	:	550.00 GAL per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	2.9 Days	Estimator	: Mihaela Tomulescu		
				GAL per	Total Cost	Unit Price Per GAL
Unit Price	:	$13.34 per GAL	Probable Low Cost Parameter	632.5	$18,137	$11.34
Total Cost	:	$21,338	Probable High Cost Parameter	385	$27,739	$17.34

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.9	8	23.20	L	$46.27	incl. in rate	incl. in rate	$1,073.46
Electrician	Active	1.00	2.9	8	23.20	L	$45.23	incl. in rate	incl. in rate	$1,049.34
Laborer	Active	4.00	2.9	8	92.80	L	$45.80	incl. in rate	incl. in rate	$4,250.24
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.9	8	23.20	E	$221.50	incl. in rate	incl. in rate	$5,138.80
Truck Driver (heavy)	Active	1.00	2.9	8	23.20	L	$57.59	incl. in rate	incl. in rate	$1,336.09
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.9	8	23.20	E	$111.64	incl. in rate	incl. in rate	$2,590.05
Equipment Operator (light)	Active	1.00	2.9	8	23.20	L	$64.90	incl. in rate	incl. in rate	$1,505.68
Pump, Centrifugal, 3"	Active	1.00	2.9	8	23.20	E	$2.76	incl. in rate	incl. in rate	$63.93
				Labor Hours	185.6				TOTAL LABOR	$9,214.81
				Equipment Hours	69.6				TOTAL EQUIPMENT	$7,792.78

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	0.00	LS	1.000	0.00	$0.00	$0.00
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	0.00	LF	1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$9,214.81	Labor Burden @	49.7%	$0.00		$9,214.81
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$7,792.78	Equipment Tax @	0.0%	$0.00		$7,792.78
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$17,008			$0	DIRECT COST SUBTOTALS	$17,008

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$17,007.59		$2,551.14
Installing Contractors Profit@	8.0%				$17,007.59		$1,360.61
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$3,911.75
General Contractors Insurance @	1.0%		on		$20,919.33		$209
Bond @	1.0%		on		$20,919.33		$209
Contingency @	0.0%		on		$21,337.72		$0
						TOTAL COST for pay item	$21,338

Additional Pay Item Notes :

The petroleum waste is saved in drums and send it to recycling or disposal. Used a crew formed of 1 Forman, 4 Laborers to takeout the petroleum waste from the mech equipment, 1 Electrician to unplug the power and to assure the temporary power at the construction site.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.027	Project	: JCBOYLE		
Description	:	Remove & Dispose of Spillway gate motor & control panel				
Quantity	:	1.00 EA				
Daily Production	:	1.00 EA per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	1.0 Days	Estimator	: Mihaela Tomulescu		
				EA per	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$1,282.33 per EA	Probable Low Cost Parameter	1.1	$1,154	$1,154.10
Total Cost	:	$1,282	Probable High Cost Parameter	0.8	$1,539	$1,538.80

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	$0.00		$732.80

Labor Hours	16	TOTAL LABOR	$732.80
Equipment Hours	0	TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 0.5% labor (Side Cutter, Sharp-Nose Pliers, Sharp Tip Tweezers PCB Clamp, etc)	3.66	LS	1.000	3.66	$73.28	$268.50
					TOTAL MATERIAL	$268.50

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$732.80	Labor Burden @		49.7%	$0.00		$732.80
Material Cost	$268.50	Material Tax @		7.8%	$20.81		$289.31
Equipment Cost	$0.00	Equipment Tax @		0.0%	$0.00		$0.00
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	**$1,001**				**$21**	**DIRECT COST SUBTOTALS**	**$1,022**
		Crew	**Material**	**Subs**	**Cost Basis**		
Installing Contractors Overhead@	15.0%				$1,022.11		$153.32
Installing Contractors Profit@	8.0%				$1,022.11		$81.77
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$235.08**
General Contractors Insurance @	1.0%		on		$1,257.19		$13
Bond @	1.0%		on		$1,257.19		$13
Contingency @	0.0%		on		$1,282.33		$0
						TOTAL COST for pay item	**$1,282**

Additional Pay Item Notes :

Assumed that two workers will work one day to unconnected and remove the control panel and the gate motor. They will discharge the control panel and the gate motor in an available truck used for the other scope of work on the construction site. Assumed weight:500 LBS

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.028	Project	: JCBOYLE
Description	: Remove & Dispose of Distribution equipment, panelboards		
Quantity	: 1.00 EA		
Daily Production	: 0.50 EA per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 2.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $5,877.55 per EA		
Total Cost	: $5,878		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	0.55	$5,290	$5,289.80
Probable High Cost Parameter	0.4	$7,053	$7,053.06

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.0	8	16.00	L	$47.23	$0.00		$755.68
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	$0.00		$723.68
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
Hydraulic Crane (17tn)	Active	1.00	2.0	8	16.00	E	$81.52	$81.52		$1,304.32

Labor Hours	48	TOTAL LABOR	$2,487.36
Equipment Hours	24	TOTAL EQUIPMENT	$2,197.44

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 0.5% labor (Side Cutter, Sharp-Nose Pliers, Sharp Tip Tweezers PCB Clamp, etc)	0.00	LS	1.000	0.00	$124.37	$0.00

TOTAL MATERIAL $0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS $0.00

SUMMARY OF COSTS

Labor Cost	$2,487.36	Labor Burden @	49.7%	$0.00	$2,487.36
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$2,197.44	Equipment Tax @	0.0%	$0.00	$2,197.44
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$4,685			$0	DIRECT COST SUBTOTALS $4,685

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,684.80	$702.72
Installing Contractors Profit@	8.0%				$4,684.80	$374.78
GC Markup on Subs @	5.0%				$0.00	$0.00

TOTAL MARKUP COSTS $1,077.50

General Contractors Insurance @	1.0%	on	$5,762.30	$58
Bond @	1.0%	on	$5,762.30	$58
Contingency @	0.0%	on	$5,877.55	$0

TOTAL COST for pay item $5,878

Additional Pay Item Notes :

Assumed that electrical crew formed of 1 Forman and 1 Electricians will work two days to unconnected and remove the distribution panels. They are going to use same crane and a truck for disposal of spillway intake, trash rake and radial motor & control panel. Assumed weight:500 LBS

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.029	Project	: JC Boyle			
Description	: Remove Powerhouse Concrete down to Elevation 3324.0					
Quantity	: 1,500.00 cy					
Daily Production	: 50.00 cy per 8 hour shift	Project #	: 1			
Work Days	: 30.0 Days	Estimator	: Felipe Poletto	cy per	Total Cost	Unit Price Per cy
Unit Price	: $546.51 per cy	Probable Low Cost Parameter		55	$737,786	$491.86
Total Cost	: $819,762	Probable High Cost Parameter		40	$983,714	$655.81

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	30.0	8	480.00	L	$48.27	incl. in rate	incl. in rate	$23,169.60
Laborer	Active	8.00	30.0	8	1,920.00	L	$45.80	incl. in rate	incl. in rate	$87,936.00
Equipment Operator (medium)	Active	4.00	30.0	8	960.00	L	$66.28	incl. in rate	incl. in rate	$63,628.80
Truck Driver (heavy)	Active	2.00	30.0	8	480.00	L	$57.59	incl. in rate	incl. in rate	$27,643.20
Air Compressor 600 cfm	Active	2.00	30.0	8	480.00	E	$21.74	incl. in rate	incl. in rate	$10,434.68
Air Compressor 900 cfm	Active	2.00	30.0	8	480.00	E	$38.87	incl. in rate	incl. in rate	$18,657.08
Air Tool, Chipping Hammer	Active	6.00	30.0	8	1,440.00	E	$1.64	incl. in rate	incl. in rate	$2,360.21
Generator, Small Generator, 10 - 15 kW	Active	4.00	30.0	8	960.00	E	$7.04	incl. in rate	incl. in rate	$6,758.40
Hydraulic Excavator (5.0cy)	Active	4.00	30.0	8	960.00	E	$274.63	incl. in rate	incl. in rate	$263,644.80
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	3.00	30.0	8	720.00	E	$62.72	incl. in rate	incl. in rate	$45,158.40
Hydraulic Thumbs/Shear Attachment	Active	2.00	30.0	8	480.00	E	$16.39	incl. in rate	incl. in rate	$7,867.20
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	30.0	8	480.00	E	$111.64	incl. in rate	incl. in rate	$53,587.20
			30.0	8	0.00					$0.00
			30.0	8	0.00					$0.00
			30.0	8	0.00					$0.00
			30.0	8	0.00					$0.00
			30.0	8	0.00					$0.00
				Labor Hours	3,840				TOTAL LABOR	$202,377.60
				Equipment Hours	6,000				TOTAL EQUIPMENT	$408,467.97

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$10,118.88	$10,118.88
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	$10,118.88

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$202,377.60	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$202,377.60
Material Cost	$10,118.88	Material Tax @	7.75%	$784.21		$10,903.09
Equipment Cost	$408,467.97	Equipment Tax @	7.75%	$31,656.27		$440,124.24
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$620,964			$32,440	DIRECT COST SUBTOTALS	$653,405

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$653,404.93	$98,010.74
Installing Contractors Profit@	8.0%				$653,404.93	$52,272.39
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$150,283.13
General Contractors Insurance @	1.0%			on	$803,688.07	$8,037
Bond @	1.0%			on	$803,688.07	$8,037
Contingency @	0.0%			on	$819,761.83	$0
					TOTAL COST for pay item	$819,762

Additional Pay Item Notes :

There will be two 5 man demo crews using chipping hammers to support demolition, 3 excavators with breakers breaking material, 1 excavator loading 20 CY off road hauling trucks, expecting for each of the 2 trucks to get 1.5 load per day 50cys per shift.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.030	Project	: JCBOYLE
Description	: Remove Structural Steel items associated with Powerhouse		
Quantity	: 94,000.00 lbs		
Daily Production	: 30,000.00 lbs per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 3.1 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $0.63 per lbs		
Total Cost	: $59,073		

	lbs per	Total Cost	Unit Price Per lbs
Probable Low Cost Parameter	33000	$53,166	$0.57
Probable High Cost Parameter	25500	$67,935	$0.72

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	3.1	8	24.80	L	$47.23	incl. in rate	incl. in rate	$1,171.30
Electrician	Active	1.00	3.1	8	24.80	L	$45.23	incl. in rate	incl. in rate	$1,121.70
Steelworker	Active	5.00	3.1	8	124.00	L	$65.52	incl. in rate	incl. in rate	$8,124.48
Loader, FE Rubber Tire (8.6cy)	Active	1.00	3.1	8	24.80	E	$221.50	incl. in rate	incl. in rate	$5,493.20
Truck Driver (heavy)	Active	1.00	3.1	8	24.80	L	$57.59	incl. in rate	incl. in rate	$1,428.23
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	3.1	8	24.80	E	$111.64	incl. in rate	incl. in rate	$2,768.67
Hydraulic Crane (120tn)	Active	1.00	3.1	8	24.80	E	$239.06	incl. in rate	incl. in rate	$5,928.69
Welder	Active	2.00	3.1	8	49.60	L	$7.84	incl. in rate	incl. in rate	$388.74
Gas Welding Machine	Active	2.00	3.1	8	49.60	E	$2.88	incl. in rate	incl. in rate	$142.70
Equipment Operator (medium)	Active	1.00	3.1	8	24.80	L	$66.28	incl. in rate	incl. in rate	$1,643.74
Equipment Operator (crane)	Active	1.00	3.1	8	24.80	L	$68.41	incl. in rate	incl. in rate	$1,696.57
Laborer	Active	10.00	3.1	8	248.00	L	$45.80	incl. in rate	incl. in rate	$11,358.40

Labor Hours	545.6	TOTAL LABOR	$26,933.17
Equipment Hours	124	TOTAL EQUIPMENT	$14,333.26

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$2,693.32	$2,693.32
					TOTAL MATERIAL	$2,693.32

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	4.70	ton	1.000	4.70	$595.00	$2,796.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
					TOTAL SUBCONTRACTS	$3,417.10

SUMMARY OF COSTS

Labor Cost	$26,933.17	Labor Burden @	49.7%	$0.00	$26,933.17
Material Cost	$2,693.32	Material Tax @	7.8%	$208.73	$2,902.05
Equipment Cost	$14,333.26	Equipment Tax @	0.0%	$0.00	$14,333.26
Subcontractors	$3,417.10				$3,417.10
DIRECT COST SUBTOTALS	$47,377			$209	DIRECT COST SUBTOTALS $47,586

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$44,168.48	$6,625.27
Installing Contractors Profit@	8.0%				$44,168.48	$3,533.48
GC Markup on Subs @	5.0%				$3,417.10	$170.86
					TOTAL MARKUP COSTS	$10,329.61
General Contractors Insurance @	1.0%		on		$57,915.19	$579
Bond @	1.0%		on		$57,915.19	$579
Contingency @	0.0%		on		$59,073.49	$0
					TOTAL COST for pay item	$59,073

Additional Pay Item Notes :

Includes columns, beams, crane girders, bracing, misc. shapes, roof trusses, purlins, etc. Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed hazardous waste 10% of the total lbs, calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling.

PAY ITEM COST DETAIL WORKSHEET

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.031		Project	: Copco 2			
Description	:	Remove Warehouse near Powerhouse						
Quantity	:	5,060.00	SF					
Daily Production	:	500.00	SF per 8 hour shift	Project #	: 1			
Work Days	:	10.1	Days	Estimator	: Eric Jones	SF per	Total Cost	Unit Price Per SF
Unit Price	:	$32.95	per SF	Probable Low Cost Parameter		525	$158,369	$31.30
Total Cost	:	$166,704		Probable High Cost Parameter		450	$183,375	$36.24

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	10.1	8	80.80	L	$46.27	incl. in rate	incl. in rate	$3,738.62
Laborer	Active	6.00	10.1	8	484.80	L	$45.80	incl. in rate	incl. in rate	$22,203.84
Equipment Operator (medium)	Active	2.00	10.1	8	161.60	L	$66.28	incl. in rate	incl. in rate	$10,710.85
Truck Driver (heavy)	Active	1.00	10.1	8	80.80	L	$57.59	incl. in rate	incl. in rate	$4,653.27
Steelworker	Active	2.00	10.1	8	161.60	L	$65.52	incl. in rate	incl. in rate	$10,588.03
Hydraulic Excavator (5.0cy)	Active	2.00	10.1	8	161.60	E	$274.63	incl. in rate	incl. in rate	$44,380.21
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	10.1	8	80.80	E	$111.64	incl. in rate	incl. in rate	$9,020.51
0		2.00	10.1	8	161.60	0	$0.00	$0.00		$0.00
0		1.00	10.1	8	80.80	0	$0.00	$0.00		$0.00
		1.00	10.1	8	80.80	0	$0.00	$0.00		$0.00
		1.00	10.1	8	80.80	0	$0.00	$0.00		$0.00
		1.00	10.1	8	80.80	0	$0.00	$0.00		$0.00
			10.1	8	0.00					$0.00
			10.1	8	0.00					$0.00
			10.1	8	0.00					$0.00
			10.1	8	0.00					$0.00
			10.1	8	0.00					$0.00
				Labor Hours	969.6				TOTAL LABOR	$51,894.61
				Equipment Hours	242.4				TOTAL EQUIPMENT	$53,400.72

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	742	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	371.07	tons	‹lamath County LandFi	$74.00	$27,458.93
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$27,458.93

SUMMARY OF COSTS

Labor Cost	$51,894.61	Labor Burden @		0.0%			$51,894.61
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$53,400.72	Equipment Tax @		7.75%	$4,138.56		$57,539.28
Subcontractors	$27,458.93						$27,458.93
DIRECT COST SUBTOTALS	$132,754				$4,139	DIRECT COST SUBTOTALS	$136,893
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$109,433.88		$16,415.08
Installing Contractors Profit@	8.0%				$109,433.88		$8,754.71
GC Markup on Subs @	5.0%				$27,458.93		$1,372.95
						TOTAL MARKUP COSTS	$26,542.74
General Contractors Insurance @	1.0%			on	$163,435.56		$1,634
Bond @	1.0%			on	$163,435.56		$1,634
Contingency @	0.0%			on	$166,704.27		$0
						TOTAL COST for pay item	$166,704

Additional Pay Item Notes :

Crew should take 3 weeks to remove building. Assuming the building is a combination of structural steel and sheet metal, 1 labor foreman to run crews 6 laborer for running and cleaning up misc mats, and backing up trucks, 2 equipment operators 2 for the excavators (1 with breaker, 1 with bucket,) excavator will be performing the demolition and the excavator will load trucks, 1 truck driver to drive off road truck, 2 steel works to cut steel members as necessary.

PAY ITEM COST DETAIL WORKSHEET **1.032 Remove & Dispose of 2 - Governor oil systems**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.032		Project	: JCBOYLE		
Description	:	Remove & Dispose of 2 - Governor oil systems					
Quantity	:	52,500.00	lbs				
Daily Production	:	30,000.00	lbs per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	1.8	Days	Estimator	: Mihaela Tomulescu		
					lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$0.80	per lbs	Probable Low Cost Parameter	31500	$39,833	$0.76
Total Cost	:	$41,929		Probable High Cost Parameter	25500	$48,219	$0.92

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.8	8	14.40	L	$47.23	incl. in rate	incl. in rate	$680.11
Electrician	Active	1.00	1.8	8	14.40	L	$45.23	incl. in rate	incl. in rate	$651.31
Ironworkers	Active	4.00	1.8	8	57.60	L	$63.95	incl. in rate	incl. in rate	$3,683.52
Hydraulic Excavator (6.0cy)	Active	1.00	1.8	8	14.40	E	$322.48	incl. in rate	incl. in rate	$4,643.71
Truck Driver (heavy)	Active	1.00	1.8	8	14.40	L	$57.59	incl. in rate	incl. in rate	$829.30
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.8	8	14.40	E	$111.64	incl. in rate	incl. in rate	$1,607.62
Hydraulic Crane (120tn)	Active	1.00	1.8	8	14.40	E	$239.06	incl. in rate	incl. in rate	$3,442.46
Welder	Active	1.00	1.8	8	14.40	L	$7.84	incl. in rate	incl. in rate	$112.86
Gas Welding Machine	Active	1.00	1.8	8	14.40	E	$2.88	incl. in rate	incl. in rate	$41.43
Equipment Operator (medium)	Active	1.00	1.8	8	14.40	L	$66.28	incl. in rate	incl. in rate	$954.43
Equipment Operator (crane)	Active	1.00	1.8	8	14.40	L	$68.41	incl. in rate	incl. in rate	$985.10
Hydraulic Impact Breaker Attachment (2k-3k ft-lb)	Active	1.00	1.8	8	14.40	E	$30.85	incl. in rate	incl. in rate	$444.24
				Labor Hours	144				TOTAL LABOR	$7,896.64
				Equipment Hours	72				TOTAL EQUIPMENT	$10,179.46

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$394.83	$394.83
					TOTAL MATERIAL	$394.83

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	26.25	ton	1.000	26.25	$595.00	$15,618.75
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
					TOTAL SUBCONTRACTS	$16,239.35

SUMMARY OF COSTS

Labor Cost	$7,896.64	Labor Burden @	49.7%	$0.00	$7,896.64
Material Cost	$394.83	Material Tax @	7.8%	$30.60	$425.43
Equipment Cost	$10,179.46	Equipment Tax @	0.0%	$0.00	$10,179.46
Subcontractors	$16,239.35				$16,239.35
DIRECT COST SUBTOTALS	$34,710			$31	DIRECT COST SUBTOTALS $34,741

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$18,501.53	$2,775.23
Installing Contractors Profit@	8.0%				$34,740.88	$2,779.27
GC Markup on Subs @	5.0%				$16,239.35	$811.97
					TOTAL MARKUP COSTS	$6,366.47
General Contractors Insurance @	1.0%		on		$41,107.34	$411
Bond @	1.0%		on		$41,107.34	$411
Contingency @	0.0%		on		$41,929.49	$0
					TOTAL COST for pay item	$41,929

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Using hydraulic impact breaker because of the systems that are encased in concrete. Assumed hazardous waste 100% of the total lbs, calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling.

PAY ITEM COST DETAIL WORKSHEET — **1.033 Remove & Dispose of Cooling water and bearing oil systems**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.033	Project	: JCBOYLE
Description	: Remove & Dispose of Cooling water and bearing oil systems		
Quantity	: 6,500.00 lbs		
Daily Production	: 6,000.00 lbs per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 1.1 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $1.06 per lbs		
Total Cost	: $6,905		

	lbs per	Total Cost	Unit Price Per lbs
Probable Low Cost Parameter	6600	$6,215	$0.96
Probable High Cost Parameter	5100	$7,941	$1.22

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.1	8	8.80	L	$48.27	incl. in rate	incl. in rate	$424.78
Laborer	Active	1.00	1.1	8	8.80	L	$45.80	incl. in rate	incl. in rate	$403.04
Steelworker	Active	1.00	1.1	8	8.80	L	$65.52	incl. in rate	incl. in rate	$576.58
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.5	8	4.00	E	$221.50	incl. in rate	incl. in rate	$886.00
Truck Driver (light)	Active	1.00	0.5	8	4.00	L	$56.29	incl. in rate	incl. in rate	$225.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	incl. in rate	incl. in rate	$259.60

Labor Hours	34.4	TOTAL LABOR	$1,889.15
Equipment Hours	8	TOTAL EQUIPMENT	$1,332.56

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, et	1.00	LS	1.000	1.00	$94.46	$94.46
TOTAL MATERIAL						$94.46

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	3.25	ton	1.000	3.25	$595.00	$1,933.75
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
TOTAL SUBCONTRACTS						$2,554.35

SUMMARY OF COSTS

Labor Cost	$1,889.15	Labor Burden @	49.7%	$0.00	$1,889.15
Material Cost	$94.46	Material Tax @	7.8%	$7.32	$101.78
Equipment Cost	$1,332.56	Equipment Tax @	0.0%	$0.00	$1,332.56
Subcontractors	$2,554.35				$2,554.35
DIRECT COST SUBTOTALS	$5,871			$7	DIRECT COST SUBTOTALS $5,878

	Rate	Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,323.49	$498.52
Installing Contractors Profit@	8.0%				$3,323.49	$265.88
GC Markup on Subs @	5.0%				$2,554.35	$127.72
TOTAL MARKUP COSTS						$892.12
General Contractors Insurance @	1.0%		on		$6,769.96	$68
Bond @	1.0%		on		$6,769.96	$68
Contingency @	0.0%		on		$6,905.36	$0
TOTAL COST for p						$6,905

Additional Pay Item Notes :

Used RS Means : Assumed " Pipe, metal pipe, to 1-1/2" diam., selective demolition", 2390 LF of 1 1/2" oil pipes at 2.72 Lbs/LF. Used 1 Forman, 1 Steelworkers to cut the pipes and 1 Laborers to load the pipes in the truck. The cooling and lubrication systems for the Hydroelectric Barge turbine, speed increaser and generator will be a combination of water and oil. These systems will be isolated from the water passages so that no contamination of passing water will occur. The following is a list of hazardous materials, substances, chemicals, and wastes normally found at a hydropower facility that may require disposal actions if not recycled or reused for their intended purpose:

1. Polychlorinated Biphenyls (PCBs)
2. Asbestos
3. Paint/abrasive blast grit (red lead paint)
4. **Oil**
5. Mercury
6. Antifreeze
7. Halogenated and non-halogenated solvents
8. Greases
9. Pesticides (includes herbicides, insecticides, and wood preservatives)
10. Petroleum contaminated
11. Chlorinated fluorocarbons (CFCs) Freon/Halon
12. Gasoline/diesel (includes product and sludge in tanks)
13. Batteries (includes acid)
14. Water treatment sludge (septic tanks/wastewater treatment). Assumed hazardous waste 100% of the total lbs

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.034	Project	: JC Boyle		
Description	: Remove & Dispose of 2 - Francis Turbines				
Quantity	: 560,000.00 LBS				
Daily Production	: 30,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	: 18.7 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $0.75 per LBS	Probable Low Cost Parameter	34500	$354,624	$0.63
Total Cost	: $417,204	Probable High Cost Parameter	22500	$521,505	$0.93

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	18.7	8	149.60	L	$48.27	incl. in rate	incl. in rate	$7,221.19
Ironworkers	Active	10.00	18.7	8	1,496.00	L	$63.95	incl. in rate	incl. in rate	$95,669.20
Crawler Crane (270tn)	Active	1.00	18.7	8	149.60	E	$399.50	incl. in rate	incl. in rate	$59,765.20
Equipment Operator (crane)	Active	1.00	18.7	8	149.60	L	$68.41	incl. in rate	incl. in rate	$10,234.14
Welder	Active	4.00	18.7	8	598.40	L	$7.84	incl. in rate	incl. in rate	$4,689.96
Gas Welding Machine	Active	4.00	18.7	8	598.40	E	$2.88	incl. in rate	incl. in rate	$1,721.59
Electrician	Active	2.00	18.7	8	299.20	L	$45.23	incl. in rate	incl. in rate	$13,532.82
Electrician Foreman	Active	1.00	18.7	8	149.60	L	$47.23	incl. in rate	incl. in rate	$7,065.61
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	6.0	8	96.00	E	$31.90	incl. in rate	incl. in rate	$3,062.40
Loader, FE Rubber Tire (8.6cy)	Active	2.00	18.7	8	299.20	E	$221.50	incl. in rate	incl. in rate	$66,272.80
Truck Driver (heavy)	Active	5.00	18.7	8	748.00	L	$57.59	incl. in rate	incl. in rate	$43,077.32
Equipment Operator (medium)	Active	1.00	18.7	8	149.60	L	$66.28	incl. in rate	incl. in rate	$9,915.49

Labor Hours	3740	TOTAL LABOR	$191,405.72
Equipment Hours	1143.2	TOTAL EQUIPMENT	$130,821.99

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$9,570.29	$9,570.29
					TOTAL MATERIAL	$9,570.29

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$191,405.72	Labor Burden @	49.7%	$0.00		$191,405.72
Material Cost	$9,570.29	Material Tax @	7.8%	$741.70		$10,311.98
Equipment Cost	$130,821.99	Equipment Tax @	0.0%	$0.00		$130,821.99
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$331,798			$742	DIRECT COST SUBTOTALS	$332,540

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$332,539.69		$49,880.95
Installing Contractors Profit@	8.0%				$332,539.69		$26,603.18
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$76,484.13
General Contractors Insurance @	1.0%		on		$409,023.82		$4,090
Bond @	1.0%		on		$409,023.82		$4,090
Contingency @	0.0%		on		$417,204.30		$0
						TOTAL COST for pay item	$417,204

Additional Pay Item Notes :

Working with a crew formed of 1 El. Foreman 2 Electrician starting to disconnect power and take care of the temporary electrical power they need at the site. The crew of 10 Ironworker / Millwright. open the engine side panels, and remove the nacelle access panels. Disconnect the engine thermocouple leads at the terminal board. Before disconnecting any lines all fuel, oil, and hydraulic fluid valves are closed. Plug all lines as they are disconnected to prevent entrance of foreign material. Remove the clamps securing the bleed-air ducts at the firewall. Then, disconnect the electrical connector plugs, engine breather and vent lines, and fuel, oil, and hydraulic lines. Disconnect the engine power lever and propeller control rods or cables. Remove the covers from the lift points, attach the sling, and remove slack from the cables using a suitable hoist. The sling must be adjusted to position. Remove the engine mount bolts. The engine ready to be removed. Move the engine forward, out of the nacelle structure, until it clears the aircraft. Lower the into position on the stand, and secure it prior to removing the engine sling. The crew of 4 Welder are going to cut in pieces the big parts of the turbine to be able to load them in the truck using a loader and dispose.

PAY ITEM COST DETAIL WORKSHEET — **1.035 Remove & Dispose of 150 Ton crane**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.035	**Project**	: JC Boyle
Description	: Remove & Dispose of 150 Ton crane		
Quantity	: 240,000.00 LBS		
Daily Production	: 24,000.00 LBS per 8 hour shift	**Project #**	: Klamath Dams Removal
Work Days	: 10.0 Days	**Estimator**	: Mihaela Tomulescu
Unit Price	: $0.82 per LBS		
Total Cost	: $196,396		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	27600	$166,937	$0.70
Probable High Cost Parameter	19200	$235,675	$0.98

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (120tn)	Active	2.00	10.0	8	160.00	E	$239.06	incl. in rate	incl. in rate	$38,249.60
Equipment Operator (crane)	Active	2.00	10.0	8	160.00	L	$68.41	incl. in rate	incl. in rate	$10,945.60
Truck Driver (heavy)	Active	1.00	10.0	8	80.00	L	$57.59	incl. in rate	incl. in rate	$4,607.20
Equipment Operator (medium)	Active	1.00	10.0	8	80.00	L	$66.28	incl. in rate	incl. in rate	$5,302.40
Loader, FE Rubber Tire (8.6cy)	Active	1.00	10.0	8	80.00	E	$221.50	incl. in rate	incl. in rate	$17,720.00
Electrician Foreman	Active	1.00	10.0	8	80.00	L	$47.23	incl. in rate	incl. in rate	$3,778.40
Truck, Tractor (400hp)	Active	1.00	10.0	8	80.00	E	$69.30	incl. in rate	incl. in rate	$5,544.00
Labor Foreman	Active	1.00	10.0	8	80.00	L	$48.27	incl. in rate	incl. in rate	$3,861.60
Welder	Active	2.00	10.0	8	160.00	L	$7.84	incl. in rate	incl. in rate	$1,254.00
Gas Welding Machine	Active	2.00	10.0	8	160.00	E	$2.88	incl. in rate	incl. in rate	$460.32
Steelworker	Active	8.00	10.0	8	640.00	L	$65.52	incl. in rate	incl. in rate	$41,932.80
Laborer	Active	4.00	10.0	8	320.00	L	$45.80	incl. in rate	incl. in rate	$14,656.00

Labor Hours	**1600**	**TOTAL LABOR**	**$86,338.00**
Equipment Hours	**480**	**TOTAL EQUIPMENT**	**$61,973.92**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$4,316.90	$4,316.90
					TOTAL MATERIAL	**$4,316.90**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (5% of total weight)	6.00	ton	1.000	6.00	$595.00	$3,570.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
					TOTAL SUBCONTRACTS	**$4,190.60**

SUMMARY OF COSTS

Labor Cost	$86,338.00	Labor Burden @	49.7%	$0.00	$86,338.00
Material Cost	$4,316.90	Material Tax @	7.8%	$334.56	$4,651.46
Equipment Cost	$61,973.92	Equipment Tax @	0.0%	$0.00	$61,973.92
Subcontractors	$4,190.60				$4,190.60
DIRECT COST SUBTOTALS	**$156,819**			**$335**	**DIRECT COST SUBTOTALS** **$157,154**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$152,963.38	$22,944.51
Installing Contractors Profit@	8.0%				$152,963.38	$12,237.07
GC Markup on Subs @	5.0%				$4,190.60	$209.53
					TOTAL MARKUP COSTS	**$35,391.11**

General Contractors Insurance @	1.0%	on	$192,545.08	$1,925
Bond @	1.0%	on	$192,545.08	$1,925
Contingency @	0.0%	on	$196,395.99	$0
			TOTAL COST for pay item	**$196,396**

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed hazardous waste 2% of the total lbs, calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.036	Project	: JCBOYLE		
Description	:	Remove & Dispose of Compressed Air systems				
Quantity	:	1,100.00 lbs				
Daily Production	:	6,000.00 lbs per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	0.183 Days	Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$0.88 per lbs	Probable Low Cost Parameter		6600	$875	$0.80
Total Cost	:	$973	Probable High Cost Parameter		4500	$1,216	$1.11

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (5.25cy)	Active	1.00	0.183	8	1.47	E	$75.42	incl. in rate	incl. in rate	$110.62
Laborer	Active	3.00	0.183	8	4.40	L	$45.80	incl. in rate	incl. in rate	$201.52
Steelworker	Active	1.00	0.183	8	1.47	L	$65.52	incl. in rate	incl. in rate	$96.10
Equipment Operator (light)	Active	1.00	0.183	8	1.47	L	$64.90	incl. in rate	incl. in rate	$95.19
Truck Driver (light)	Active	1.00	0.183	8	1.47	L	$56.29	incl. in rate	incl. in rate	$82.56
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.183	8	1.47	E	$111.64	incl. in rate	incl. in rate	$163.74
Labor Hours					8.8				TOTAL LABOR	$475.36
Equipment Hours					2.933333333				TOTAL EQUIPMENT	$274.35

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$23.77	$23.77
					TOTAL MATERIAL	$23.77

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$475.36	Labor Burden @	49.7%	$0.00		$475.36
Material Cost	$23.77	Material Tax @	7.8%	$1.84		$25.61
Equipment Cost	$274.35	Equipment Tax @	0.0%	$0.00		$274.35
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$773			$2	DIRECT COST SUBTOTALS	$775

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$775.33		$116.30
Installing Contractors Profit@	8.0%				$775.33		$62.03
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$178.33
General Contractors Insurance @	1.0%			on	$953.65		$10
Bond @	1.0%			on	$953.65		$10
Contingency @	0.0%			on	$972.72		$0
						TOTAL COST for pay item	$973

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 400 LF of 1 1/2" pipes at 2.72 Lbs/LF. Used 1 Steelworkers to cut the pipes and 3 Laborers for hauling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.037	Project	: JCBOYLE		
Description	:	Remove & Dispose of 2 - CO2 systems				
Quantity	:	6,600.00 lbs				
Daily Production	:	6,000.00 lbs per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	1.1 Days	Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$0.99 per lbs	Probable Low Cost Parameter	6600	$5,853	$0.89
Total Cost	:	$6,504	Probable High Cost Parameter	4800	$7,805	$1.18

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.1	8	8.80	L	$48.27	incl. in rate	incl. in rate	$424.78
Laborer	Active	2.00	1.1	8	17.60	L	$45.80	incl. in rate	incl. in rate	$806.08
Steelworker	Active	2.00	1.1	8	17.60	L	$65.52	incl. in rate	incl. in rate	$1,153.15
Equipment Operator (light)	Active	1.00	1.1	8	8.80	L	$64.90	incl. in rate	incl. in rate	$571.12
Loader, FE Rubber Tire (3.5cy)	Active	1.00	1.1	8	8.80	E	$64.23	incl. in rate	incl. in rate	$565.22
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.1	8	8.80	E	$111.64	incl. in rate	incl. in rate	$982.43
Truck Driver (light)	Active	1.00	1.1	8	8.80	L	$56.29	incl. in rate	incl. in rate	$495.35

Labor Hours	61.6	TOTAL LABOR	$3,450.48
Equipment Hours	17.6	TOTAL EQUIPMENT	$1,547.66

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$172.52	$172.52
					TOTAL MATERIAL	$172.52

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$3,450.48	Labor Burden @	49.7%	$0.00	$3,450.48
Material Cost	$172.52	Material Tax @	7.8%	$13.37	$185.89
Equipment Cost	$1,547.66	Equipment Tax @	0.0%	$0.00	$1,547.66
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$5,171			$13	DIRECT COST SUBTOTALS $5,184

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,184.03	$777.60
Installing Contractors Profit@	8.0%				$5,184.03	$414.72
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,192.33

General Contractors Insurance @	1.0%	on	$6,376.36	$64
Bond @	1.0%	on	$6,376.36	$64
Contingency @	0.0%	on	$6,503.88	$0
			TOTAL COST for pay item	$6,504

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 2430 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 2 Laborers to load the pipes in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.038	Project	: JCBOYLE		
Description	: Remove & Dispose of Plant Water and Fire Protection				
Quantity	: 3,100.00 lbs				
Daily Production	: 6,000.00 lbs per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	: 0.5 Days	Estimator	: Mihaela Tomulescu		
			lbs per	Total Cost	Unit Price Per lbs
Unit Price	: $0.74 per lbs	Probable Low Cost Parameter	6600	$2,068	$0.67
Total Cost	: $2,298	Probable High Cost Parameter	4800	$2,757	$0.89

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.5	8	4.00	L	$48.27	incl. in rate	incl. in rate	$193.08
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Steelworker	Active	2.00	0.5	8	8.00	L	$65.52	incl. in rate	incl. in rate	$524.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36

Labor Hours	24	TOTAL LABOR	$1,314.00
Equipment Hours	4	TOTAL EQUIPMENT	$446.56

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$65.70	$65.70
					TOTAL MATERIAL	$65.70

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,314.00	Labor Burden @	49.7%	$0.00		$1,314.00
Material Cost	$65.70	Material Tax @	7.8%	$5.09		$70.79
Equipment Cost	$446.56	Equipment Tax @	0.0%	$0.00		$446.56
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$1,826			$5	DIRECT COST SUBTOTALS	$1,831

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,831.35	$274.70
Installing Contractors Profit@	8.0%				$1,831.35	$146.51
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$421.21
General Contractors Insurance @	1.0%		on		$2,252.56	$23
Bond @	1.0%		on		$2,252.56	$23
Contingency @	0.0%		on		$2,297.61	$0
					TOTAL COST for pay item	$2,298

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 1140 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 2 Laborers to load the pipes in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.039	Project	: JCBOYLE	
Description	: Remove & Dispose of Transformer Oil Fire Protection			
Quantity	: 6,500.00 lbs			
Daily Production	: 6,000.00 lbs per 8 hour shift	Project #	: Klamath Dams Removal	
Work Days	: 1.1 Days	Estimator	: Mihaela Tomulescu	
Unit Price	: $0.80 per lbs			
Total Cost	: $5,207			

	lbs per	Total Cost	Unit Price Per lbs
Probable Low Cost Parameter	6900	$4,426	$0.68
Probable High Cost Parameter	4800	$6,248	$0.96

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.1	8	8.80	L	$48.27	incl. in rate	incl. in rate	$424.78
Laborer	Active	2.00	1.1	8	17.60	L	$45.80	incl. in rate	incl. in rate	$806.08
Steelworker	Active	2.00	1.1	8	17.60	L	$65.52	incl. in rate	incl. in rate	$1,153.15
Pump, Centrifugal, 3"	Active	1.00	1.1	8	8.80	E	$2.76	incl. in rate	incl. in rate	$24.25
Truck Driver (light)	Active	1.00	1.1	8	8.80	L	$56.29	incl. in rate	incl. in rate	$495.35
Truck, Pickup (4x4, 3/4tn)	Active	1.00	1.1	8	8.80	E	$16.94	incl. in rate	incl. in rate	$149.07

Labor Hours	52.8	TOTAL LABOR	$2,879.36
Equipment Hours	17.6	TOTAL EQUIPMENT	$173.32

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$143.97	$143.97
					TOTAL MATERIAL	$143.97

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.81	ton	1.000	0.81	$595.00	$483.44
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
					TOTAL SUBCONTRACTS	$1,104.04

SUMMARY OF COSTS

Labor Cost	$2,879.36	Labor Burden @	49.7%	$0.00		$2,879.36
Material Cost	$143.97	Material Tax @	7.8%	$11.16		$155.13
Equipment Cost	$173.32	Equipment Tax @	0.0%	$0.00		$173.32
Subcontractors	$1,104.04					$1,104.04
DIRECT COST SUBTOTALS	$4,301			$11	DIRECT COST SUBTOTALS	$4,312

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,207.81	$481.17
Installing Contractors Profit@	8.0%				$3,207.81	$256.62
GC Markup on Subs @	5.0%				$1,104.04	$55.20
					TOTAL MARKUP COSTS	$793.00
General Contractors Insurance @	1.0%		on		$5,104.84	$51
Bond @	1.0%		on		$5,104.84	$51
Contingency @	0.0%		on		$5,206.94	$0
					TOTAL COST for pay item	$5,207

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 2390 LF of 1 1/2" fire protection pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 3 Laborers to load the pipes in the truck. Calculated 58.6 miles from JC Boyle to Yreka Transfer Recycling. Each hydropower facility has at least 150,000 gallons to 250,000 gallon of oil currently in use. This oil would have to be properly disposed of in the event of decommissioning. Oil removed from the turbines and other equipment, including transformer oil, would be either a waste oil or used oil, depending on prior use and contaminants found in the oil. Containerized oil containing contaminants such as solvents are commonly encountered at hydropower facilities. Oil sludge are common in tanks. Oil disposal would likely be costly due to the large volumes found at hydropower facilities and the ease of contamination with other regulated hazardous wastes.

PAY ITEM COST DETAIL WORKSHEET

1.040 Remove & Dispose of Unwatering Piping

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.040	**Project**	: JCBOYLE
Description	: Remove & Dispose of Unwatering Piping		
Quantity	: 33,000.00 lbs		
Daily Production	: 18,000.00 lbs per 8 hour shift	**Project #**	: Klamath Dams Removal
Work Days	: 1.8 Days	**Estimator**	: Mihaela Tomulescu
Unit Price	: $0.74 per lbs		
Total Cost	: $24,351		

	lbs per	Total Cost	Unit Price Per lbs
Probable Low Cost Parameter	21600	$19,481	$0.59
Probable High Cost Parameter	13500	$30,439	$0.92

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	1.8	8	28.80	L	$48.27	incl. in rate	incl. in rate	$1,390.18
Electrician	Active	1.00	1.8	8	14.40	L	$45.23	incl. in rate	incl. in rate	$651.31
Steelworker	Active	4.00	1.8	8	57.60	L	$65.52	incl. in rate	incl. in rate	$3,773.95
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.8	8	14.40	E	$221.50	incl. in rate	incl. in rate	$3,189.60
Truck Driver (heavy)	Active	1.00	1.8	8	14.40	L	$57.59	incl. in rate	incl. in rate	$829.30
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.8	8	14.40	E	$111.64	incl. in rate	incl. in rate	$1,607.62
Laborer	Active	4.00	1.8	8	57.60	L	$45.80	incl. in rate	incl. in rate	$2,638.08
Welder	Active	1.00	1.8	8	14.40	L	$7.84	incl. in rate	incl. in rate	$112.86
Gas Welding Machine	Active	1.00	1.8	8	14.40	E	$2.88	incl. in rate	incl. in rate	$41.43
Equipment Operator (medium)	Active	1.00	1.8	8	14.40	L	$66.28	incl. in rate	incl. in rate	$954.43
Equipment Operator (crane)	Active	1.00	1.8	8	14.40	L	$68.41	incl. in rate	incl. in rate	$985.10

Labor Hours	**216**	**TOTAL LABOR**	**$11,335.21**
Equipment Hours	**43.2**	**TOTAL EQUIPMENT**	**$4,838.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$566.76	$566.76
					TOTAL MATERIAL	**$566.76**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (25% from total weight)	4.13	ton	1.000	4.13	$595.00	$2,454.38
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
					TOTAL SUBCONTRACTS	**$3,074.98**

SUMMARY OF COSTS

Labor Cost	$11,335.21	Labor Burden @	49.7%	$0.00	$11,335.21
Material Cost	$566.76	Material Tax @	7.8%	$43.92	$610.68
Equipment Cost	$4,838.64	Equipment Tax @	0.0%	$0.00	$4,838.64
Subcontractors	$3,074.98				$3,074.98
DIRECT COST SUBTOTALS	**$19,816**			**$44**	**DIRECT COST SUBTOTALS $19,860**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$16,784.54	$2,517.68
Installing Contractors Profit@	8.0%				$16,784.54	$1,342.76
GC Markup on Subs @	5.0%				$3,074.98	$153.75
					TOTAL MARKUP COSTS	**$4,014.19**

General Contractors Insurance @	1.0%	on	$23,873.71	$239
Bond @	1.0%	on	$23,873.71	$239
Contingency @	0.0%	on	$24,351.18	$0
			TOTAL COST for pay item	**$24,351**

Additional Pay Item Notes :

Used RS Means : Assumed Pipe, metal pipe, to 1-1/2" diam., selective demolition, 12150 LF of 1 1/2" pipes at 2.72 Lbs. Used 2 Crew formed of 1 Forman, 2 Steelworkers to cut the pipes, 1 Welder to cut steel in inaccessible places , 2 Laborers to haul the pipes in the truck with the loader, 1 electrician to unplug the power and to assure the temporary power at the construction site. Calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.041	Project	: JCBOYLE
Description	:	Remove & Dispose of Drainage Piping		
Quantity	:	10,000.00 lbs		
Daily Production	:	4,450.00 lbs per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	:	2.2 Days	Estimator	: Mihaela Tomulescu
Unit Price	:	$0.84 per lbs		
Total Cost	:	$8,353		

	lbs per	Total Cost	Unit Price Per lbs
Probable Low Cost Parameter	5117.5	$7,100	$0.71
Probable High Cost Parameter	3560	$10,024	$1.00

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.2	8	17.60	L	$48.27	incl. in rate	incl. in rate	$849.55
Laborer	Active	1.00	2.2	8	17.60	L	$45.80	incl. in rate	incl. in rate	$806.08
Steelworker	Active	1.00	2.2	8	17.60	L	$65.52	incl. in rate	incl. in rate	$1,153.15
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Equipment Operator (light)	Active	1.00	1.0	8	8.00	L	$64.90	incl. in rate	incl. in rate	$519.20

Labor Hours	68.8	TOTAL LABOR	$3,788.70
Equipment Hours	16	TOTAL EQUIPMENT	$2,665.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$189.44	$189.44

TOTAL MATERIAL $189.44

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS $0.00

SUMMARY OF COSTS

Labor Cost	$3,788.70	Labor Burden @	49.7%	$0.00	$3,788.70
Material Cost	$189.44	Material Tax @	7.8%	$14.68	$204.12
Equipment Cost	$2,665.12	Equipment Tax @	0.0%	$0.00	$2,665.12
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$6,643			$15	DIRECT COST SUBTOTALS $6,658

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,657.94	$998.69
Installing Contractors Profit@	8.0%				$6,657.94	$532.64
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,531.33
General Contractors Insurance @	1.0%		on		$8,189.27	$82
Bond @	1.0%		on		$8,189.27	$82
Contingency @	0.0%		on		$8,353.05	$0

TOTAL COST for pay item $8,353

Additional Pay Item Notes :

2750 LF of 1 " drainage pipes at 3.66 Lbs. Used 1 Loader and 1 Forman, 1 Steelworkers to cut the pipes and 1 Laborers to load the pipes in the truck.

PAY ITEM COST DETAIL WORKSHEET — **1.042 Remove & Dispose of 2-Oil Sump pumps**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.042		**Project**	: JCBOYLE		
Description	:	Remove & Dispose of 2-Oil Sump pumps					
Quantity	:	2,000.00 lbs					
Daily Production	:	6,000.00 lbs per	8 hour shift	**Project #**	: Klamath Dams Removal		
Work Days	:	0.3	Days	**Estimator**	: Mihaela Tomulescu		
					lbs per	**Total Cost**	**Unit Price Per lbs**
Unit Price	:	$1.27 per lbs		**Probable Low Cost Parameter**	6600	$2,283	$1.14
Total Cost	:	$2,536		**Probable High Cost Parameter**	5100	$2,917	$1.46

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.3	8	2.40	L	$48.27	incl. in rate	incl. in rate	$115.85
Electrician	Active	1.00	0.3	8	2.40	L	$45.23	incl. in rate	incl. in rate	$108.55
Laborer	Active	2.00	0.3	8	4.80	L	$45.80	incl. in rate	incl. in rate	$219.84
Hydraulic Crane (17tn)	Active	1.00	0.2	8	1.60	E	$81.52	incl. in rate	incl. in rate	$130.43
Truck Driver (heavy)	Active	1.00	0.2	8	1.60	L	$57.59	incl. in rate	incl. in rate	$92.14
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	incl. in rate	incl. in rate	$178.62
Equipment Operator (light)	Active	1.00	0.2	8	1.60	L	$64.90	incl. in rate	incl. in rate	$103.84

Labor Hours	**12.8**	**TOTAL LABOR**	**$640.22**
Equipment Hours	**3.2**	**TOTAL EQUIPMENT**	**$309.06**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$32.01	$32.01
					TOTAL MATERIAL	**$32.01**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (assumed weight)	1.00	ton	1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
					TOTAL SUBCONTRACTS	**$1,215.60**

SUMMARY OF COSTS

Labor Cost	$640.22	Labor Burden @	49.7%	$0.00	$640.22
Material Cost	$32.01	Material Tax @	7.8%	$2.48	$34.49
Equipment Cost	$309.06	Equipment Tax @	0.0%	$0.00	$309.06
Subcontractors	$1,215.60				$1,215.60
DIRECT COST SUBTOTALS	**$2,197**			**$2**	**DIRECT COST SUBTOTALS** **$2,199**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$983.77	$147.57
Installing Contractors Profit@	8.0%				$983.77	$78.70
GC Markup on Subs @	5.0%				$1,215.60	$60.78
					TOTAL MARKUP COSTS	**$287.05**
General Contractors Insurance @	1.0%		on		$2,486.42	$25
Bond @	1.0%		on		$2,486.42	$25
Contingency @	0.0%		on		$2,536.15	$0
					TOTAL COST for pay item	**$2,536**

Additional Pay Item Notes :

Used 1 crane to pick up the oil sump pumps, 1 Forman and 2 Laborers to remove the pumps. One electrician to unplug the power and assure the temporary power at the construction site. Assumed hazardous waste since we deal with the oil sump pump.

PAY ITEM COST DETAIL WORKSHEET

1.043 Remove & Dispose of Draft Tube Bulk Head Gates and Hoists at the Powerhouse

PAY ITEM INFORMATION

PAY ITEM NUMBER :	1.043		Project : JCBOYLE			
Description :	Remove & Dispose of Draft Tube Bulk Head Gates and Hoists at the Powerhouse					
Quantity :	65,000.00 lbs					
Daily Production :	25,000.00 lbs per	8 hour shift	Project # : Klamath Dams Removal			
Work Days :	2.6 Days		Estimator : Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price :	$0.71 per lbs		Probable Low Cost Parameter	28750	$39,403	$0.61
Total Cost :	$46,356		Probable High Cost Parameter	18750	$57,946	$0.89

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.6	8	20.80	L	$48.27	incl. in rate	incl. in rate	$1,004.02
Electrician	Active	1.00	2.6	8	20.80	L	$45.23	incl. in rate	incl. in rate	$940.78
Ironworkers	Active	4.00	2.6	8	83.20	L	$63.95	incl. in rate	incl. in rate	$5,320.64
Millwright	Active	6.00	2.6	8	124.80	L	$69.46	incl. in rate	incl. in rate	$8,668.61
Truck Driver (heavy)	Active	4.00	2.6	8	83.20	L	$57.59	incl. in rate	incl. in rate	$4,791.49
Truck, Flatbed (4x4, 10,000 gvw)	Active	4.00	2.6	8	83.20	E	$31.90	incl. in rate	incl. in rate	$2,654.08
Crawler Crane (270tn)	Active	1.00	2.6	8	20.80	E	$399.50	incl. in rate	incl. in rate	$8,309.60
Welder	Active	2.00	2.6	8	41.60	L	$7.84	incl. in rate	incl. in rate	$326.04
Gas Welding Machine	Active	2.00	2.6	8	41.60	E	$2.88	incl. in rate	incl. in rate	$119.68
Equipment Operator (crane)	Active	1.00	2.6	8	20.80	L	$68.41	incl. in rate	incl. in rate	$1,422.93
				Labor Hours	395.2				TOTAL LABOR	$22,474.50
				Equipment Hours	145.6				TOTAL EQUIPMENT	$11,083.36

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,123.73	$1,123.73
					TOTAL MATERIAL	$1,123.73

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	3.25	ton	1.000	3.25	$595.00	$1,933.75
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	$2,554.35

SUMMARY OF COSTS

Labor Cost	$22,474.50	Labor Burden @	49.7%	$0.00		$22,474.50
Material Cost	$1,123.73	Material Tax @	7.8%	$87.09		$1,210.81
Equipment Cost	$11,083.36	Equipment Tax @	0.0%	$0.00		$11,083.36
Subcontractors	$2,554.35					$2,554.35
DIRECT COST SUBTOTALS	$37,236			$87	DIRECT COST SUBTOTALS	$37,323

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$34,768.68		$5,215.30
Installing Contractors Profit@	8.0%				$34,768.68		$2,781.49
GC Markup on Subs @	5.0%				$2,554.35		$127.72
						TOTAL MARKUP COSTS	$8,124.51
General Contractors Insurance @	1.0%			on	$45,447.54		$454
Bond @	1.0%			on	$45,447.54		$454
Contingency @	0.0%			on	$46,356.50		$0
						TOTAL COST for pay item	$46,356

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed contains paint with heavy metals 10% of the total lbs., calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling.

PAY ITEM COST DETAIL WORKSHEET

1.043a Remove petroleum products from Mechanical Equipment

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.043a	**Project**	: JCBOYLE			
Description	: Remove petroleum products from Mechanical Equipment					
Quantity	: 2,700.00 GAL					
Daily Production	: 550.00 GAL per 8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	: 4.9 Days	**Estimator**	: Mihaela Tomulescu	**GAL per**	**Total Cost**	**Unit Price Per GAL**
Unit Price	: $10.27 per GAL	**Probable Low Cost Parameter**		**632.5**	**$23,575**	**$8.73**
Total Cost	: $27,735	**Probable High Cost Parameter**		**385**	**$36,056**	**$13.35**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	4.9	8	39.20	L	$48.27	incl. in rate	incl. in rate	$1,892.18
Electrician	Active	1.00	4.9	8	39.20	L	$45.23	incl. in rate	incl. in rate	$1,773.02
Laborer	Active	4.00	4.9	8	156.80	L	$45.80	incl. in rate	incl. in rate	$7,181.44
Pump, Centrifugal, 3"	Active	3.00	4.9	8	117.60	E	$2.76	incl. in rate	incl. in rate	$324.07
Truck Driver (heavy)	Active	1.00	4.9	8	39.20	L	$57.59	incl. in rate	incl. in rate	$2,257.53
Truck, Tractor (400hp)	Active	1.00	4.9	8	39.20	E	$69.30	incl. in rate	incl. in rate	$2,716.56
Equipment Operator (medium)	Active	1.00	4.9	8	39.20	L	$66.28	incl. in rate	incl. in rate	$2,598.18
Loader, FE Rubber Tire (3.5cy)	Active	1.00	4.9	8	39.20	E	$64.23	incl. in rate	incl. in rate	$2,517.82
				Labor Hours	**313.6**				**TOTAL LABOR**	**$15,702.34**
				Equipment Hours	**196**				**TOTAL EQUIPMENT**	**$5,558.44**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (filters, pads, etc)	1.00	LS	1.000	1.00	$785.12	$785.12
					TOTAL MATERIAL	**$785.12**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$15,702.34	Labor Burden @	49.7%	$0.00	$15,702.34
Material Cost	$785.12	Material Tax @	7.8%	$60.85	$845.96
Equipment Cost	$5,558.44	Equipment Tax @	0.0%	$0.00	$5,558.44
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$22,046**			**$61**	**DIRECT COST SUBTOTALS** **$22,107**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$22,106.75	$3,316.01
Installing Contractors Profit@	8.0%				$22,106.75	$1,768.54
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$5,084.55**
General Contractors Insurance @	1.0%			on	$27,191.30	$272
Bond @	1.0%			on	$27,191.30	$272
Contingency @	0.0%			on	$27,735.13	$0
					TOTAL COST for pay item	**$27,735**

Additional Pay Item Notes :

The petroleum waste is saved in drums using the loader they are sent to recycling or disposal. Used a crew formed of 1 Forman, 4 Laborers to takeout the petroleum waste with a pump from the mech equipment, 1 Electrician to unplug the power and to assure the temporary power at the construction site.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.044	**Project**	: JC Boyle		
Description	: Remove & Dispose of Outdoor Vertical AC Generator, Unit 1: 53 MVA				
Quantity	: 2.00 EA				
Daily Production	: 0.40 EA per 8 hour shift	**Project #**	: Klamath Dams Removal		
Work Days	: 5.0 Days	**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**
Unit Price	: $158,304.56 per EA	**Probable Low Cost Parameter**	0.46	$269,118	$134,558.88
Total Cost	: $316,609	**Probable High Cost Parameter**	0.34	$364,100	$182,050.25

(Last column header: **Unit Price Per EA**)

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Crawler Crane (270tn)	Active	2.00	5.0	8	80.00	E	$399.50	incl. in rate	incl. in rate	$31,960.00
Electrician	Active	12.00	5.0	8	480.00	L	$45.23	incl. in rate	incl. in rate	$21,710.40
Equipment Operator (oiler)	Active	1.00	5.0	8	40.00	L	$62.94	incl. in rate	incl. in rate	$2,517.60
Equipment Operator (crane)	Active	2.00	5.0	8	80.00	L	$68.41	incl. in rate	incl. in rate	$5,472.80
Steelworker	Active	20.00	5.0	8	800.00	L	$65.52	incl. in rate	incl. in rate	$52,416.00
Loader, FE Rubber Tire (8.6cy)	Active	2.00	5.0	8	80.00	E	$221.50	incl. in rate	incl. in rate	$17,720.00
Labor Foreman	Active	4.00	5.0	8	160.00	L	$48.27	incl. in rate	incl. in rate	$7,723.20
Welder	Active	4.00	5.0	8	160.00	L	$7.84	incl. in rate	incl. in rate	$1,254.00
Gas Welding Machine	Active	4.00	5.0	8	160.00	E	$2.88	incl. in rate	incl. in rate	$460.32
Truck Driver (heavy)	Active	4.00	5.0	8	160.00	L	$57.59	incl. in rate	incl. in rate	$9,214.40
Truck, Flatbed (4x4, 10,000 gvw)	Active	4.00	5.0	8	160.00	E	$31.90	incl. in rate	incl. in rate	$5,104.00
Electrician Foreman	Active	4.00	5.0	8	160.00	L	$47.23	incl. in rate	incl. in rate	$7,556.80
				Labor Hours	2040				TOTAL LABOR	$107,865.20
				Equipment Hours	480				TOTAL EQUIPMENT	$55,244.32

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$10,786.52	$10,786.52
					TOTAL MATERIAL	$10,786.52

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$89,760.00	$89,760.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
					TOTAL SUBCONTRACTS	$90,380.60

SUMMARY OF COSTS

Labor Cost	$107,865.20	Labor Burden @	49.7%	$0.00	$107,865.20
Material Cost	$10,786.52	Material Tax @	7.8%	$835.96	$11,622.48
Equipment Cost	$55,244.32	Equipment Tax @	0.0%	$0.00	$55,244.32
Subcontractors	$90,380.60				$90,380.60
DIRECT COST SUBTOTALS	**$264,277**			**$836**	**DIRECT COST SUBTOTALS** **$265,113**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$174,731.99	$26,209.80
Installing Contractors Profit@	8.0%				$174,731.99	$13,978.56
GC Markup on Subs @	5.0%				$102,003.08	$5,100.15
					TOTAL MARKUP COSTS	$45,288.51
General Contractors Insurance @	1.0%			on	$310,401.11	$3,104
Bond @	1.0%			on	$310,401.11	$3,104
Contingency @	0.0%			on	$316,609.13	$0
					TOTAL COST for pay item	**$316,609**

Additional Pay Item Notes :

Used RS Means, 4- R13 Crew formed of 1 Forman, 3 Electricians, 1 Oiler, 0 .25 Equipment Crane, 5 Steelworkers to cut adjacent appurtenances and 1 Welder to cut pipes. Calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling (back and forth). Total Weight 650,000 LBS; Heaviest lift around: 300,000 LBS.

PAY ITEM COST DETAIL WORKSHEET — **1.045 Remove & Dispose of Excitation equipment for 53/50 MVA Generator**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.045	Project	: JCBOYLE
Description	: Remove & Dispose of Excitation equipment for 53/50 MVA Generator		
Quantity	: 2.00 EA		
Daily Production	: 1.00 EA per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 2.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $13,425.63 per EA		
Total Cost	: $26,851		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	1.1	$24,166	$12,083.07
Probable High Cost Parameter	0.9	$29,536	$14,768.20

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	2.00	2.0	8	32.00	L	$47.23	incl. in rate	incl. in rate	$1,511.36
Electrician	Active	4.00	2.0	8	64.00	L	$45.23	incl. in rate	incl. in rate	$2,894.72
Laborer	Active	4.00	2.0	8	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.0	8	16.00	E	$221.50	incl. in rate	incl. in rate	$3,544.00
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Hydraulic Crane (120tn)	Active	1.00	2.0	8	16.00	E	$239.06	incl. in rate	incl. in rate	$3,824.96
Welder	Active	2.00	2.0	8	32.00	L	$7.84	incl. in rate	incl. in rate	$250.80
Gas Welding Machine	Active	2.00	2.0	8	32.00	E	$2.88	incl. in rate	incl. in rate	$92.06
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	incl. in rate	incl. in rate	$1,094.56
				Labor Hours	240				TOTAL LABOR	$10,664.56
				Equipment Hours	80				TOTAL EQUIPMENT	$9,247.26

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$533.23	$533.23
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	1,000.00	LF	1.000	1,000.00	$0.85	$850.00
					TOTAL MATERIAL	$1,383.23

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$10,664.56	Labor Burden @	49.7%	$0.00	$10,664.56
Material Cost	$1,383.23	Material Tax @	7.8%	$107.20	$1,490.43
Equipment Cost	$9,247.26	Equipment Tax @	0.0%	$0.00	$9,247.26
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$21,295			$107	DIRECT COST SUBTOTALS $21,402

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$21,402.25	$3,210.34
Installing Contractors Profit@	8.0%				$21,402.25	$1,712.18
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$4,922.52
General Contractors Insurance @	1.0%		on		$26,324.77	$263
Bond @	1.0%		on		$26,324.77	$263
Contingency @	0.0%		on		$26,851.27	$0
					TOTAL COST for pay item	$26,851

Additional Pay Item Notes :

2 sections, weight 1000LBS - Used 2 Crew of 1 Forman, 1 Electrician, 1 Welder to cut to remove the electrical equipment and 1 laborer to haul. Equipment used 1 Loader and 1 Crane for disposal.

PAY ITEM COST DETAIL WORKSHEET

1.046 Remove & Dispose of Surge protection equip. for 53/50 MVA Generator

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.046		Project	: JCBOYLE		
Description	:	Remove & Dispose of Surge protection equip. for 53/50 MVA Generator					
Quantity	:	2.00	EA				
Daily Production	:	1.00	EA per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	2.0	Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$8,153.33	per EA	Probable Low Cost Parameter	1.1	$14,676	$7,337.99
Total Cost	:	$16,307		Probable High Cost Parameter	0.9	$17,937	$8,968.66

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	2.00	2.0	8	32.00	L	$47.23	incl. in rate	incl. in rate	$1,511.36
Electrician	Active	2.00	2.0	8	32.00	L	$45.23	incl. in rate	incl. in rate	$1,447.36
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.0	8	16.00	E	$221.50	incl. in rate	incl. in rate	$3,544.00
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
				Labor Hours	128				TOTAL LABOR	$6,406.24
				Equipment Hours	32				TOTAL EQUIPMENT	$5,330.24

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$320.31	$320.31
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	1,000.00	LF	1.000	1,000.00	$0.85	$850.00
					TOTAL MATERIAL	$1,170.31

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$6,406.24	Labor Burden @		49.7%	$0.00		$6,406.24
Material Cost	$1,170.31	Material Tax @		7.8%	$90.70		$1,261.01
Equipment Cost	$5,330.24	Equipment Tax @		0.0%	$0.00		$5,330.24
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$12,907				$91	DIRECT COST SUBTOTALS	$12,997

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$12,997.49		$1,949.62
Installing Contractors Profit@	8.0%				$12,997.49		$1,039.80
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$2,989.42
General Contractors Insurance @	1.0%		on		$15,986.91		$160
Bond @	1.0%		on		$15,986.91		$160
Contingency @	0.0%		on		$16,306.65		$0
						TOTAL COST for pay item	$16,307

Additional Pay Item Notes :

Used 1 Forman, 1 Electrician to remove the electrical equipment and 1 laborer to haul.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.047	Project	: JCBOYLE		
Description	:	Remove & Dispose of Neutral grounding equip. for 53/50 MVA Generator				
Quantity	:	2.00 EA				
Daily Production	:	1.00 EA per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	2.0 Days	Estimator	: Mihaela Tomulescu		
				EA per	Total Cost	Unit Price Per EA
Unit Price	:	$3,980.33 per EA	Probable Low Cost Parameter	1.1	$7,165	$3,582.30
Total Cost	:	$7,961	Probable High Cost Parameter	0.9	$8,757	$4,378.36

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.0	8	16.00	L	$47.23	incl. in rate	incl. in rate	$755.68
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Ironworkers	Active	1.00	2.0	8	16.00	L	$63.95	incl. in rate	incl. in rate	$1,023.20
Laborer	Active	1.00	2.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Gas Welding Machine	Active	1.00	2.0	8	16.00	E	$2.88	incl. in rate	incl. in rate	$46.03
Welder	Active	1.00	2.0	8	16.00	L	$7.84	incl. in rate	incl. in rate	$125.40

Labor Hours	96	TOTAL LABOR	$4,282.20
Equipment Hours	32	TOTAL EQUIPMENT	$1,832.27

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$214.11	$214.11
					TOTAL MATERIAL	$214.11

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$4,282.20	Labor Burden @	49.7%	$0.00		$4,282.20
Material Cost	$214.11	Material Tax @	7.8%	$16.59		$230.70
Equipment Cost	$1,832.27	Equipment Tax @	0.0%	$0.00		$1,832.27
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$6,329			$17	DIRECT COST SUBTOTALS	$6,345

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,345.18	$951.78
Installing Contractors Profit@	8.0%				$6,345.18	$507.61
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,459.39

General Contractors Insurance @	1.0%	on	$7,804.57	$78
Bond @	1.0%	on	$7,804.57	$78
Contingency @	0.0%	on	$7,960.66	$0
			TOTAL COST for pay item	$7,961

Additional Pay Item Notes :

Used 1 Forman, 1 Electrician, 1 Ironworker and 1 welder to cut rods, to remove the electrical equipment and 1 laborer to haul in the truck.

PAY ITEM COST DETAIL WORKSHEET

1.048 Remove & Dispose of Generator Switchgear, 15kV - (6 sections)

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.048		Project	: JCBOYLE		
Description	: Remove & Dispose of Generator Switchgear, 15kV - (6 sections)					
Quantity	: 1.00 EA					
Daily Production	: 1.00 EA per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 1.0 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $19,730.68 per EA		Probable Low Cost Parameter		1.15	$16,771	$16,771.08
Total Cost	: $19,731		Probable High Cost Parameter		0.75	$24,663	$24,663.35

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	3.00	1.0	8	24.00	L	$47.23	incl. in rate	incl. in rate	$1,133.52
Electrician	Active	9.00	1.0	8	72.00	L	$45.23	incl. in rate	incl. in rate	$3,256.56
Laborer	Active	6.00	1.0	8	48.00	L	$45.80	incl. in rate	incl. in rate	$2,198.40
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	2.00	1.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Hydraulic Crane (120tn)	Active	1.00	1.0	8	8.00	E	$239.06	incl. in rate	incl. in rate	$1,912.48
Welder	Active	1.00	1.0	8	8.00	L	$7.84	incl. in rate	incl. in rate	$62.70
Gas Welding Machine	Active	1.00	1.0	8	8.00	E	$2.88	incl. in rate	incl. in rate	$23.02
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
				Labor Hours	184				TOTAL LABOR	$8,650.14
				Equipment Hours	40				TOTAL EQUIPMENT	$5,493.74

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$432.51	$432.51
					TOTAL MATERIAL	$432.51

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (assumed qty)	1.00	ton	1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum (assumed qty)	85.60	mile	1.000	85.60	$7.25	$620.60
					TOTAL SUBCONTRACTS	$1,215.60

SUMMARY OF COSTS

Labor Cost	$8,650.14	Labor Burden @	49.7%	$0.00		$8,650.14
Material Cost	$432.51	Material Tax @	7.8%	$33.52		$466.03
Equipment Cost	$5,493.74	Equipment Tax @	0.0%	$0.00		$5,493.74
Subcontractors	$1,215.60					$1,215.60
DIRECT COST SUBTOTALS	$15,792			$34	DIRECT COST SUBTOTALS	$15,826

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$14,609.90	$2,191.49
Installing Contractors Profit@	8.0%				$15,825.50	$1,266.04
GC Markup on Subs @	5.0%				$1,215.60	$60.78
					TOTAL MARKUP COSTS	$3,518.31
General Contractors Insurance @	1.0%		on		$19,343.81	$193
Bond @	1.0%		on		$19,343.81	$193
Contingency @	0.0%		on		$19,730.68	$0
					TOTAL COST for pay item	$19,731

Additional Pay Item Notes :

Used 3 Crews (2 sections each) formed of 1 Forman, 3 Electrician, 2 laborer to haul with the crane in the truck. Assumed containing hazardous waste that will be disposed at 85.6 miles away from the construction site. In normal circumstances, decontaminated residual components could be accepted at landfill sites but Polychlorinated biphenyl, otherwise known as PCB, is a synthetic chemical that is widely used for industrial and commercial use as dielectric fluid in transformers and capacitors because of its high resistance to decomposition, low electrical conductivity, low flammability and high heat capacity. Transformer repair, reconditioning and retro-filling facilities are the major industry sectors that contributes to the spread of PCB contamination. Types of PCB Wastes:
PCB wastes are discarded materials that contain PCB or have been contaminated with PCBs and that are without any commercial, industrial, or economic use. For the purpose of this Code of Practice, PCBs wastes are classified as follows: Liquid PCB wastes
o PCB-based dielectric fluids removed from transformers and other equipment
o PCB-based heat transfer and hydraulic fluids Metallic solid wastes
o PCB equipment such as capacitors, transformers, switchgears, circuit breakers, heat transfer systems, etc.
o Contaminated components removed from electrical equipment such as windings; PCB-contaminated containers and equipment such as metal drums, tanks, pumps, metal filters, etc. Calculated 85.6 miles fromJC Boyle to Yreka Transfer Recycling

PAY ITEM COST DETAIL WORKSHEET — **1.049 Remove & Dispose of Station Service Switchgear, 600 volt - (5 sections)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.049		Project	: JCBOYLE		
Description	:	Remove & Dispose of Station Service Switchgear, 600 volt - (5 sections)					
Quantity	:	1.00 EA					
Daily Production	:	1.00 EA per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	:	1.0 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$10,780.56 per EA		Probable Low Cost Parameter		1.1	$9,703	$9,702.50
Total Cost	:	$10,781		Probable High Cost Parameter		0.9	$11,859	$11,858.62

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	3.00	1.0	8	24.00	L	$47.23	incl. in rate	incl. in rate	$1,133.52
Electrician	Active	4.00	1.0	8	32.00	L	$45.23	incl. in rate	incl. in rate	$1,447.36
Laborer	Active	4.00	1.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Welder	Active	1.00	1.0	8	8.00	L	$7.84	incl. in rate	incl. in rate	$62.70
Gas Welding Machine	Active	1.00	1.0	8	8.00	E	$2.88	incl. in rate	incl. in rate	$23.02
				Labor Hours	112				TOTAL LABOR	$5,100.14
				Equipment Hours	24				TOTAL EQUIPMENT	$2,688.14

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$255.01	$255.01
					TOTAL MATERIAL	$255.01

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum (assumed qty)	85.60	mile	1.000	85.60	$7.25	$620.60
					TOTAL SUBCONTRACTS	$620.60

SUMMARY OF COSTS

Labor Cost	$5,100.14	Labor Burden @	49.7%	$0.00		$5,100.14
Material Cost	$255.01	Material Tax @	7.8%	$19.76		$274.77
Equipment Cost	$2,688.14	Equipment Tax @	0.0%	$0.00		$2,688.14
Subcontractors	$620.60					$620.60
DIRECT COST SUBTOTALS	$8,664			$20	DIRECT COST SUBTOTALS	$8,684

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$8,063.05	$1,209.46
Installing Contractors Profit@	8.0%				$8,063.05	$645.04
GC Markup on Subs @	5.0%				$620.60	$31.03
					TOTAL MARKUP COSTS	$1,885.53
General Contractors Insurance @	1.0%			on	$10,569.18	$106
Bond @	1.0%			on	$10,569.18	$106
Contingency @	0.0%			on	$10,780.56	$0
					TOTAL COST for pay item	$10,781

Additional Pay Item Notes :

Used 3 Crews (2 sections each) formed of 1 Forman, 2 Electrician, 1welder to cut, 2 laborer to haul with the loader in the truck. Assumed containing hazardous waste that will be disposed . Calculated 85.6 miles fromJC Boyle to Yreka Transfer Recycling

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.050		Project	: JCBOYLE		
Description	: Remove & Dispose of Unit and plant control switchboard					
Quantity	: 1.00 EA					
Daily Production	: 1.00 EA per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 1.0 Days		Estimator	: Mihaela Tomulescu		
				EA per	Total Cost	Unit Price Per EA
Unit Price	: $5,903.27 per EA		Probable Low Cost Parameter	1.1	$5,313	$5,312.94
Total Cost	: $5,903		Probable High Cost Parameter	0.9	$6,494	$6,493.60

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	2.00	1.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (light)	Active	0.50	1.0	8	4.00	L	$56.29	incl. in rate	incl. in rate	$225.16
Truck, Off-Road, Articulated Rear, 20cy	Active	0.50	1.0	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56
				Labor Hours	36				TOTAL LABOR	$1,856.92
				Equipment Hours	12				TOTAL EQUIPMENT	$2,218.56

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$92.85	$92.85
					TOTAL MATERIAL	$92.85

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum (assumed qty)	85.60	mile	1.000	85.60	$7.25	$620.60
					TOTAL SUBCONTRACTS	$620.60

SUMMARY OF COSTS

Labor Cost	$1,856.92	Labor Burden @	49.7%	$0.00		$1,856.92
Material Cost	$92.85	Material Tax @	7.8%	$7.20		$100.04
Equipment Cost	$2,218.56	Equipment Tax @	0.0%	$0.00		$2,218.56
Subcontractors	$620.60					$620.60
DIRECT COST SUBTOTALS	$4,789			$7	DIRECT COST SUBTOTALS	$4,796

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,175.52	$626.33
Installing Contractors Profit@	8.0%				$4,175.52	$334.04
GC Markup on Subs @	5.0%				$620.60	$31.03
					TOTAL MARKUP COSTS	$991.40
General Contractors Insurance @	1.0%		on		$5,787.52	$58
Bond @	1.0%		on		$5,787.52	$58
Contingency @	0.0%		on		$5,903.27	$0
					TOTAL COST for pay item	$5,903

Additional Pay Item Notes :

Used 1 crew formed of 1 Forman, 2 Electrician, 1 laborer to haul with the loader in the truck. Assumed containing hazardous waste that will be disposed . Calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.051	Project	: JCBOYLE
Description	: Remove & Dispose - Battery system		
Quantity	: 1.00 EA		
Daily Production	: 0.50 EA per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 2.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $7,430.59 per EA		
Total Cost	: $7,431		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	0.55	$6,688	$6,687.53
Probable High Cost Parameter	0.45	$8,174	$8,173.65

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	$0.00		$740.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	$0.00		$723.68
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	$0.00		$1,465.60
Loader, FE Rubber Tire (3.5cy)	Active	1.00	1.0	8	8.00	E	$64.23	$64.23		$513.84
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Equipment Operator (light)	Active	1.00	1.0	8	8.00	L	$64.90	$0.00		$519.20
Welder	Active	1.00	2.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	1.00	2.0	8	16.00	E	$2.88	$2.88		$46.03

Labor Hours	96	TOTAL LABOR	$4,034.92
Equipment Hours	32	TOTAL EQUIPMENT	$1,452.99

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$403.49	$403.49
TOTAL MATERIAL						$403.49

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
TOTAL SUBCONTRACTS					$0.00

SUMMARY OF COSTS

Labor Cost	$4,034.92	Labor Burden @	49.7%	$0.00	$4,034.92
Material Cost	$403.49	Material Tax @	7.8%	$31.27	$434.76
Equipment Cost	$1,452.99	Equipment Tax @	0.0%	$0.00	$1,452.99
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$5,891			$31	DIRECT COST SUBTOTALS $5,923

	Rate	Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,922.67	$888.40
Installing Contractors Profit@	8.0%				$5,922.67	$473.81
GC Markup on Subs @	5.0%				$0.00	$0.00
TOTAL MARKUP COSTS						$1,362.22

General Contractors Insurance @	1.0%	on	$7,284.89	$73
Bond @	1.0%	on	$7,284.89	$73
Contingency @	0.0%	on	$7,430.59	$0
TOTAL COST for pay item				$7,431

Additional Pay Item Notes :

Assuming 2 days of work disposing around 40 batteries, racks and supports. Using Crews E-19 for metals demolition, E-12 and E-25 for cutting steel and A-3H for equipment disposal, B-34A for hauling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.052		Project	: JCBOYLE		
Description	:	Remove & Dispose of Raceways, Conduit and Cable					
Quantity	:	1.00 EA					
Daily Production	:	0.50 EA per	8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	2.0	Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$13,891.88 per EA		Probable Low Cost Parameter		0.55	$12,503	$12,502.69
Total Cost	:	$13,892		Probable High Cost Parameter		0.45	$15,281	$15,281.07

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.0	8	16.00	L	$48.27	incl. in rate	incl. in rate	$772.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.0	8	16.00	E	$221.50	incl. in rate	incl. in rate	$3,544.00
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
				Labor Hours	96				TOTAL LABOR	$4,943.52
				Equipment Hours	32				TOTAL EQUIPMENT	$5,330.24

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$741.53	$741.53
					TOTAL MATERIAL	$741.53

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$4,943.52	Labor Burden @	49.7%	$0.00		$4,943.52
Material Cost	$741.53	Material Tax @	7.8%	$57.47		$799.00
Equipment Cost	$5,330.24	Equipment Tax @	0.0%	$0.00		$5,330.24
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$11,015			$57	DIRECT COST SUBTOTALS	$11,073

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$11,072.76		$1,660.91
Installing Contractors Profit@	8.0%				$11,072.76		$885.82
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$2,546.73
General Contractors Insurance @	1.0%		on		$13,619.49		$136
Bond @	1.0%		on		$13,619.49		$136
Contingency @	0.0%		on		$13,891.88		$0
						TOTAL COST for pay item	$13,892

Additional Pay Item Notes :

Used 1 Forman, 2 Electrician, 1 Laborer hauling with the loader in the truck.

PAY ITEM COST DETAIL WORKSHEET

1.053 Remove & Dispose of Misc. power & control boards

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.053		Project	: JCBOYLE		
Description	:	Remove & Dispose of Misc. power & control boards					
Quantity	:	1.00 EA					
Daily Production	:	0.50 EA per	8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	2.0	Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$7,140.08	per EA	Probable Low Cost Parameter		0.55	$6,426	$6,426.07
Total Cost	:	$7,140		Probable High Cost Parameter		0.45	$7,854	$7,854.09

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.0	8	16.00	L	$48.27	incl. in rate	incl. in rate	$772.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Laborer	Active	1.00	2.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24

Labor Hours	60	TOTAL LABOR	$2,989.40
Equipment Hours	12	TOTAL EQUIPMENT	$2,218.56

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$448.41	$448.41
					TOTAL MATERIAL	$448.41

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,989.40	Labor Burden @		49.7%	$0.00		$2,989.40
Material Cost	$448.41	Material Tax @		7.8%	$34.75		$483.16
Equipment Cost	$2,218.56	Equipment Tax @		0.0%	$0.00		$2,218.56
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$5,656				$35	DIRECT COST SUBTOTALS	$5,691

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,691.12		$853.67
Installing Contractors Profit@	8.0%				$5,691.12		$455.29
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$1,308.96
General Contractors Insurance @	1.0%		on		$7,000.08		$70
Bond @	1.0%		on		$7,000.08		$70
Contingency @	0.0%		on		$7,140.08		$0
						TOTAL COST for pay item	$7,140

Additional Pay Item Notes :

Used 1 Forman, 1 Electrician, 1 Laborer hauling with the loader in the truck.

PAY ITEM COST DETAIL WORKSHEET — **1.054 Remove & Dispose of 5 Gantry Crane motors - hoist (50Hp*), aux hoist**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.054		**Project**	: JCBOYLE			
Description	:	Remove & Dispose of 5 Gantry Crane motors - hoist (50Hp*), aux hoist						
Quantity	:	1.00	EA					
Daily Production	:	5.00	EA per 8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	0.2	Days	**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$1,729.51	per EA	**Probable Low Cost Parameter**		**5.5**	**$1,557**	**$1,556.56**
Total Cost	:	$1,730		**Probable High Cost Parameter**		**4**	**$2,075**	**$2,075.41**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.2	8	3.20	E	$111.64	$111.64		$357.25
Hydraulic Crane (17tn)	Active	1.00	0.2	8	1.60	E	$81.52	$81.52		$130.43
Laborer	Active	2.00	0.2	8	3.20	L	$45.80	$0.00		$146.56
Equipment Operator (crane)	Active	1.00	0.2	8	1.60	L	$68.41	$0.00		$109.46
Truck Driver (heavy)	Active	2.00	0.2	8	3.20	L	$57.59	$0.00		$184.29

Labor Hours	**8**	**TOTAL LABOR**	**$440.30**
Equipment Hours	**4.8**	**TOTAL EQUIPMENT**	**$487.68**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$22.02	$22.02
					TOTAL MATERIAL	**$22.02**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$500.00	$500.00
					TOTAL SUBCONTRACTS	**$500.00**

SUMMARY OF COSTS

Labor Cost	$440.30	Labor Burden @	49.7%	$0.00	$440.30
Material Cost	$22.02	Material Tax @	7.8%	$1.71	$23.72
Equipment Cost	$487.68	Equipment Tax @	0.0%	$0.00	$487.68
Subcontractors	$500.00				$500.00
DIRECT COST SUBTOTALS	**$1,450**			**$2**	**DIRECT COST SUBTOTALS** **$1,452**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$951.71	$142.76
Installing Contractors Profit@	8.0%				$951.71	$76.14
GC Markup on Subs @	5.0%				$500.00	$25.00
					TOTAL MARKUP COSTS	**$243.89**
General Contractors Insurance @	1.0%		on		$1,695.60	$17
Bond @	1.0%		on		$1,695.60	$17
Contingency @	0.0%		on		$1,729.51	$0
					TOTAL COST for pay item	**$1,730**

Additional Pay Item Notes :

Assumed removal of hoist, hoist trolley, gantry: 2 Laborers to load the overhead crane motors in the truck using the crane.

PAY ITEM COST DETAIL WORKSHEET — **1.055 Remove & Dispose of Gantry Crane control equipment (3 cubicles)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.055	**Project**	: JCBOYLE		
Description	:	Remove & Dispose of Gantry Crane control equipment (3 cubicles)				
Quantity	:	1.00 EA				
Daily Production	:	1.00 EA per 8 hour shift	**Project #**	: Klamath Dams Removal		
Work Days	:	1.0 Days	**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**
Unit Price	:	$5,869.29 per EA	**Probable Low Cost Parameter**	**1.1**	**$5,282**	**$5,282.36**
Total Cost	:	$5,869	**Probable High Cost Parameter**	**0.9**	**$6,456**	**$6,456.22**

(Column heading of last column: **Unit Price Per EA**)

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Hydraulic Crane (80tn)	Active	1.00	1.0	8	8.00	E	$190.46	$190.46		$1,523.68
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	$0.00		$732.80
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72

Labor Hours	**32**	**TOTAL LABOR**	**$1,740.80**
Equipment Hours	**16**	**TOTAL EQUIPMENT**	**$2,416.80**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$87.04	$87.04
					TOTAL MATERIAL	**$87.04**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$500.00	$500.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$500.00**

SUMMARY OF COSTS

Labor Cost	$1,740.80	Labor Burden @	49.7%	$0.00	$1,740.80
Material Cost	$87.04	Material Tax @	7.8%	$6.75	$93.79
Equipment Cost	$2,416.80	Equipment Tax @	0.0%	$0.00	$2,416.80
Subcontractors	$500.00				$500.00
DIRECT COST SUBTOTALS	**$4,745**			**$7**	**DIRECT COST SUBTOTALS** **$4,751**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,251.39	$637.71
Installing Contractors Profit@	8.0%				$4,251.39	$340.11
GC Markup on Subs @	5.0%				$500.00	$25.00
					TOTAL MARKUP COSTS	**$1,002.82**
General Contractors Insurance @	1.0%		on		$5,754.20	$58
Bond @	1.0%		on		$5,754.20	$58
Contingency @	0.0%		on		$5,869.29	$0
					TOTAL COST for pay item	**$5,869**

Additional Pay Item Notes :

One day work for 3 cubicles: 2 Laborers and 1 Electrician will load in the truck with the crane the control equipment. Assumed weight: 900 LBS

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.056	Project	: COPCO 2
Description	: Remove & Dispose of Conduit and Cable		
Quantity	: 1.00 EA		
Daily Production	: 0.50 EA per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 2.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $10,561.93 per EA		
Total Cost	: $10,562		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	0.55	$9,506	$9,505.74
Probable High Cost Parameter	0.4	$12,674	$12,674.32

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	4.00	2.0	8	64.00	L	$45.80	$0.00		$2,931.20
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	$0.00		$1,060.48
Loader, FE Rubber Tire (3.5cy)	Active	1.00	2.0	8	16.00	E	$64.23	$64.23		$1,027.68
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	$111.64		$1,786.24
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	$0.00		$921.44

Labor Hours	96	TOTAL LABOR	$4,913.12
Equipment Hours	32	TOTAL EQUIPMENT	$2,813.92

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$245.66	$245.66
					TOTAL MATERIAL	$245.66

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Disposal fee (Allowance)	1.00	EA	1.000	1.00	$500.00	$500.00
					TOTAL SUBCONTRACTS	$500.00

SUMMARY OF COSTS

Labor Cost	$4,913.12	Labor Burden @	49.7%	$0.00	$4,913.12
Material Cost	$245.66	Material Tax @	7.8%	$19.04	$264.69
Equipment Cost	$2,813.92	Equipment Tax @	0.0%	$0.00	$2,813.92
Subcontractors	$500.00				$500.00
DIRECT COST SUBTOTALS	$8,473			$19	DIRECT COST SUBTOTALS $8,492

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$7,991.73	$1,198.76
Installing Contractors Profit@	8.0%				$7,991.73	$639.34
GC Markup on Subs @	5.0%				$500.00	$25.00
					TOTAL MARKUP COSTS	$1,863.10
General Contractors Insurance @	1.0%			on	$10,354.83	$104
Bond @	1.0%			on	$10,354.83	$104
Contingency @	0.0%			on	$10,561.93	$0
					TOTAL COST for pay item	$10,562

Additional Pay Item Notes :

Around 4000 LF of cable and conduit: 4 Laborers will load in the truck with the loader the overhead crane cable.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.057	Project	: JC BOYLE		
Description	: Remove & Dispose of Exterior Lighting				
Quantity	: 1.00 EA				
Daily Production	: 1.00 EA per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $10,640.74 per EA	Probable Low Cost Parameter		1.1	$9,577	$9,576.66
Total Cost	: $10,641	Probable High Cost Parameter		0.85	$12,237	$12,236.85

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Hydraulic Crane (17tn)	Active	1.00	1.0	8	8.00	E	$81.52	incl. in rate	incl. in rate	$652.16
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Hydraulic Excavator (1.5cy)	Active	1.00	1.0	8	8.00	E	$141.92	incl. in rate	incl. in rate	$1,135.36
Truck, Utility, with Man-Basket	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
				Labor Hours	48				TOTAL LABOR	$2,455.76
				Equipment Hours	32				TOTAL EQUIPMENT	$2,935.84

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$122.79	$122.79
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	6.00	CY	1.000	6.00	$4.74	$28.44
					TOTAL MATERIAL	$151.23

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
line work - Rent per day	1.00	days		$3,000.00	$3,000.00
				TOTAL SUBCONTRACTS	$3,000.00

SUMMARY OF COSTS

Labor Cost	$2,455.76	Labor Burden @	49.7%	$0.00	$2,455.76
Material Cost	$151.23	Material Tax @	7.8%	$11.72	$162.95
Equipment Cost	$2,935.84	Equipment Tax @	0.0%	$0.00	$2,935.84
Subcontractors	$3,000.00				$3,000.00
DIRECT COST SUBTOTALS	$8,543			$12	DIRECT COST SUBTOTALS $8,555

	%	Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$8,554.55	$1,283.18
Installing Contractors Profit@	8.0%				$5,554.55	$444.36
GC Markup on Subs @	5.0%				$3,000.00	$150.00
					TOTAL MARKUP COSTS	$1,877.55
General Contractors Insurance @	1.0%		on		$10,432.09	$104
Bond @	1.0%		on		$10,432.09	$104
Contingency @	0.0%		on		$10,640.74	$0
					TOTAL COST for pay item	$10,641

Additional Pay Item Notes :

6 Poles with lights, weight 1500 LBS. Production is based of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane and 1 man-basket truck to help untie the line) for one day work. Considered 2 laborer and 1 Excavator for demolish the pole foundation, helping placing poles in a designated place and loading them in the truck for disposal. This process includes filling in pole locations with gravel, clean fill and topsoil.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.058		Project	: JCBOYLE		
Description	: Remove & Dispose of Transmission Line No. 59					
Quantity	: 1.66 Mile					
Daily Production	: 0.50 Mile per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 3.3 Days		Estimator	: Mihaela Tomulescu	Mile per	Total Cost	Unit Price Per Mile
Unit Price	: $31,411.84 per Mile		Probable Low Cost Parameter		0.575	$44,322	$26,700.06
Total Cost	: $52,144		Probable High Cost Parameter		0.375	$65,180	$39,264.80

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	3.3	8	26.56	L	$47.23	$0.00		$1,254.43
Electrician	Active	2.00	3.3	8	53.12	L	$45.23	$0.00		$2,402.62
Truck, Utility, with Man-Basket	Active	2.00	3.3	8	53.12	E	$31.90	$31.90		$1,694.53
Truck Driver (heavy)	Active	4.00	3.3	8	106.24	L	$57.59	$0.00		$6,118.36
Laborer	Active	2.00	3.3	8	53.12	L	$45.80	$0.00		$2,432.90
Hydraulic Excavator (2.5cy)	Active	1.00	3.3	8	26.56	E	$203.63	$203.63		$5,408.41
Hydraulic Crane (80tn)	Active	1.00	3.3	8	26.56	E	$190.46	$190.46		$5,058.62
Equipment Operator (crane)	Active	1.00	3.3	8	26.56	L	$68.41	$0.00		$1,816.97
Equipment Operator (light)	Active	1.00	3.3	8	26.56	L	$64.90	$0.00		$1,723.74
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	3.3	8	26.56	E	$62.72	$62.72		$1,665.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	3.3	8	79.68	E	$31.90	$31.90		$2,541.79
				Labor Hours	292.16				TOTAL LABOR	$15,749.02
				Equipment Hours	212.48				TOTAL EQUIPMENT	$16,369.19

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$787.45	$787.45
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	31.00	CY	1.000	31.00	$4.74	$146.94
					TOTAL MATERIAL	$934.39

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	3.32	days		$3,000.00	$9,960.00
				TOTAL SUBCONTRACTS	$9,960.00

SUMMARY OF COSTS

Labor Cost	$15,749.02	Labor Burden @		49.7%	$0.00		$15,749.02
Material Cost	$934.39	Material Tax @		7.8%	$72.42		$1,006.81
Equipment Cost	$16,369.19	Equipment Tax @		0.0%	$0.00		$16,369.19
Subcontractors	$9,960.00						$9,960.00
DIRECT COST SUBTOTALS	$43,013				$72	DIRECT COST SUBTOTALS	$43,085

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$33,125.02		$4,968.75
Installing Contractors Profit@	8.0%				$32,118.21		$2,569.46
GC Markup on Subs @	5.0%				$9,960.00		$498.00
						TOTAL MARKUP COSTS	$8,036.21
General Contractors Insurance @	1.0%			on	$51,121.23		$511
Bond @	1.0%			on	$51,121.23		$511
Contingency @	0.0%			on	$52,143.65		$0
						TOTAL COST for pay item	$52,144

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :2 Electrician,, 1 utility truck to access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. Transmission line poles or structures are commonly between 60 and 140 feet tall. There are several different kinds of transmission structures. Transmission structures can be constructed of metal or wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. Assumed based on RSMs we have "Communications transmission tower, radio towers self-supporting, wind load 70 mph basic wind speed, 120' high" (33811310). Pole height and load capacity limitations determine the distance between poles (span length) either on the basis of ground clearance or ability to support heavy wind and ice loads. Assumed average span between structures to be 275 feet so for 1.66 miles of overhead transmission we will have approximately 31 structures. In areas where single-pole structures are preferred, weak or wet soils may require concrete foundations for support. Where a transmission line must cross a street or slightly change direction, larger angle structures or guy wires may be required. Poles with guy wires impact a much larger area. Angle structures are usually more than double the diameter of other steel poles. They are made of steel, usually five to six feet in diameter, and have a large concrete base. The base may be buried ten or more feet below the ground surface. The diameter of the pole and the depth the base is buried depends on the condition of the soils and the voltage of the line. Assumed the structures are disposed to Yreka recycling, 85.6 miles away. This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM COST DETAIL WORKSHEET — **1.059 Remove & Dispose of Transmission Line No. 98**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.059	Project	: JCBOYLE		
Description	:	Remove & Dispose of Transmission Line No. 98				
Quantity	:	0.24 Mile				
Daily Production	:	0.50 Mile per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	0.5 Days	Estimator	: Mihaela Tomulescu	Mile per	Total Cost	Unit Price Per Mile
Unit Price	:	$27,715.54 per Mile	Probable Low Cost Parameter		0.575	$5,654	$23,558.21
Total Cost	:	$6,652	Probable High Cost Parameter		0.375	$8,315	$34,644.42

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.5	8	3.84	L	$47.23	$0.00		$181.36
Electrician	Active	2.00	0.5	8	7.68	L	$45.23	$0.00		$347.37
Truck, Utility, with Man-Basket	Active	2.00	0.5	8	7.68	E	$31.90	$31.90		$244.99
Truck Driver (heavy)	Active	2.00	0.5	8	7.68	L	$57.59	$0.00		$442.29
Laborer	Active	2.00	0.5	8	7.68	L	$45.80	$0.00		$351.74
Hydraulic Excavator (2.5cy)	Active	1.00	0.5	8	3.84	E	$203.63	$203.63		$781.94
Hydraulic Crane (80tn)	Active	1.00	0.5	8	3.84	E	$190.46	$190.46		$731.37
Equipment Operator (crane)	Active	1.00	0.5	8	3.84	L	$68.41	$0.00		$262.69
Equipment Operator (light)	Active	1.00	0.5	8	3.84	L	$64.90	$0.00		$249.22
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	0.5	8	3.84	E	$62.72	$62.72		$240.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.5	8	3.84	E	$31.90	$31.90		$122.50
				Labor Hours	34.56				TOTAL LABOR	$1,834.68
				Equipment Hours	23.04				TOTAL EQUIPMENT	$2,121.64

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$91.73	$91.73
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	5.00	CY	1.000	5.00	$4.74	$23.70
					TOTAL MATERIAL	$115.43

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	0.48	days		$3,000.00	$1,440.00
				TOTAL SUBCONTRACTS	$1,440.00

SUMMARY OF COSTS

Labor Cost	$1,834.68	Labor Burden @	49.7%	$0.00		$1,834.68
Material Cost	$115.43	Material Tax @	7.8%	$8.95		$124.38
Equipment Cost	$2,121.64	Equipment Tax @	0.0%	$0.00		$2,121.64
Subcontractors	$1,440.00					$1,440.00
DIRECT COST SUBTOTALS	$5,512			$9	DIRECT COST SUBTOTALS	$5,521

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,080.69	$612.10
Installing Contractors Profit@	8.0%				$3,956.31	$316.51
GC Markup on Subs @	5.0%				$1,440.00	$72.00
					TOTAL MARKUP COSTS	$1,000.61
General Contractors Insurance @	1.0%		on		$6,521.30	$65
Bond @	1.0%		on		$6,521.30	$65
Contingency @	0.0%		on		$6,651.73	$0
					TOTAL COST for pay item	$6,652

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :2 Electrician,, 1 utility truck to access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. Transmission line poles or structures are commonly between 60 and 140 feet tall. There are several different kinds of transmission structures. Transmission structures can be constructed of metal or wood, assumed we have wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. Assumed based on RSMs we have "Communications transmission tower, radio towers self-supporting, wind load 70 mph basic wind speed, 120' high" (33811310). Pole height and load capacity limitations determine the distance between poles (span length) either on the basis of ground clearance or ability to support heavy wind and ice loads. Assumed average span between structures to be 275 feet so for 0.24 miles of overhead transmission we will have approximately 5 structures. In areas where single-pole structures are preferred, weak or wet soils may require concrete foundations for support. Where a transmission line must cross a street or slightly change direction, larger angle structures or guy wires may be required. Poles with guy wires impact a much larger area. Angle structures are usually more than double the diameter of other steel poles. They are made of steel, usually five to six feet in diameter, and have a large concrete base. The base may be buried ten or more feet below the ground surface. The diameter of the pole and the depth the base is buried depends on the condition of the soils and the voltage of the line. Assumed the structures are disposed to Yreka recycling, 85.6 miles away. This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.060		Project	: JCBOYLE		
Description	: Remove & Dispose of Transmission Line No. 58					
Quantity	: 1.66 Mile					
Daily Production	: 0.50 Mile per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 3.3 Days		Estimator	: Mihaela Tomulescu	Mile per / Total Cost / Unit Price Per Mile	
Unit Price	: $31,411.84 per Mile		Probable Low Cost Parameter	0.575	$44,322	$26,700.06
Total Cost	: $52,144		Probable High Cost Parameter	0.375	$65,180	$39,264.80

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	3.3	8	26.56	L	$47.23	$0.00		$1,254.43
Electrician	Active	2.00	3.3	8	53.12	L	$45.23	$0.00		$2,402.62
Truck, Utility, with Man-Basket	Active	2.00	3.3	8	53.12	E	$31.90	$31.90		$1,694.53
Truck Driver (heavy)	Active	4.00	3.3	8	106.24	L	$57.59	$0.00		$6,118.36
Laborer	Active	2.00	3.3	8	53.12	L	$45.80	$0.00		$2,432.90
Hydraulic Excavator (2.5cy)	Active	1.00	3.3	8	26.56	E	$203.63	$203.63		$5,408.41
Hydraulic Crane (80tn)	Active	1.00	3.3	8	26.56	E	$190.46	$190.46		$5,058.62
Equipment Operator (crane)	Active	1.00	3.3	8	26.56	L	$68.41	$0.00		$1,816.97
Equipment Operator (light)	Active	1.00	3.3	8	26.56	L	$64.90	$0.00		$1,723.74
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	3.3	8	26.56	E	$62.72	$62.72		$1,665.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	3.3	8	79.68	E	$31.90	$31.90		$2,541.79
				Labor Hours	292.16				TOTAL LABOR	$15,749.02
				Equipment Hours	212.48				TOTAL EQUIPMENT	$16,369.19

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$787.45	$787.45
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	31.00	CY	1.000	31.00	$4.74	$146.94
					TOTAL MATERIAL	$934.39

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	3.32	days		$3,000.00	$9,960.00
				TOTAL SUBCONTRACTS	$9,960.00

SUMMARY OF COSTS

Labor Cost	$15,749.02	Labor Burden @	49.7%	$0.00		$15,749.02
Material Cost	$934.39	Material Tax @	7.8%	$72.42		$1,006.81
Equipment Cost	$16,369.19	Equipment Tax @	0.0%	$0.00		$16,369.19
Subcontractors	$9,960.00					$9,960.00
DIRECT COST SUBTOTALS	$43,013			$72	DIRECT COST SUBTOTALS	$43,085

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$33,125.02		$4,968.75
Installing Contractors Profit@	8.0%				$32,118.21		$2,569.46
GC Markup on Subs @	5.0%				$9,960.00		$498.00
						TOTAL MARKUP COSTS	$8,036.21
General Contractors Insurance @	1.0%			on	$51,121.23		$511
Bond @	1.0%			on	$51,121.23		$511
Contingency @	0.0%			on	$52,143.65		$0
						TOTAL COST for pay item	$52,144

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :2 Electrician,, 1 utility truck to access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. Transmission line poles or structures are commonly between 60 and 140 feet tall. There are several different kinds of transmission structures. Transmission structures can be constructed of metal or wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. Assumed based on RSMs we have "Communications transmission tower, radio towers self-supporting, wind load 70 mph basic wind speed, 120' high" (33811310). Pole height and load capacity limitations determine the distance between poles (span length) either on the basis of ground clearance or ability to support heavy wind and ice loads. Assumed average span between structures to be 275 feet so for 1.66 miles of overhead transmission we will have approximately 31 structures. In areas where single-pole structures are preferred, weak or wet soils may require concrete foundations for support. Where a transmission line must cross a street or slightly change direction, larger angle structures or guy wires may be required. Poles with guy wires impact a much larger area. Angle structures are usually more than double the diameter of other steel poles. They are made of steel, usually five to six feet in diameter, and have a large concrete base. The base may be buried ten or more feet below the ground surface. The diameter of the pole and the depth the base is buried depends on the condition of the soils and the voltage of the line. Assumed the structures are disposed to Yreka recycling, 85.6 miles away. This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM COST DETAIL WORKSHEET | **1.061 Remove Intake Structure Concrete**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.061		**Project**	: JC Boyle		
Description	:	Remove Intake Structure Concrete					
Quantity	:	1,600.00	cy				
Daily Production	:	60.00	cy per 8 hour shift	**Project #**	: 1		
Work Days	:	26.7	Days	**Estimator**	: Felipe Poletto	**cy per**	**Total Cost** / **Unit Price Per cy**
Unit Price	:	$294.80	per cy	**Probable Low Cost Parameter**		**66**	**$424,508** / **$265.32**
Total Cost	:	$471,675		**Probable High Cost Parameter**		**48**	**$566,010** / **$353.76**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	26.7	8	427.20	L	$48.27	incl. in rate	incl. in rate	$20,620.94
Laborer	Active	8.00	26.7	8	1,708.80	L	$45.80	incl. in rate	incl. in rate	$78,263.04
Equipment Operator (medium)	Active	2.00	26.7	8	427.20	L	$66.28	incl. in rate	incl. in rate	$28,314.82
Truck Driver (heavy)	Active	1.00	26.7	8	213.60	L	$57.59	incl. in rate	incl. in rate	$12,301.22
Air Compressor 600 cfm	Active	1.00	26.7	8	213.60	E	$21.74	incl. in rate	incl. in rate	$4,643.43
Air Compressor 900 cfm	Active	1.00	26.7	8	213.60	E	$38.87	incl. in rate	incl. in rate	$8,302.40
Air Tool, Chipping Hammer	Active	5.00	26.7	8	1,068.00	E	$1.64	incl. in rate	incl. in rate	$1,750.49
Generator, Small Generator, 10 - 15 kW	Active	2.00	26.7	8	427.20	E	$7.04	incl. in rate	incl. in rate	$3,007.49
Hydraulic Excavator (5.0cy)	Active	2.00	26.7	8	427.20	E	$274.63	incl. in rate	incl. in rate	$117,321.94
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	2.00	26.7	8	427.20	E	$62.72	incl. in rate	incl. in rate	$26,793.98
Hydraulic Thumbs/Shear Attachment	Active	2.00	26.7	8	427.20	E	$16.39	incl. in rate	incl. in rate	$7,001.81
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	26.7	8	213.60	E	$111.64	incl. in rate	incl. in rate	$23,846.30
			26.7	8	0.00					$0.00
			26.7	8	0.00					$0.00
			26.7	8	0.00					$0.00
			26.7	8	0.00					$0.00
			26.7	8	0.00					$0.00
				Labor Hours	**2,777**				**TOTAL LABOR**	**$139,500.02**
				Equipment Hours	**3,418**				**TOTAL EQUIPMENT**	**$192,667.84**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$6,975.00	$6,975.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$6,975.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	10	EA	**Cost per Mob**	$2,500.00	$25,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$25,000.00**

SUMMARY OF COSTS

Labor Cost	$139,500.02	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$139,500.02
Material Cost	$6,975.00	Material Tax @	7.75%	$540.56		$7,515.56
Equipment Cost	$192,667.84	Equipment Tax @	7.75%	$14,931.76		$207,599.60
Subcontractors	$25,000.00					$25,000.00
DIRECT COST SUBTOTALS	**$364,143**			**$15,472**	**DIRECT COST SUBTOTALS**	**$379,615**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$354,615.19	$53,192.28
Installing Contractors Profit@	8.0%				$354,615.19	$28,369.22
GC Markup on Subs @	5.0%				$25,000.00	$1,250.00
					TOTAL MARKUP COSTS	**$82,811.49**
General Contractors Insurance @	1.0%		on		$462,426.68	$4,624
Bond @	1.0%		on		$462,426.68	$4,624
Contingency @	0.0%		on		$471,675.22	$0
					TOTAL COST for pay item	**$471,675**

Additional Pay Item Notes :

The work is done by one 6-men crew (foreman, 4 laborers, and 2 equipment operators). Concrete hauling to scour hole is also included - based on the current production rate only 3 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. This productivity is considerably slower than flume demolition due to access. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET

1.062 Remove Fish Screen Building

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.062	**Project**	: JC Boyle		
Description	:	Remove Fish Screen Building				
Quantity	:	2,010.00 SF				
Daily Production	:	260.00 SF per 8 hour shift	**Project #**	: 1		
Work Days	:	7.7 Days	**Estimator**	: Eric Jones	**SF per** / **Total Cost**	**Unit Price Per SF**
Unit Price	:	$70.46 per SF	**Probable Low Cost Parameter**	273	$134,535	$66.93
Total Cost	:	$141,616	**Probable High Cost Parameter**	234	$155,777	$77.50

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	7.7	8	61.60	L	$48.27	incl. in rate	incl. in rate	$2,973.43
Laborer	Active	2.00	7.7	8	123.20	L	$45.80	incl. in rate	incl. in rate	$5,642.56
Truck Driver (heavy)	Active	4.00	7.7	8	246.40	L	$57.59	incl. in rate	incl. in rate	$14,190.18
Equipment Operator (medium)	Active	3.00	7.7	8	184.80	L	$66.28	incl. in rate	incl. in rate	$12,248.54
Equipment Operator (crane)	Active	1.00	7.7	8	61.60	L	$68.41	incl. in rate	incl. in rate	$4,214.06
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	7.7	8	123.20	E	$31.90	incl. in rate	incl. in rate	$3,930.08
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	7.7	8	123.20	E	$70.35	incl. in rate	incl. in rate	$8,667.12
Hydraulic Crane (80tn)	Active	1.00	7.7	8	61.60	E	$190.46	incl. in rate	incl. in rate	$11,732.34
Hydraulic Excavator (5.0cy)	Active	2.00	7.7	8	123.20	E	$274.63	incl. in rate	incl. in rate	$33,834.42
Loader, FE Rubber Tire (5.25cy)	Active	1.00	***2.5***	8	20.00	E	$75.42	incl. in rate	incl. in rate	$1,508.40
		1.00	7.7	8	61.60	0	$0.00	$0.00		$0.00
		1.00	7.7	8	61.60	0	$0.00	$0.00		$0.00
			7.7	8	0.00					$0.00
			7.7	8	0.00					$0.00
			7.7	8	0.00					$0.00
			7.7	8	0.00					$0.00
			7.7	8	0.00					$0.00
				Labor Hours	**677.6**				**TOTAL LABOR**	**$39,268.77**
				Equipment Hours	**451.2**				**TOTAL EQUIPMENT**	**$59,672.35**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	295	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	147.40	tons	**Klamath County LandFill**	$74.00	$10,907.60
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$10,907.60**

SUMMARY OF COSTS

Labor Cost	$39,268.77	Labor Burden @	0.0%			$39,268.77
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$59,672.35	Equipment Tax @	7.75%	$4,624.61		$64,296.96
Subcontractors	$10,907.60					$10,907.60
DIRECT COST SUBTOTALS	**$109,849**			**$4,625**	**DIRECT COST SUBTOTALS**	**$114,473**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$103,565.73	$15,534.86
Installing Contractors Profit@	8.0%				$103,565.73	$8,285.26
GC Markup on Subs @	5.0%				$10,907.60	$545.38
					TOTAL MARKUP COSTS	**$24,365.50**
General Contractors Insurance @	1.0%		on		$138,838.82	$1,388
Bond @	1.0%		on		$138,838.82	$1,388
Contingency @	0.0%		on		$141,615.60	$0
					TOTAL COST for pay item	**$141,616**

Additional Pay Item Notes :

Duration accounts for mobilization and demobilization, crane is to be used for flying material out of the demolition area as the excavator tears building down building, some of the building will need to be taken down by hand with crane support due to excavator not be able to reach certain sections. 1 excavator will be used to load trucks, 1 FE loader will be used half of the time to maintain hauling area. due to the building being near water limiting access the production has been reduced when compared to other buildings being demolished.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.063	Project	: JCBOYLE		
Description	:	Remove 24" Steel Fish Discahrge Pipe				
Quantity	:	37,978.00 LBS				
Daily Production	:	25,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	1.5 Days	Estimator	: Mihaela Tomulescu		
				LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.31 per LBS	Probable Low Cost Parameter	28750	$10,033	$0.26
Total Cost	:	$11,804	Probable High Cost Parameter	18750	$14,755	$0.39

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.5	8	12.00	L	$48.27	incl. in rate	incl. in rate	$579.24
Laborer	Active	1.00	1.5	8	12.00	L	$45.80	incl. in rate	incl. in rate	$549.60
Steelworker	Active	1.00	1.5	8	12.00	L	$65.52	incl. in rate	incl. in rate	$786.24
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.5	8	12.00	E	$221.50	incl. in rate	incl. in rate	$2,658.00
Truck Driver (heavy)	Active	1.00	1.5	8	12.00	L	$57.59	incl. in rate	incl. in rate	$691.08
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.5	8	12.00	E	$111.64	incl. in rate	incl. in rate	$1,339.68
Equipment Operator (light)	Active	1.00	1.5	8	12.00	L	$64.90	incl. in rate	incl. in rate	$778.80
Hydraulic Crane (17tn)	Active	1.00	1.5	8	12.00	E	$81.52	incl. in rate	incl. in rate	$978.24
Equipment Operator (crane)	Active	1.00	1.5	8	12.00	L	$68.41	incl. in rate	incl. in rate	$820.92
				Labor Hours	72				TOTAL LABOR	$4,205.88
				Equipment Hours	36				TOTAL EQUIPMENT	$4,975.92

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$210.29	$210.29
					TOTAL MATERIAL	$210.29

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$4,205.88	Labor Burden @	49.7%	$0.00		$4,205.88
Material Cost	$210.29	Material Tax @	7.8%	$16.30		$226.59
Equipment Cost	$4,975.92	Equipment Tax @	0.0%	$0.00		$4,975.92
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$9,392			$16	DIRECT COST SUBTOTALS	$9,408

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$9,408.39	$1,411.26
Installing Contractors Profit@	8.0%				$9,408.39	$752.67
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$2,163.93
General Contractors Insurance @	1.0%		on		$11,572.32	$116
Bond @	1.0%		on		$11,572.32	$116
Contingency @	0.0%		on		$11,803.77	$0
					TOTAL COST for pay item	$11,804

Additional Pay Item Notes :

340 LF of 24" iron drainage pipes at 111.7Lbs/LF. Used 1 Loader and 1 Forman, 1 Steelworkers to cut the pipes and 1 Laborers to load the pipes in the truck.

PAY ITEM COST DETAIL WORKSHEET — **1.064 Remove Concrete Items associated with the 14-ft-diameter Steel Pipe**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.064	**Project**	: JC Boyle		
Description	: Remove Concrete Items associated with the 14-ft-diameter Steel Pipe				
Quantity	: 1,100.00 cy				
Daily Production	: 40.00 cy per 8 hour shift	**Project #**	: 1		
Work Days	: 27.5 Days	**Estimator**	: Felipe Poletto	**cy per**	**Total Cost** / **Unit Price Per cy**
Unit Price	: $287.96 per cy	**Probable Low Cost Parameter**		**46**	**$269,239** / **$244.76**
Total Cost	: $316,752	**Probable High Cost Parameter**		**34**	**$364,265** / **$331.15**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	27.5	8	220.00	L	$48.27	incl. in rate	incl. in rate	$10,619.40
Laborer	Active	4.00	27.5	8	880.00	L	$45.80	incl. in rate	incl. in rate	$40,304.00
Equipment Operator (medium)	Active	2.00	27.5	8	440.00	L	$66.28	incl. in rate	incl. in rate	$29,163.20
Truck Driver (heavy)	Active	1.00	27.5	8	220.00	L	$57.59	incl. in rate	incl. in rate	$12,669.80
Air Compressor 900 cfm	Active	1.00	27.5	8	220.00	E	$38.87	incl. in rate	incl. in rate	$8,551.16
Air Tool, Chipping Hammer	Active	3.00	27.5	8	660.00	E	$1.64	incl. in rate	incl. in rate	$1,081.76
Generator, Small Generator, 10 - 15 kW	Active	2.00	27.5	8	440.00	E	$7.04	incl. in rate	incl. in rate	$3,097.60
Hydraulic Excavator (5.0cy)	Active	1.00	27.5	8	220.00	E	$274.63	incl. in rate	incl. in rate	$60,418.60
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	27.5	8	220.00	E	$62.72	incl. in rate	incl. in rate	$13,798.40
Hydraulic Thumbs/Shear Attachment	Active	1.00	27.5	8	220.00	E	$16.39	incl. in rate	incl. in rate	$3,605.80
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	27.5	8	220.00	E	$111.64	incl. in rate	incl. in rate	$24,560.80
Loader, FE Rubber Tire (5.25cy)	Active	1.00	27.5	8	220.00	E	$75.42	incl. in rate	incl. in rate	$16,592.40
			27.5	8	0.00					$0.00
			27.5	8	0.00					$0.00
			27.5	8	0.00					$0.00
			27.5	8	0.00					$0.00
			27.5	8	0.00					$0.00
				Labor Hours	**1,760**				**TOTAL LABOR**	**$92,756.40**
				Equipment Hours	**2,420**				**TOTAL EQUIPMENT**	**$131,706.53**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$4,637.82	$4,637.82
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$4,637.82**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	6	EA	**Cost per Mob**	$2,500.00	$15,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$15,000.00**

SUMMARY OF COSTS

Labor Cost	$92,756.40	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$92,756.40
Material Cost	$4,637.82	Material Tax @	7.75%	$359.43		$4,997.25
Equipment Cost	$131,706.53	Equipment Tax @	7.75%	$10,207.26		$141,913.78
Subcontractors	$15,000.00					$15,000.00
DIRECT COST SUBTOTALS	**$244,101**			**$10,567**	**DIRECT COST SUBTOTALS**	**$254,667**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$239,667.43	$35,950.11
Installing Contractors Profit@	8.0%				$239,667.43	$19,173.39
GC Markup on Subs @	5.0%				$15,000.00	$750.00
					TOTAL MARKUP COSTS	**$55,873.51**
General Contractors Insurance @	1.0%			on	$310,540.94	$3,105
Bond @	1.0%			on	$310,540.94	$3,105
Contingency @	0.0%			on	$316,751.76	$0
					TOTAL COST for pay item	**$316,752**

Additional Pay Item Notes :

The work is done by FOUR 7-men crew (foreman, 4 laborers, and 2 equipment operators). Concrete hauling to scour hole is also included - based on the current production rate only 3 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. This productivity is considerably slower than flume demolition due to access. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET — **1.065 Remove Open Concrete Flume**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.065	Project	: JC Boyle		
Description	: Remove Open Concrete Flume				
Quantity	: 26,000.00 cy				
Daily Production	: 180.00 cy per 8 hour shift	Project #	: 1		
Work Days	: 144.4 Days	Estimator	: Felipe Poletto	cy per	Total Cost	Unit Price Per cy
Unit Price	: $266.49 per cy	Probable Low Cost Parameter	198	$6,235,894	$239.84
Total Cost	: $6,928,771	Probable High Cost Parameter	144	$8,314,525	$319.79

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	4.00	144.4	8	4,620.80	L	$48.27	incl. in rate	incl. in rate	$223,046.02
Laborer	Active	16.00	144.4	8	18,483.20	L	$45.80	incl. in rate	incl. in rate	$846,530.56
Equipment Operator (medium)	Active	10.00	144.4	8	11,552.00	L	$66.28	incl. in rate	incl. in rate	$765,666.56
Truck Driver (heavy)	Active	2.00	144.4	8	2,310.40	L	$57.59	incl. in rate	incl. in rate	$133,055.94
Air Compressor 900 cfm	Active	4.00	144.4	8	4,620.80	E	$38.87	incl. in rate	incl. in rate	$179,605.51
Air Tool, Chipping Hammer	Active	12.00	144.4	8	13,862.40	E	$1.64	incl. in rate	incl. in rate	$22,720.95
Generator, Small Generator, 10 - 15 kW	Active	8.00	144.4	8	9,241.60	E	$7.04	incl. in rate	incl. in rate	$65,060.86
Hydraulic Excavator (5.0cy)	Active	6.00	144.4	8	6,931.20	E	$274.63	incl. in rate	incl. in rate	$1,903,515.46
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	4.00	144.4	8	4,620.80	E	$62.72	incl. in rate	incl. in rate	$289,816.58
Hydraulic Thumbs/Shear Attachment	Active	4.00	144.4	8	4,620.80	E	$16.39	incl. in rate	incl. in rate	$75,734.91
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	144.4	8	2,310.40	E	$111.64	incl. in rate	incl. in rate	$257,933.06
Loader, FE Rubber Tire (5.25cy)	Active	4.00	144.4	8	4,620.80	E	$75.42	incl. in rate	incl. in rate	$348,500.74
			144.4	8	0.00					$0.00
			144.4	8	0.00					$0.00
			144.4	8	0.00					$0.00
			144.4	8	0.00					$0.00
			144.4	8	0.00					$0.00
				Labor Hours	36,966				TOTAL LABOR	$1,968,299.07
				Equipment Hours	50,829				TOTAL EQUIPMENT	$3,142,888.05

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$98,414.95	$98,414.95
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	$98,414.95

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	29	EA	Cost per Mob	$2,500.00	$72,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$72,500.00

SUMMARY OF COSTS

Labor Cost	$1,968,299.07	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.		$1,968,299.07
Material Cost	$98,414.95	Material Tax @	7.75%	$7,627.16			$106,042.11
Equipment Cost	$3,142,888.05	Equipment Tax @	7.75%	$243,573.82			$3,386,461.88
Subcontractors	$72,500.00						$72,500.00
DIRECT COST SUBTOTALS	**$5,282,102**			**$251,201**		**DIRECT COST SUBTOTALS**	**$5,533,303**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,460,803.06	$819,120.46
Installing Contractors Profit@	8.0%				$5,460,803.06	$436,864.24
GC Markup on Subs @	5.0%				$72,500.00	$3,625.00
					TOTAL MARKUP COSTS	**$1,259,609.70**
General Contractors Insurance @	1.0%			on	$6,792,912.77	$67,929
Bond @	1.0%			on	$6,792,912.77	$67,929
Contingency @	0.0%			on	$6,928,771.02	$0
					TOTAL COST for pay item	**$6,928,771**

Additional Pay Item Notes :

The work is done by FOUR 7-men crew (foreman, 4 laborers, and 2 equipment operators). Concrete hauling to scour hole is also included - based on the current production rate only 3 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.066		Project	: JCBOYLE			
Description	: Remove Structural Steel items associated with Forebay Trash Rack Piers						
Quantity	: 11,500.00 LBS						
Daily Production	: 25,000.00 LBS per 8 hour shift		Project #	: Klamath Dams Removal			
Work Days	: 0.5 Days		Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $0.49 per LBS		Probable Low Cost Parameter		28750	$4,784	$0.42
Total Cost	: $5,628		Probable High Cost Parameter		18750	$7,035	$0.61

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.5	8	4.00	L	$48.27	incl. in rate	incl. in rate	$193.08
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Steelworker	Active	1.00	0.5	8	4.00	L	$65.52	incl. in rate	incl. in rate	$262.08
Crawler Crane (90tn)	Active	1.00	1.0	8	8.00	E	$208.09	incl. in rate	incl. in rate	$1,664.72
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
				Labor Hours	32				TOTAL LABOR	$1,829.56
				Equipment Hours	16				TOTAL EQUIPMENT	$2,557.84

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$91.48	$91.48
					TOTAL MATERIAL	$91.48

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,829.56	Labor Burden @		49.7%	$0.00		$1,829.56
Material Cost	$91.48	Material Tax @		7.8%	$7.09		$98.57
Equipment Cost	$2,557.84	Equipment Tax @		0.0%	$0.00		$2,557.84
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$4,479				$7	DIRECT COST SUBTOTALS	$4,486

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$4,485.97		$672.90
Installing Contractors Profit@	8.0%				$4,485.97		$358.88
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$1,031.77
General Contractors Insurance @	1.0%			on	$5,517.74		$55
Bond @	1.0%			on	$5,517.74		$55
Contingency @	0.0%			on	$5,628.09		$0
						TOTAL COST for pay item	$5,628

Additional Pay Item Notes :

Used 1 Crane and 1 Foreman, 1 Steelworkers to cut the beams that support the trash rack and 2 Laborers to load the pipes in the truck.

PAY ITEM COST DETAIL WORKSHEET

1.067 Remove Forebay Concrete

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.067	**Project**	: JC Boyle			
Description	: Remove Forebay Concrete					
Quantity	: 2,500.00 cy					
Daily Production	: 75.00 cy per 8 hour shift	**Project #**	: 1			
Work Days	: 33.3 Days	**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	: $298.78 per cy	**Probable Low Cost Parameter**		**82.5**	**$672,256**	**$268.90**
Total Cost	: $746,951	**Probable High Cost Parameter**		**60**	**$896,341**	**$358.54**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	33.3	8	532.80	L	$48.27	incl. in rate	incl. in rate	$25,718.26
Laborer	Active	8.00	33.3	8	2,131.20	L	$45.80	incl. in rate	incl. in rate	$97,608.96
Equipment Operator (medium)	Active	4.00	33.3	8	1,065.60	L	$66.28	incl. in rate	incl. in rate	$70,627.97
Truck Driver (heavy)	Active	2.00	33.3	8	532.80	L	$57.59	incl. in rate	incl. in rate	$30,683.95
Air Compressor 900 cfm	Active	2.00	33.3	8	532.80	E	$38.87	incl. in rate	incl. in rate	$20,709.36
Air Tool, Chipping Hammer	Active	6.00	33.3	8	1,598.40	E	$1.64	incl. in rate	incl. in rate	$2,619.83
Generator, Small Generator, 10 - 15 kW	Active	4.00	33.3	8	1,065.60	E	$7.04	incl. in rate	incl. in rate	$7,501.82
Hydraulic Excavator (5.0cy)	Active	2.00	33.3	8	532.80	E	$274.63	incl. in rate	incl. in rate	$146,322.86
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	2.00	33.3	8	532.80	E	$62.72	incl. in rate	incl. in rate	$33,417.22
Hydraulic Thumbs/Shear Attachment	Active	2.00	33.3	8	532.80	E	$16.39	incl. in rate	incl. in rate	$8,732.59
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	33.3	8	532.80	E	$111.64	incl. in rate	incl. in rate	$59,481.79
Loader, FE Rubber Tire (5.25cy)	Active	2.00	33.3	8	532.80	E	$75.42	incl. in rate	incl. in rate	$40,183.78
			33.3	8	0.00					$0.00
			33.3	8	0.00					$0.00
			33.3	8	0.00					$0.00
			33.3	8	0.00					$0.00
			33.3	8	0.00					$0.00
				Labor Hours	**4,262**				**TOTAL LABOR**	**$224,639.14**
				Equipment Hours	**5,861**				**TOTAL EQUIPMENT**	**$318,969.26**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$11,231.96	$11,231.96
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$11,231.96**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	7	EA	**Cost per Mob**	$2,500.00	$17,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$17,500.00**

SUMMARY OF COSTS

Labor Cost	$224,639.14	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$224,639.14
Material Cost	$11,231.96	Material Tax @	7.75%	$870.48		$12,102.43
Equipment Cost	$318,969.26	Equipment Tax @	7.75%	$24,720.12		$343,689.37
Subcontractors	$17,500.00					$17,500.00
DIRECT COST SUBTOTALS	**$572,340**			**$25,591**	**DIRECT COST SUBTOTALS**	**$597,931**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$580,430.94	$87,064.64
Installing Contractors Profit@	8.0%				$580,430.94	$46,434.48
GC Markup on Subs @	5.0%				$17,500.00	$875.00
					TOTAL MARKUP COSTS	**$134,374.12**
General Contractors Insurance @	1.0%			on	$732,305.06	$7,323
Bond @	1.0%			on	$732,305.06	$7,323
Contingency @	0.0%			on	$746,951.16	$0
					TOTAL COST for pay item	**$746,951**

Additional Pay Item Notes :

The work is done by FOUR 7-men crew (foreman, 4 laborers, and 2 equipment operators). Concrete hauling to scour hole is also included - based on the current production rate only 3 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. This productivity is considerably slower than flume demolition due to access. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET **1.068 Place Concrete Plugs at Tunnel Portals**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.068		Project	: JC Boyle		
Description	: Place Concrete Plugs at Tunnel Portals					
Quantity	: 30.00 CY					
Daily Production	: 6.00 CY per 8 hour shift		Project #	: 1		
Work Days	: 5.0 Days		Estimator	: Eric Jones		
				CY per	**Total Cost**	**Unit Price Per CY**
Unit Price	: $1,616.26 per CY		Probable Low Cost Parameter	6.3	$46,063	$1,535.45
Total Cost	: $48,488		Probable High Cost Parameter	5.7	$50,912	$1,697.08

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Carpenter Foreman (out)	Active	1.00	5.0	8	40.00	L	$46.40	incl. in rate	incl. in rate	$1,856.00
Carpenters	Active	2.00	5.0	8	80.00	L	$72.60	incl. in rate	incl. in rate	$5,808.00
Carpenters, Journeyman	Active	4.00	5.0	8	160.00	L	$65.37	incl. in rate	incl. in rate	$10,459.20
Equipment Operator (crane)	Active	2.00	5.0	8	80.00	L	$68.41	incl. in rate	incl. in rate	$5,472.80
Equipment Operator (light)	Active	2.00	***1.0***	8	16.00	L	$64.90	incl. in rate	incl. in rate	$1,038.40
Hydraulic Crane (80tn)	Active	1.00	5.0	8	40.00	E	$190.46	incl. in rate	incl. in rate	$7,618.40
Conc Pump (small)	Active	1.00	***1.0***	8	8.00	E	$61.43	incl. in rate	incl. in rate	$491.44
0		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
0		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
				Labor Hours	**376**				**TOTAL LABOR**	**$24,634.40**
				Equipment Hours	**48**				**TOTAL EQUIPMENT**	**$8,109.84**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Concrete	30.00	gal	1.000	30.00	$144.13	$4,323.90
Concrete blocks for backing	400.00	lbs PLS	1.000	400.00	$1.43	$572.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$4,895.90**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$24,634.40	Labor Burden @		0.0%			$24,634.40
Material Cost	$4,895.90	Material Tax @		7.75%	$379.43		$5,275.33
Equipment Cost	$8,109.84	Equipment Tax @		7.75%	$628.51		$8,738.35
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	**$37,640**				**$1,008**	**DIRECT COST SUBTOTALS**	**$38,648**
		Crew	**Material**	**Subs**	**Cost Basis**		
Installing Contractors Overhead@	15.0%				$38,648.08		$5,797.21
Installing Contractors Profit@	8.0%				$38,648.08		$3,091.85
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$8,889.06**
General Contractors Insurance @	1.0%			on	$47,537.14		$475
Bond @	1.0%			on	$47,537.14		$475
Contingency @	0.0%			on	$48,487.89		$0
						TOTAL COST for pay item	**$48,488**

Additional Pay Item Notes :

Carpenter crew will be used to form and pour plugs in the dry after penstock is removed, Hydraulic Crane will be supporting crew for materials, Concrete pump is expected to used 1 day to pour concrete. Figuring a total of 5 days to mobilize and construct plug.

PAY ITEM COST DETAIL WORKSHEET

1.069 Remove Concrete Items associated with Penstocks D/S from Tunnel

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.069		Project	: JC Boyle			
Description	:	Remove Concrete Items associated with Penstocks D/S from Tunnel						
Quantity	:	1,800.00	cy					
Daily Production	:	40.00	cy per	8 hour shift	Project #	: 1		
Work Days	:	50.0	Days		Estimator	: Felipe Poletto	cy per	Total Cost	Unit Price Per cy
Unit Price	:	$495.44	per cy		Probable Low Cost Parameter		44	$802,619	$445.90
Total Cost	:	$891,799			Probable High Cost Parameter		32	$1,070,158	$594.53

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	50.0	8	800.00	L	$48.27	incl. in rate	incl. in rate	$38,616.00
Laborer	Active	8.00	50.0	8	3,200.00	L	$45.80	incl. in rate	incl. in rate	$146,560.00
Equipment Operator (medium)	Active	3.00	50.0	8	1,200.00	L	$66.28	incl. in rate	incl. in rate	$79,536.00
Truck Driver (heavy)	Active	1.00	50.0	8	400.00	L	$57.59	incl. in rate	incl. in rate	$23,036.00
Air Compressor 600 cfm	Active	1.00	50.0	8	400.00	E	$21.74	incl. in rate	incl. in rate	$8,695.57
Air Compressor 900 cfm	Active	1.00	50.0	8	400.00	E	$38.87	incl. in rate	incl. in rate	$15,547.57
Air Tool, Chipping Hammer	Active	5.00	50.0	8	2,000.00	E	$1.64	incl. in rate	incl. in rate	$3,278.07
Generator, Small Generator, 10 - 15 kW	Active	2.00	50.0	8	800.00	E	$7.04	incl. in rate	incl. in rate	$5,632.00
Hydraulic Excavator (5.0cy)	Active	2.00	50.0	8	800.00	E	$274.63	incl. in rate	incl. in rate	$219,704.00
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	50.0	8	800.00	E	$70.35	incl. in rate	incl. in rate	$56,280.00
Loader, FE Rubber Tire (5.25cy)	Active	1.00	50.0	8	400.00	E	$75.42	incl. in rate	incl. in rate	$30,168.00
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	50.0	*8*	400.00	E	$62.72	incl. in rate	incl. in rate	$25,088.00
			50.0	8	0.00					$0.00
			50.0	8	0.00					$0.00
			50.0	8	0.00					$0.00
			50.0	8	0.00					$0.00
			50.0	8	0.00					$0.00
				Labor Hours	5,600				TOTAL LABOR	$287,748.00
				Equipment Hours	6,000				TOTAL EQUIPMENT	$364,393.20

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$14,387.40	$14,387.40
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	$14,387.40

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	7	EA	Cost per Mob	$2,500.00	$17,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$17,500.00

SUMMARY OF COSTS

Labor Cost	$287,748.00	Labor Burden @		0.0%	$0.00	Included in hourly labor rate.		$287,748.00
Material Cost	$14,387.40	Material Tax @		7.75%	$1,115.02			$15,502.42
Equipment Cost	$364,393.20	Equipment Tax @		7.75%	$28,240.47			$392,633.68
Subcontractors	$17,500.00							$17,500.00
DIRECT COST SUBTOTALS	$684,029				$29,355		DIRECT COST SUBTOTALS	$713,384
		Crew	Material	Subs	Cost Basis			
Installing Contractors Overhead@	15.0%				$695,884.10			$104,382.62
Installing Contractors Profit@	8.0%				$695,884.10			$55,670.73
GC Markup on Subs @	5.0%				$17,500.00			$875.00
							TOTAL MARKUP COSTS	$160,928.34
General Contractors Insurance @	1.0%			on	$874,312.44			$8,743
Bond @	1.0%			on	$874,312.44			$8,743
Contingency @	0.0%			on	$891,798.69			$0
							TOTAL COST for pay item	$891,799

Additional Pay Item Notes :

Three locations on steep sloped area, production will be reduced due to access restrictions, 2 5 man ground crews to assist with demolition, 1 excavator with breaker to demolish concrete items, 1 excavator will load or oragnize material, 1 loader will assist with maintaining haul roads and loading material, concrete is to brought to scour location.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.070	Project	: JC Boyle			
Description	: Remove Head gate Control Building at Flume Entrance					
Quantity	: 500.00 SF					
Daily Production	: 165.00 SF per 8 hour shift	Project #	: 1			
Work Days	: 3.0 Days	Estimator	: Eric Jones	SF per	Total Cost	Unit Price Per SF
Unit Price	: $99.08 per SF	Probable Low Cost Parameter		181.5	$44,588	$89.18
Total Cost	: $49,542	Probable High Cost Parameter		140.25	$56,973	$113.95

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	3.0	8	24.00	L	$48.27	incl. in rate	incl. in rate	$1,158.48
Laborer	Active	3.00	3.0	8	72.00	L	$45.80	incl. in rate	incl. in rate	$3,297.60
Truck Driver (heavy)	Active	3.00	3.0	8	72.00	L	$57.59	incl. in rate	incl. in rate	$4,146.48
Equipment Operator (medium)	Active	3.00	3.0	8	72.00	L	$66.28	incl. in rate	incl. in rate	$4,772.16
Equipment Operator (light)	Active	1.00	3.0	8	24.00	L	$64.90	incl. in rate	incl. in rate	$1,557.60
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	3.0	8	24.00	E	$31.90	incl. in rate	incl. in rate	$765.60
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	3.0	8	48.00	E	$70.35	incl. in rate	incl. in rate	$3,376.80
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	3.0	8	24.00	E	$62.72	incl. in rate	incl. in rate	$1,505.28
Hydraulic Excavator (5.0cy)	Active	2.00	3.0	8	48.00	E	$274.63	incl. in rate	incl. in rate	$13,182.24
Loader, FE Rubber Tire (5.25cy)	Active	1.00	3.0	8	24.00	E	$75.42	incl. in rate	incl. in rate	$1,810.08
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
				Labor Hours	264				TOTAL LABOR	$14,932.32
				Equipment Hours	168				TOTAL EQUIPMENT	$20,640.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	73	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	36.67	tons	**Klamath County LandFill**	$74.00	$2,713.33
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$2,713.33

SUMMARY OF COSTS

Labor Cost	$14,932.32	Labor Burden @	0.0%			$14,932.32
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$20,640.00	Equipment Tax @	7.75%	$1,599.60		$22,239.60
Subcontractors	$2,713.33					$2,713.33
DIRECT COST SUBTOTALS	**$38,286**			**$1,600**	**DIRECT COST SUBTOTALS**	**$39,885**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$37,171.92		$5,575.79
Installing Contractors Profit@	8.0%				$37,171.92		$2,973.75
GC Markup on Subs @	5.0%				$2,713.33		$135.67
						TOTAL MARKUP COSTS	**$8,685.21**
General Contractors Insurance @	1.0%		on		$48,570.46		$486
Bond @	1.0%		on		$48,570.46		$486
Contingency @	0.0%		on		$49,541.87		$0
						TOTAL COST for pay item	**$49,542**

Additional Pay Item Notes :

3 days to demolish concrete block building and demo existing slab, 1 excavator with breaker to demolish structure, 1 excavator loading trucks. 1 FE load maintaining area and loading trucks, expecting rough 50 CY of debris 2 dump trucks will be used to haul concrete material to scour site, 1 flatbed will haul roofing material to disposal site.

PAY ITEM COST DETAIL WORKSHEET

1.071 Remove Fore bay Spillway Gate House

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.071		Project	: JC Boyle		
Description	: Remove Fore bay Spillway Gate House					
Quantity	: 610.00 SF					
Daily Production	: 204.00 SF per 8 hour shift		Project #	: 1		
Work Days	: 3.0 Days		Estimator	: Eric Jones		
				SF per	Total Cost	Unit Price Per SF
Unit Price	: $89.23 per SF		Probable Low Cost Parameter	224.4	$48,988	$80.31
Total Cost	: $54,431		Probable High Cost Parameter	163.2	$65,318	$107.08

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	3.0	8	24.00	L	$48.27	incl. in rate	incl. in rate	$1,158.48
Laborer	Active	3.00	3.0	8	72.00	L	$45.80	incl. in rate	incl. in rate	$3,297.60
Truck Driver (heavy)	Active	3.00	3.0	8	72.00	L	$57.59	incl. in rate	incl. in rate	$4,146.48
Equipment Operator (medium)	Active	3.00	3.0	8	72.00	L	$66.28	incl. in rate	incl. in rate	$4,772.16
Equipment Operator (crane)	Active	1.00	3.0	8	24.00	L	$68.41	incl. in rate	incl. in rate	$1,641.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	3.0	8	24.00	E	$31.90	incl. in rate	incl. in rate	$765.60
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	3.0	8	48.00	E	$70.35	incl. in rate	incl. in rate	$3,376.80
Hydraulic Crane (80tn)	Active	1.00	3.0	8	24.00	E	$190.46	incl. in rate	incl. in rate	$4,571.04
Hydraulic Excavator (5.0cy)	Active	2.00	3.0	8	48.00	E	$274.63	incl. in rate	incl. in rate	$13,182.24
Loader, FE Rubber Tire (5.25cy)	Active	1.00	3.0	8	24.00	E	$75.42	incl. in rate	incl. in rate	$1,810.08
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
				Labor Hours	264				TOTAL LABOR	$15,016.56
				Equipment Hours	168				TOTAL EQUIPMENT	$23,705.76

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	89	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	44.73	tons	Klamath County LandFill	$74.00	$3,310.27
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$3,310.27

SUMMARY OF COSTS

Labor Cost	$15,016.56	Labor Burden @	0.0%			$15,016.56
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$23,705.76	Equipment Tax @	7.75%	$1,837.20		$25,542.96
Subcontractors	$3,310.27					$3,310.27
DIRECT COST SUBTOTALS	$42,033			$1,837	DIRECT COST SUBTOTALS	$43,870

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$40,559.52		$6,083.93
Installing Contractors Profit@	8.0%				$40,559.52		$3,244.76
GC Markup on Subs @	5.0%				$3,310.27		$165.51
						TOTAL MARKUP COSTS	$9,494.20
General Contractors Insurance @	1.0%		on		$53,363.99		$534
Bond @	1.0%		on		$53,363.99		$534
Contingency @	0.0%		on		$54,431.26		$0
						TOTAL COST for pay item	$54,431

Additional Pay Item Notes :

3 days to demolish building which includes set up and break down, 1 excavator to demolish the building, 1 excavator to load dump trucks, 1crane to load flat bed truck, flat bed truck to haul roofing Material, dump trucks will haul demolish building material, FE load will be used to maintain area for trucks and equipment, laborers will assist with directing trucks and assisting equipment demolition, Foreman will oversee operation. Klamath Falls Dump is roughly 20 miles or 1 hour away from site

PAY ITEM COST DETAIL WORKSHEET

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.072	Project : JC Boyle		
Description	: Remove Fore bay Control Building			
Quantity	: 560.00 SF			
Daily Production	: 187.00 SF per 8 hour shift	Project # : 1		
Work Days	: 3.0 Days	Estimator : Eric Jones	SF per	Total Cost	Unit Price Per SF
Unit Price	: $96.68 per SF	Probable Low Cost Parameter	205.7	$48,727	$87.01
Total Cost	: $54,141	Probable High Cost Parameter	149.6	$64,969	$116.02

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	3.0	8	24.00	L	$48.27	incl. in rate	incl. in rate	$1,158.48
Laborer	Active	3.00	3.0	8	72.00	L	$45.80	incl. in rate	incl. in rate	$3,297.60
Truck Driver (heavy)	Active	3.00	3.0	8	72.00	L	$57.59	incl. in rate	incl. in rate	$4,146.48
Equipment Operator (medium)	Active	3.00	3.0	8	72.00	L	$66.28	incl. in rate	incl. in rate	$4,772.16
Equipment Operator (crane)	Active	1.00	3.0	8	24.00	L	$68.41	incl. in rate	incl. in rate	$1,641.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	3.0	8	24.00	E	$31.90	incl. in rate	incl. in rate	$765.60
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	3.0	8	48.00	E	$70.35	incl. in rate	incl. in rate	$3,376.80
Hydraulic Crane (80tn)	Active	1.00	3.0	8	24.00	E	$190.46	incl. in rate	incl. in rate	$4,571.04
Hydraulic Excavator (5.0cy)	Active	2.00	3.0	8	48.00	E	$274.63	incl. in rate	incl. in rate	$13,182.24
Loader, FE Rubber Tire (5.25cy)	Active	1.00	3.0	8	24.00	E	$75.42	incl. in rate	incl. in rate	$1,810.08
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
				Labor Hours	264				TOTAL LABOR	$15,016.56
				Equipment Hours	168				TOTAL EQUIPMENT	$23,705.76

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	82	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	41.07	tons	Klamath County LandFill	$74.00	$3,038.93
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$3,038.93

SUMMARY OF COSTS

Labor Cost	$15,016.56	Labor Burden @		0.0%			$15,016.56
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$23,705.76	Equipment Tax @		7.75%	$1,837.20		$25,542.96
Subcontractors	$3,038.93						$3,038.93
DIRECT COST SUBTOTALS	$41,761				$1,837	DIRECT COST SUBTOTALS	$43,598
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$40,559.52		$6,083.93
Installing Contractors Profit@	8.0%				$40,559.52		$3,244.76
GC Markup on Subs @	5.0%				$3,038.93		$151.95
						TOTAL MARKUP COSTS	$9,480.64
General Contractors Insurance @	1.0%		on		$53,079.09		$531
Bond @	1.0%		on		$53,079.09		$531
Contingency @	0.0%		on		$54,140.67		$0
						TOTAL COST for pay item	$54,141

Additional Pay Item Notes :

3 days to demolish building which includes set up and break down, 1 excavator to demolish the building, 1 excavator to load dump trucks, 1 crane to load flat bed truck, flat bed truck to haul roofing Material, dump trucks will haul demolish building material, FE load will be used to maintain area for trucks and equipment, laborers will assist with directing trucks and assisting equipment demolition, Foreman will oversee operation. Klamath Falls Dump is roughly 20 miles or 1 Hour away from site.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.074		Project	: JC Boyle		
Description	:	Remove Insulated Generator Building next to Fore bay Control Building					
Quantity	:	90.00 SF					
Daily Production	:	60.00 SF per 8 hour shift		Project #	: 1		
Work Days	:	1.5 Days		Estimator	: Eric Jones	SF per	Total Cost	Unit Price Per SF
Unit Price	:	$166.30 per SF		Probable Low Cost Parameter	66	$13,470	$149.67
Total Cost	:	$14,967		Probable High Cost Parameter	48	$17,960	$199.56

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.5	8	12.00	L	$48.27	incl. in rate	incl. in rate	$579.24
Laborer	Active	2.00	1.5	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Truck Driver (heavy)	Active	1.00	1.5	8	12.00	L	$57.59	incl. in rate	incl. in rate	$691.08
Equipment Operator (medium)	Active	1.00	1.5	8	12.00	L	$66.28	incl. in rate	incl. in rate	$795.36
Equipment Operator (light)	Active	1.00	1.5	8	12.00	L	$64.90	incl. in rate	incl. in rate	$778.80
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.5	8	12.00	E	$31.90	incl. in rate	incl. in rate	$382.80
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	1.5	8	24.00	E	$70.35	incl. in rate	incl. in rate	$1,688.40
Hydraulic Excavator (5.0cy)	Active	1.00	1.5	8	12.00	E	$274.63	incl. in rate	incl. in rate	$3,295.56
Loader, FE Rubber Tire (5.25cy)	Active	1.00	1.5	8	12.00	E	$75.42	incl. in rate	incl. in rate	$905.04
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	1.5	8	12.00	E	$62.72	incl. in rate	incl. in rate	$752.64
		1.00	1.5	8	12.00	0	$0.00	$0.00		$0.00
		1.00	1.5	8	12.00	0	$0.00	$0.00		$0.00
			1.5	8	0.00					$0.00
			1.5	8	0.00					$0.00
			1.5	8	0.00					$0.00
			1.5	8	0.00					$0.00
			1.5	8	0.00					$0.00
				Labor Hours	72				TOTAL LABOR	$3,943.68
				Equipment Hours	72				TOTAL EQUIPMENT	$7,024.44

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Dump Fee Coversion (SFXH*.33/27)	13	CY			$0.00
Dump Fee Conversion (295 CY / 2 Tons)	6.60	tons	Klamath County LandFill	$74.00	$488.40
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$488.40

SUMMARY OF COSTS

Labor Cost	$3,943.68	Labor Burden @	0.0%			$3,943.68
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$7,024.44	Equipment Tax @	7.75%	$544.39		$7,568.83
Subcontractors	$488.40					$488.40
DIRECT COST SUBTOTALS	$11,457			$544	DIRECT COST SUBTOTALS	$12,001

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$11,512.51	$1,726.88
Installing Contractors Profit@	8.0%				$11,512.51	$921.00
GC Markup on Subs @	5.0%				$488.40	$24.42
					TOTAL MARKUP COSTS	$2,672.30
General Contractors Insurance @	1.0%		on		$14,673.21	$147
Bond @	1.0%		on		$14,673.21	$147
Contingency @	0.0%		on		$14,966.68	$0
					TOTAL COST for pay item	$14,967

Additional Pay Item Notes :

It will take 1.5 days to set up, demolish, and haul off material, 1 excavator will be demolishing the building, Loader will be loading trucks and maintaining area, dump trucks will haul demolished material to dump/ scour site, flat bed truck will hall material to dump, Laborers will direct truck traffic and assist equipment demolition, Foreman to oversee operation.

PAY ITEM COST DETAIL WORKSHEET

1.075 Remove Fixed Wheel Gate (Gate, Frame, and Hoist)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.075	Project	: JCBOYLE			
Description	:	Remove Fixed Wheel Gate (Gate, Frame, and Hoist)					
Quantity	:	55,000.00 lbs					
Daily Production	:	30,000.00 lbs per 8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	1.8 Days	Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$0.53 per lbs	Probable Low Cost Parameter		36000	$23,272	$0.42
Total Cost	:	$29,090	Probable High Cost Parameter		22500	$36,363	$0.66

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.8	8	14.40	L	$47.23	incl. in rate	incl. in rate	$680.11
Electrician	Active	1.00	1.8	8	14.40	L	$45.23	incl. in rate	incl. in rate	$651.31
Ironworkers	Active	5.00	1.8	8	72.00	L	$63.95	incl. in rate	incl. in rate	$4,604.40
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.8	8	14.40	E	$221.50	incl. in rate	incl. in rate	$3,189.60
Truck Driver (heavy)	Active	1.00	1.8	8	14.40	L	$57.59	incl. in rate	incl. in rate	$829.30
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.8	8	14.40	E	$111.64	incl. in rate	incl. in rate	$1,607.62
Hydraulic Crane (120tn)	Active	1.00	1.8	8	14.40	E	$239.06	incl. in rate	incl. in rate	$3,442.46
Welder	Active	1.00	1.8	8	14.40	L	$7.84	incl. in rate	incl. in rate	$112.86
Gas Welding Machine	Active	1.00	1.8	8	14.40	E	$2.88	incl. in rate	incl. in rate	$41.43
Equipment Operator (medium)	Active	1.00	1.8	8	14.40	L	$66.28	incl. in rate	incl. in rate	$954.43
Equipment Operator (crane)	Active	1.00	1.8	8	14.40	L	$68.41	incl. in rate	incl. in rate	$985.10
				Labor Hours	158.4				TOTAL LABOR	$8,817.52
				Equipment Hours	57.6				TOTAL EQUIPMENT	$8,281.11

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$440.88	$440.88
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	2,500.00	LF	1.000	2,500.00	$0.85	$2,125.00
					TOTAL MATERIAL	$2,565.88

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	5.50	ton	1.000	5.50	$595.00	$3,272.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
					TOTAL SUBCONTRACTS	$3,893.10

SUMMARY OF COSTS

Labor Cost	$8,817.52	Labor Burden @	49.7%	$0.00		$8,817.52
Material Cost	$2,565.88	Material Tax @	7.8%	$198.86		$2,764.73
Equipment Cost	$8,281.11	Equipment Tax @	0.0%	$0.00		$8,281.11
Subcontractors	$3,893.10					$3,893.10
DIRECT COST SUBTOTALS	$23,558			$199	DIRECT COST SUBTOTALS	$23,756

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$19,863.36	$2,979.50
Installing Contractors Profit@	8.0%				$19,863.36	$1,589.07
GC Markup on Subs @	5.0%				$3,893.10	$194.66
					TOTAL MARKUP COSTS	$4,763.23
General Contractors Insurance @	1.0%		on		$28,519.68	$285
Bond @	1.0%		on		$28,519.68	$285
Contingency @	0.0%		on		$29,090.08	$0
					TOTAL COST for pay item	$29,090

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed hazardous waste 20% of the total lbs, calculated 85.6 miles from JC Boyle to Yreka Transfer Recycling.

PAY ITEM COST DETAIL WORKSHEET — **1.076 Remove Trash rack and trash rake (steel)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.076		Project	: JCBOYLE	
Description	: Remove Trash rack and trash rake (steel)				
Quantity	: 75,000.00 lbs				
Daily Production	: 30,000.00 lbs per 8 hour shift		Project #	: Klamath Dams Removal	
Work Days	: 2.5 Days		Estimator	: Mihaela Tomulescu	
Unit Price	: $0.51 per lbs				
Total Cost	: $38,047				

	lbs per	Total Cost	Unit Price Per lbs
Probable Low Cost Parameter	36000	$30,438	$0.41
Probable High Cost Parameter	22500	$47,559	$0.63

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.5	8	20.00	L	$47.23	incl. in rate	incl. in rate	$944.60
Electrician	Active	1.00	2.5	8	20.00	L	$45.23	incl. in rate	incl. in rate	$904.60
Ironworkers	Active	3.00	2.5	8	60.00	L	$63.95	incl. in rate	incl. in rate	$3,837.00
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.5	8	20.00	E	$221.50	incl. in rate	incl. in rate	$4,430.00
Truck Driver (heavy)	Active	1.00	2.5	8	20.00	L	$57.59	incl. in rate	incl. in rate	$1,151.80
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.5	8	20.00	E	$111.64	incl. in rate	incl. in rate	$2,232.80
Hydraulic Crane (120tn)	Active	1.00	2.5	8	20.00	E	$239.06	incl. in rate	incl. in rate	$4,781.20
Welder	Active	2.00	2.5	8	40.00	L	$7.84	incl. in rate	incl. in rate	$313.50
Gas Welding Machine	Active	2.00	2.5	8	40.00	E	$2.88	incl. in rate	incl. in rate	$115.08
Equipment Operator (medium)	Active	1.00	2.5	8	20.00	L	$66.28	incl. in rate	incl. in rate	$1,325.60
Equipment Operator (crane)	Active	1.00	2.5	8	20.00	L	$68.41	incl. in rate	incl. in rate	$1,368.20
Laborer	Active	3.00	2.5	8	60.00	L	$45.80	incl. in rate	incl. in rate	$2,748.00

Labor Hours	260	TOTAL LABOR	$12,593.30
Equipment Hours	100	TOTAL EQUIPMENT	$11,559.08

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$629.67	$629.67
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	6,000.00	LF	1.000	6,000.00	$0.85	$5,100.00
					TOTAL MATERIAL	$5,729.67

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$12,593.30	Labor Burden @	49.7%	$0.00		$12,593.30
Material Cost	$5,729.67	Material Tax @	7.8%	$444.05		$6,173.71
Equipment Cost	$11,559.08	Equipment Tax @	0.0%	$0.00		$11,559.08
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$29,882			$444	DIRECT COST SUBTOTALS	$30,326

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$30,326.09	$4,548.91
Installing Contractors Profit@	8.0%				$30,326.09	$2,426.09
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$6,975.00
General Contractors Insurance @	1.0%		on		$37,301.10	$373
Bond @	1.0%		on		$37,301.10	$373
Contingency @	0.0%		on		$38,047.12	$0
					TOTAL COST for pay item	$38,047

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal.

PAY ITEM COST DETAIL WORKSHEET

1.077 Remove Stop Logs and Slots (steel)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.077	**Project**	: JCBOYLE
Description	:	Remove Stop Logs and Slots (steel)		
Quantity	:	136,000.00 lbs		
Daily Production	:	30,000.00 lbs per 8 hour shift	**Project #**	: Klamath Dams Removal
Work Days	:	4.5 Days	**Estimator**	: Mihaela Tomulescu
Unit Price	:	$0.79 per lbs		
Total Cost	:	$107,370		

	lbs per	Total Cost	Unit Price Per lbs
Probable Low Cost Parameter	33000	$96,633	$0.71
Probable High Cost Parameter	22500	$134,213	$0.99

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.5	8	36.00	L	$46.27	incl. in rate	incl. in rate	$1,665.72
Electrician	Active	1.00	4.5	8	36.00	L	$45.23	incl. in rate	incl. in rate	$1,628.28
Steelworker	Active	5.00	4.5	8	180.00	L	$65.52	incl. in rate	incl. in rate	$11,793.60
Loader, FE Rubber Tire (8.6cy)	Active	1.00	4.5	8	36.00	E	$221.50	incl. in rate	incl. in rate	$7,974.00
Truck Driver (heavy)	Active	1.00	4.5	8	36.00	L	$57.59	incl. in rate	incl. in rate	$2,073.24
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	4.5	8	36.00	E	$111.64	incl. in rate	incl. in rate	$4,019.04
Hydraulic Crane (120tn)	Active	1.00	4.5	8	36.00	E	$239.06	incl. in rate	incl. in rate	$8,606.16
Welder	Active	1.00	4.5	8	36.00	L	$7.84	incl. in rate	incl. in rate	$282.15
Gas Welding Machine	Active	1.00	4.5	8	36.00	E	$2.88	incl. in rate	incl. in rate	$103.57
Equipment Operator (medium)	Active	1.00	4.5	8	36.00	L	$66.28	incl. in rate	incl. in rate	$2,386.08
Equipment Operator (crane)	Active	1.00	4.5	8	36.00	L	$68.41	incl. in rate	incl. in rate	$2,462.76
Laborer	Active	1.00	4.5	8	36.00	L	$45.80	incl. in rate	incl. in rate	$1,648.80

Labor Hours	**432**	**TOTAL LABOR**	**$23,940.63**
Equipment Hours	**144**	**TOTAL EQUIPMENT**	**$20,702.77**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,197.03	$1,197.03
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	5,000.00	LF	1.000	5,000.00	$0.85	$4,250.00
					TOTAL MATERIAL	**$5,447.03**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	68.00	ton	1.000	68.00	$595.00	$40,460.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$41,080.60**

SUMMARY OF COSTS

Labor Cost	$23,940.63	Labor Burden @	49.7%	$0.00	$23,940.63
Material Cost	$5,447.03	Material Tax @	7.8%	$422.14	$5,869.18
Equipment Cost	$20,702.77	Equipment Tax @	0.0%	$0.00	$20,702.77
Subcontractors	$41,080.60				$41,080.60
DIRECT COST SUBTOTALS	**$91,171**			**$422**	**DIRECT COST SUBTOTALS** **$91,593**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$50,512.58	$7,576.89
Installing Contractors Profit@	8.0%				$50,512.58	$4,041.01
GC Markup on Subs @	5.0%				$41,080.60	$2,054.03
					TOTAL MARKUP COSTS	**$13,671.92**

General Contractors Insurance @	1.0%	on	$105,265.10	$1,053
Bond @	1.0%	on	$105,265.10	$1,053
Contingency @	0.0%	on	$107,370.40	$0
			TOTAL COST for pay item	**$107,370**

Additional Pay Item Notes :

The process of removing stop logs is not manual, but done with hydraulic stop log lifters and hoists done by one 12-men crew (5 steelworkers, 1 laborer, 1 electrician, 1 welder and 4 equipment operators). Based on the current production rate and 1 truck per day. The gate side guides and invert assumed having a minimum weight of 4 lbs./ft. for wall mounted and 3 lbs./ft. for embedded in concrete. The gate invert should contain a removable neoprene seal. Including stop log grooves, lifter, guide - weight around 136,000 lbs.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.078		**Project**	: JCBOYLE		
Description	: Remove Traveling Water Screen					
Quantity	: 124,000.00 lbs					
Daily Production	: 30,000.00 lbs per	8 hour shift	**Project #**	: Klamath Dams Removal		
Work Days	: 4.1 Days		**Estimator**	: Mihaela Tomulescu	**lbs per**	**Total Cost**
Unit Price	: $0.50 per lbs		**Probable Low Cost Parameter**		33000	$56,258
Total Cost	: $62,509		**Probable High Cost Parameter**		22500	$78,136

	Unit Price Per lbs
Probable Low Cost Parameter	$0.45
Probable High Cost Parameter	$0.63

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	4.1	8	65.60	L	$46.27	incl. in rate	incl. in rate	$3,035.31
Electrician	Active	1.00	4.1	8	32.80	L	$45.23	incl. in rate	incl. in rate	$1,483.54
Ironworkers	Active	6.00	4.1	8	196.80	L	$63.95	incl. in rate	incl. in rate	$12,585.36
Loader, FE Rubber Tire (8.6cy)	Active	1.00	4.1	8	32.80	E	$221.50	incl. in rate	incl. in rate	$7,265.20
Truck Driver (heavy)	Active	2.00	4.1	8	65.60	L	$57.59	incl. in rate	incl. in rate	$3,777.90
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	4.1	8	65.60	E	$111.64	incl. in rate	incl. in rate	$7,323.58
Hydraulic Crane (120tn)	Active	1.00	4.1	8	32.80	E	$239.06	incl. in rate	incl. in rate	$7,841.17
Welder	Active	2.00	4.1	8	65.60	L	$7.84	incl. in rate	incl. in rate	$514.14
Gas Welding Machine	Active	2.00	4.1	8	65.60	E	$2.88	incl. in rate	incl. in rate	$188.73
Equipment Operator (medium)	Active	1.00	4.1	8	32.80	L	$66.28	incl. in rate	incl. in rate	$2,173.98
Equipment Operator (crane)	Active	1.00	4.1	8	32.80	L	$68.41	incl. in rate	incl. in rate	$2,243.85
				Labor Hours	**492**				**TOTAL LABOR**	**$25,814.09**
				Equipment Hours	**196.8**				**TOTAL EQUIPMENT**	**$22,618.68**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,290.70	$1,290.70
					TOTAL MATERIAL	**$1,290.70**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$25,814.09	Labor Burden @	49.7%	$0.00	$25,814.09
Material Cost	$1,290.70	Material Tax @	7.8%	$100.03	$1,390.73
Equipment Cost	$22,618.68	Equipment Tax @	0.0%	$0.00	$22,618.68
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$49,723**			**$100**	**DIRECT COST SUBTOTALS** **$49,824**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$49,823.51	$7,473.53
Installing Contractors Profit@	8.0%				$49,823.51	$3,985.88
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$11,459.41**
General Contractors Insurance @	1.0%		on		$61,282.92	$613
Bond @	1.0%		on		$61,282.92	$613
Contingency @	0.0%		on		$62,508.57	$0
					TOTAL COST for pay item	**$62,509**

Additional Pay Item Notes :

Used RS Means Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal.

PAY ITEM COST DETAIL WORKSHEET — **1.079 Remove Fish By-Pass and Supports (steel)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.079		**Project**	: JC Boyle			
Description	:	Remove Fish By-Pass and Supports (steel)						
Quantity	:	610,000.00	lb					
Daily Production	:	20,000.00	lb per 8 hour shift	**Project #**	: 1			
Work Days	:	30.5	Days	**Estimator**	: Felipe Poletto	**lb per**	**Total Cost**	**Unit Price Per lb**
Unit Price	:	$0.77	per lb	**Probable Low Cost Parameter**		**22000**	**$422,080**	**$0.69**
Total Cost	:	$468,978		**Probable High Cost Parameter**		**17000**	**$539,325**	**$0.88**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	30.5	8	244.00	L	$48.27	incl. in rate	incl. in rate	$11,777.88
Ironworkers	Active	3.00	30.5	8	732.00	L	$63.95	incl. in rate	incl. in rate	$46,811.40
Diver, Tender	Active	2.00	10.0	8	160.00	L	$79.22	incl. in rate	incl. in rate	$12,675.20
Diver, Wet	Active	2.00	10.0	8	160.00	L	$124.57	incl. in rate	incl. in rate	$19,931.20
Electrician Foreman	Active	1.00	30.5	8	244.00	L	$47.23	incl. in rate	incl. in rate	$11,524.12
Tugboat Captain	Active	1.00	30.5	8	244.00	L	$67.76	incl. in rate	incl. in rate	$16,533.44
Equipment Operator (crane)	Active	1.00	30.5	8	244.00	L	$68.41	incl. in rate	incl. in rate	$16,692.04
Barge Operator	Active	1.00	30.5	8	244.00	L	$68.11	incl. in rate	incl. in rate	$16,618.84
Barge (400T)	Active	3.00	30.5	8	732.00	E	$99.50	incl. in rate	incl. in rate	$72,834.00
Crawler Crane (270tn)	Active	1.00	30.5	8	244.00	E	$399.50	incl. in rate	incl. in rate	$97,478.00
Welder, Portable	Active	3.00	30.5	8	732.00	E	$7.84	incl. in rate	incl. in rate	$5,737.05
Tugboat (250hp)	Active	1.00	30.5	8	244.00	E	$88.74	incl. in rate	incl. in rate	$21,652.56
			30.5	8	0.00					$0.00
			30.5	8	0.00					$0.00
			30.5	8	0.00					$0.00
			30.5	8	0.00					$0.00
			30.5	8	0.00					$0.00
				Labor Hours	**2,272**				**TOTAL LABOR**	**$152,564.12**
				Equipment Hours	**1,952**				**TOTAL EQUIPMENT**	**$197,701.61**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$7,628.21	$7,628.21
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$7,628.21**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$152,564.12	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$152,564.12
Material Cost	$7,628.21	Material Tax @	7.75%	$591.19		$8,219.39
Equipment Cost	$197,701.61	Equipment Tax @	7.75%	$15,321.87		$213,023.48
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$357,894**			**$15,913**	**DIRECT COST SUBTOTALS**	**$373,807**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$373,807.00	$56,071.05
Installing Contractors Profit@	8.0%				$373,807.00	$29,904.56
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$85,975.61**
General Contractors Insurance @	1.0%			on	$459,782.61	$4,598
Bond @	1.0%			on	$459,782.61	$4,598
Contingency @	0.0%			on	$468,978.26	$0
					TOTAL COST for pay item	**$468,978**

Additional Pay Item Notes :

Barge is will be placed near fish bypass area, crane will attach to equipment, Iron workers will disassemble items and crane will load them on to truck for disposal. Production is affected due to the location of the recylcing plant.

PAY ITEM INFORMATION

PAY ITEM NUMBER :	1.080	Project :	JCBOYLE
Description :	Remove Gates and Hoists		
Quantity :	18,500.00 LBS		
Daily Production :	25,000.00 LBS per 8 hour shift	Project # :	Klamath Dams Removal
Work Days :	0.7 Days	Estimator :	Mihaela Tomulescu
Unit Price :	$0.48 per LBS		
Total Cost :	$8,848		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	28750	$7,521	$0.41
Probable High Cost Parameter	17500	$11,503	$0.62

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.7	8	5.60	L	$47.23	$0.00		$264.49
Electrician	Active	1.00	0.7	8	5.60	L	$45.23	$0.00		$253.29
Steelworker	Active	2.00	0.7	8	11.20	L	$65.52	$0.00		$733.82
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.7	8	5.60	E	$221.50	$221.50		$1,240.40
Truck Driver (heavy)	Active	2.00	0.7	8	11.20	L	$57.59	$0.00		$645.01
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.7	8	11.20	E	$111.64	$111.64		$1,250.37
Crawler Crane (90tn)	Active	1.00	0.7	8	5.60	E	$208.09	$208.09		$1,165.30
Welder	Active	1.00	0.7	8	5.60	L	$7.84	$0.00		$43.89
Gas Welding Machine	Active	1.00	0.7	8	5.60	E	$2.88	$2.88		$16.11
Equipment Operator (medium)	Active	1.00	0.7	8	5.60	L	$66.28	$0.00		$371.17
Equipment Operator (crane)	Active	1.00	0.7	8	5.60	L	$68.41	$0.00		$383.10
Laborer	Active	2.00	0.7	8	11.20	L	$45.80	$0.00		$512.96
				Labor Hours	61.6				TOTAL LABOR	$3,207.72
				Equipment Hours	28				TOTAL EQUIPMENT	$3,672.18

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$160.39	$160.39
					TOTAL MATERIAL	$160.39

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$3,207.72	Labor Burden @	49.7%	$0.00	$3,207.72
Material Cost	$160.39	Material Tax @	7.8%	$12.43	$172.82
Equipment Cost	$3,672.18	Equipment Tax @	0.0%	$0.00	$3,672.18
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$7,040			$12	DIRECT COST SUBTOTALS $7,053

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$7,052.72	$1,057.91
Installing Contractors Profit@	8.0%				$7,052.72	$564.22
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,622.13

General Contractors Insurance @	1.0%	on	$8,674.85	$87
Bond @	1.0%	on	$8,674.85	$87
Contingency @	0.0%	on	$8,848.34	$0
			TOTAL COST for pay item	$8,848

Additional Pay Item Notes :

Production based on crew 1 Forman, 2 Steelworkers and 1 Welder to cut and attach hooks to 2 gates and 2 hoists for disposal, 2 Laborers to rigging wire rope slings, 1 Electrician to provide power for tools, 1 Truck for disposal to Yreka facility. Assuming 1/2 days of work;

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.081	Project	: JCBOYLE		
Description	: Remove Trash rack and trash rake (steel)				
Quantity	: 47,249.00 LBS				
Daily Production	: 30,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	: 1.6 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $0.60 per LBS	Probable Low Cost Parameter		34500	$24,001	$0.51
Total Cost	: $28,236	Probable High Cost Parameter		21000	$36,707	$0.78

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.6	8	12.80	L	$46.27	$0.00		$592.26
Electrician	Active	1.00	1.6	8	12.80	L	$45.23	$0.00		$578.94
Steelworker	Active	6.00	1.6	8	76.80	L	$65.52	$0.00		$5,031.94
Hydraulic Excavator (6.0cy)	Active	1.00	1.6	8	12.80	E	$322.48	$322.48		$4,127.74
Truck Driver (heavy)	Active	1.00	1.6	8	12.80	L	$57.59	$0.00		$737.15
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.6	8	12.80	E	$111.64	$111.64		$1,428.99
Hydraulic Crane (120tn)	Active	1.00	1.6	8	12.80	E	$239.06	$239.06		$3,059.97
Welder	Active	2.00	1.6	8	25.60	L	$7.84	$0.00		$200.64
Gas Welding Machine	Active	2.00	1.6	8	25.60	E	$2.88	$2.88		$73.65
Equipment Operator (medium)	Active	2.00	1.6	8	25.60	L	$66.28	$0.00		$1,696.77
Equipment Operator (crane)	Active	1.00	1.6	8	12.80	L	$68.41	$0.00		$875.65
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	1.6	8	12.80	E	$62.72	$62.72		$802.82
				Labor Hours	179.2				TOTAL LABOR	$9,713.34
				Equipment Hours	76.8				TOTAL EQUIPMENT	$9,493.17

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, electrodes, wrenches, hard hats etc)	1.00	LS	1.000	1.00	$1,457.00	$1,457.00
					TOTAL MATERIAL	$1,457.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (25%)	2.36	ton	1.000	$595.00	$1,405.66
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	$7.25	$620.60
				TOTAL SUBCONTRACTS	$2,026.26

SUMMARY OF COSTS

Labor Cost	$9,713.34	Labor Burden @	49.7%	$0.00		$9,713.34
Material Cost	$1,457.00	Material Tax @	7.8%	$112.92		$1,569.92
Equipment Cost	$9,493.17	Equipment Tax @	0.0%	$0.00		$9,493.17
Subcontractors	$2,026.26					$2,026.26
DIRECT COST SUBTOTALS	$22,690			$113	DIRECT COST SUBTOTALS	$22,803

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$20,776.43		$3,116.47
Installing Contractors Profit@	8.0%				$20,776.43		$1,662.11
GC Markup on Subs @	5.0%				$2,026.26		$101.31
						TOTAL MARKUP COSTS	$4,879.89
General Contractors Insurance @	1.0%		on		$27,682.58		$277
Bond @	1.0%		on		$27,682.58		$277
Contingency @	0.0%		on		$28,236.24		$0
						TOTAL COST for pay item	$28,236

Additional Pay Item Notes :

The removal of gate, frame and hoist is done by one 9-men crew (1 foreman, 6 steelworkers, 1 welder, 1 electrician and 2 equipment operators). Based on the current production rate and the fact that we dispose big pieces of steel we use 1 trucks per day. Assumed hazardous waste cleanup 10% of total weight disposal.

PAY ITEM COST DETAIL WORKSHEET — **1.082 Remove stop Logs and slots (steel)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.082		Project	: JCBOYLE		
Description	: Remove stop Logs and slots (steel)					
Quantity	: 37,069.00 LBS					
Daily Production	: 30,000.00 LBS per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 1.2 Days		Estimator	: Mihaela Tomulescu		
				LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $0.62 per LBS		Probable Low Cost Parameter	34500	$19,692	$0.53
Total Cost	: $23,167		Probable High Cost Parameter	21000	$30,117	$0.81

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.2	8	9.60	L	$46.27	$0.00		$444.19
Electrician	Active	1.00	1.2	8	9.60	L	$45.23	$0.00		$434.21
Steelworker	Active	6.00	1.2	8	57.60	L	$65.52	$0.00		$3,773.95
Hydraulic Excavator (6.0cy)	Active	1.00	1.2	8	9.60	E	$322.48	$322.48		$3,095.81
Truck Driver (heavy)	Active	1.00	1.2	8	9.60	L	$57.59	$0.00		$552.86
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.2	8	9.60	E	$111.64	$111.64		$1,071.74
Hydraulic Crane (120tn)	Active	1.00	1.2	8	9.60	E	$239.06	$239.06		$2,294.98
Welder	Active	2.00	1.2	8	19.20	L	$7.84	$0.00		$150.48
Gas Welding Machine	Active	2.00	1.2	8	19.20	E	$2.88	$2.88		$55.24
Equipment Operator (medium)	Active	2.00	1.2	8	19.20	L	$66.28	$0.00		$1,272.58
Equipment Operator (crane)	Active	1.00	1.2	8	9.60	L	$68.41	$0.00		$656.74
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	1.2	8	9.60	E	$62.72	$62.72		$602.11
				Labor Hours	134.4				TOTAL LABOR	$7,285.01
				Equipment Hours	57.6				TOTAL EQUIPMENT	$7,119.88

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, electrodes, wrenches, hard hats etc)	1.00	LS	1.000	1.00	$1,092.75	$1,092.75
					TOTAL MATERIAL	$1,092.75

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	4.63	ton	1.000	$595.00	$2,757.01
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	$7.25	$620.60
				TOTAL SUBCONTRACTS	$3,377.61

SUMMARY OF COSTS

Labor Cost	$7,285.01	Labor Burden @	49.7%	$0.00		$7,285.01
Material Cost	$1,092.75	Material Tax @	7.8%	$84.69		$1,177.44
Equipment Cost	$7,119.88	Equipment Tax @	0.0%	$0.00		$7,119.88
Subcontractors	$3,377.61					$3,377.61
DIRECT COST SUBTOTALS	$18,875			$85	DIRECT COST SUBTOTALS	$18,960

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$15,582.33	$2,337.35
Installing Contractors Profit@	8.0%				$15,582.33	$1,246.59
GC Markup on Subs @	5.0%				$3,377.61	$168.88
					TOTAL MARKUP COSTS	$3,752.82
General Contractors Insurance @	1.0%		on		$22,712.75	$227
Bond @	1.0%		on		$22,712.75	$227
Contingency @	0.0%		on		$23,167.00	$0
					TOTAL COST for pay item	$23,167

Additional Pay Item Notes :

The removal of gate, frame and hoist is done by one 9-men crew (1 foreman, 6 steelworkers, 1 welder, 1 electrician and 2 equipment operators). Based on the current production rate and the fact that we dispose big pieces of steel we use 1 trucks per day. Assumed hazardous waste cleanup 25% of total weight disposal.

PAY ITEM COST DETAIL WORKSHEET **1.083 Remove & Dispose Penstocks and bifurcation (steel)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.083	Project	: JC Boyle			
Description	:	Remove & Dispose Penstocks and bifurcation (steel)					
Quantity	:	1,600,000.00 LBS					
Daily Production	:	40,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	40.0 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.70 per LBS	Probable Low Cost Parameter		46000	$945,385	$0.59
Total Cost	:	$1,112,218	Probable High Cost Parameter		32000	$1,334,661	$0.83

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	3.00	40.0	8	960.00	L	$46.27	incl. in rate	incl. in rate	$44,419.20
Steelworker	Active	12.00	40.0	8	3,840.00	L	$65.52	incl. in rate	incl. in rate	$251,596.80
Equipment Operator (crane)	Active	1.00	40.0	8	320.00	L	$68.41	incl. in rate	incl. in rate	$21,891.20
Crawler Crane (130tn)	Active	1.00	40.0	8	320.00	E	$258.66	incl. in rate	incl. in rate	$82,771.20
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	40.0	8	640.00	E	$111.64	incl. in rate	incl. in rate	$71,449.60
Hydraulic Excavator (5.0cy)	Active	1.00	40.0	8	320.00	E	$274.63	incl. in rate	incl. in rate	$87,881.60
Welder	Active	3.00	40.0	8	960.00	L	$7.84	incl. in rate	incl. in rate	$7,524.00
Gas Welding Machine	Active	2.00	40.0	8	640.00	E	$2.88	incl. in rate	incl. in rate	$1,841.27
Carpenters, Journeyman	Active	6.00	40.0	8	1,920.00	L	$65.37	incl. in rate	incl. in rate	$125,510.40
Carpenter Foreman (out)	Active	4.00	40.0	8	1,280.00	L	$46.40	incl. in rate	incl. in rate	$59,392.00
Truck Driver (heavy)	Active	2.00	40.0	8	640.00	L	$57.59	incl. in rate	incl. in rate	$36,857.60
Loader, FE Rubber Tire (3.5cy)	Active	1.00	40.0	8	320.00	E	$64.23	incl. in rate	incl. in rate	$20,553.60
	Active	1.00	40.0	8	320.00	0	$0.00	incl. in rate	incl. in rate	$0.00
				Labor Hours	9920				TOTAL LABOR	$547,191.20
				Equipment Hours	2240				TOTAL EQUIPMENT	$264,497.27

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$27,359.56	$27,359.56
					TOTAL MATERIAL	$27,359.56

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10% of total)	80.00	ton	1.000	$595.00	$47,600.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	760.89	mile	1.000	$7.25	$5,516.44
				TOTAL SUBCONTRACTS	$53,116.44

SUMMARY OF COSTS

Labor Cost	$547,191.20	Labor Burden @	49.7%	$0.00		$547,191.20
Material Cost	$27,359.56	Material Tax @	7.8%	$2,120.37		$29,479.93
Equipment Cost	$264,497.27	Equipment Tax @	0.0%	$0.00		$264,497.27
Subcontractors	$53,116.44					$53,116.44
DIRECT COST SUBTOTALS	$892,164			$2,120	DIRECT COST SUBTOTALS	$894,285

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$841,168.40		$126,175.26
Installing Contractors Profit@	8.0%				$841,168.40		$67,293.47
GC Markup on Subs @	5.0%				$53,116.44		$2,655.82
						TOTAL MARKUP COSTS	$196,124.55
General Contractors Insurance @	1.0%		on		$1,090,409.40		$10,904
Bond @	1.0%		on		$1,090,409.40		$10,904
Contingency @	0.0%		on		$1,112,217.58		$0
						TOTAL COST for pa	$1,112,218

Additional Pay Item Notes :

Removal for pipe, expansion joints and support rings using E-19 crews for demolition. 3 Crews formed from 1 Forman, 4 steelworker, 1 welder, 2 carpenters. 3 equipment operators 1 for the crane, 1 excavator and 1 loader. 2 truck driver to drive off road truck Assumed that the steel includes exterior coatings containing heavy metals so the scrap metal painted with heavy metals will be sent to Yreka salvage yard for recycling 10% of totals Lbs, average miles 85.6. Fuel charges and consumable for field repair, lubrication, tire, etc are applied.

PAY ITEM COST DETAIL WORKSHEET — **1.084 Remove & Dispose Surge Tank (steel)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.084	Project	: JCBOYLE		
Description	: Remove & Dispose Surge Tank (steel)				
Quantity	: 79,000.00 LBS				
Daily Production	: 19,750.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	: 4.0 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $0.82 per LBS	Probable Low Cost Parameter		21725	$58,000	$0.73
Total Cost	: $64,445	Probable High Cost Parameter		13825	$83,778	$1.06

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	$0.00		$1,480.64
Electrician	Active	1.00	4.0	8	32.00	L	$45.23	$0.00		$1,447.36
Steelworker	Active	6.00	4.0	8	192.00	L	$65.52	$0.00		$12,579.84
Equipment Operator (crane)	Active	1.00	4.0	8	32.00	L	$68.41	$0.00		$2,189.12
Truck Driver (heavy)	Active	3.00	4.0	8	96.00	L	$57.59	$0.00		$5,528.64
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	4.0	8	32.00	E	$111.64	$111.64		$3,572.48
Hydraulic Crane (120tn)	Active	1.00	4.0	8	32.00	E	$239.06	$239.06		$7,649.92
Welder	Active	2.00	4.0	8	64.00	L	$7.84	$0.00		$501.60
Gas Welding Machine	Active	2.00	4.0	8	64.00	E	$2.88	$2.88		$184.13
Loader, FE Rubber Tire (5.25cy)	Active	2.00	4.0	8	64.00	E	$75.42	$75.42		$4,826.88
Truck, Utility, with Man-Basket	Active	2.00	4.0	8	64.00	E	$31.90	$31.90		$2,041.60
Equipment Operator (medium)	Active	1.00	4.0	8	32.00	L	$66.28	$0.00		$2,120.96
				Labor Hours	480				TOTAL LABOR	$25,848.16
				Equipment Hours	256				TOTAL EQUIPMENT	$18,275.01

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, electrodes, wrenches, hard hats etc)	1.00	LS	1.000	1.00	$3,877.22	$3,877.22
					TOTAL MATERIAL	$3,877.22

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	3.95	ton	1.000	$595.00	$2,350.25
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	171.20	mile	1.000	$7.25	$1,241.20
				TOTAL SUBCONTRACTS	$3,591.45

SUMMARY OF COSTS

Labor Cost	$25,848.16	Labor Burden @	49.7%	$0.00	$25,848.16
Material Cost	$3,877.22	Material Tax @	7.8%	$300.48	$4,177.71
Equipment Cost	$18,275.01	Equipment Tax @	0.0%	$0.00	$18,275.01
Subcontractors	$3,591.45				$3,591.45
DIRECT COST SUBTOTALS	$51,592			$300	DIRECT COST SUBTOTALS $51,892

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$48,300.88	$7,245.13
Installing Contractors Profit@	8.0%				$48,300.88	$3,864.07
GC Markup on Subs @	5.0%				$3,591.45	$179.57
					TOTAL MARKUP COSTS	$11,288.77
General Contractors Insurance @	1.0%		on		$63,181.10	$632
Bond @	1.0%		on		$63,181.10	$632
Contingency @	0.0%		on		$64,444.72	$0
					TOTAL COST for pay item	$64,445

Additional Pay Item Notes :

The removal of surge tank, 79000 LBS is done by one 9-men crew (1 foreman, 6 steelworkers, 2 welders, 1 electrician and 4 equipment operators). Surge tank is high that's why we will use 2 trucks with basket to cut at the top. Assumed hazardous waste cleanup 10% of total weight disposal.

PAY ITEM COST DETAIL WORKSHEET — **1.085 Remove & Dispose 2 - 108" Butterfly valves**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.085	Project	: JCBOYLE
Description	: Remove & Dispose 2 - 108" Butterfly valves		
Quantity	: 148,000.00 LBS		
Daily Production	: 25,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 5.9 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $0.74 per LBS		
Total Cost	: $109,839		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	27500	$98,855	$0.67
Probable High Cost Parameter	17500	$142,790	$0.96

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	5.9	8	94.40	L	$46.27	$0.00		$4,367.89
Steelworker	Active	4.00	5.9	8	188.80	L	$65.52	$0.00		$12,370.18
Laborer	Active	4.00	5.9	8	188.80	L	$45.80	$0.00		$8,647.04
Crawler Crane (90tn)	Active	1.00	5.9	8	47.20	E	$208.09	$208.09		$9,821.85
Carpenters, Journeyman	Active	4.00	5.9	8	188.80	L	$65.37	$0.00		$12,341.86
Welder	Active	2.00	5.9	8	94.40	L	$7.84	$0.00		$739.86
Gas Welding Machine	Active	2.00	5.9	8	94.40	E	$2.88	$2.88		$271.59
Loader, FE Rubber Tire (3.5cy)	Active	2.00	5.9	8	94.40	E	$64.23	$64.23		$6,063.31
Equipment Operator (crane)	Active	1.00	5.9	8	47.20	L	$68.41	$0.00		$3,228.95
Equipment Operator (medium)	Active	1.00	5.9	8	47.20	L	$66.28	$0.00		$3,128.42
				Labor Hours	849.6				TOTAL LABOR	$44,824.19
				Equipment Hours	236				TOTAL EQUIPMENT	$16,156.75

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, electrodes, drill bits, etc)	1.00	LS	1.000	1.00	$6,723.63	$6,723.63
					TOTAL MATERIAL	$6,723.63

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (50%)	37.00	ton	1.000	37.00	$595.00	$22,015.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	85.60	mile	1.000	85.60	$7.25	$620.60
					TOTAL SUBCONTRACTS	$22,635.60

SUMMARY OF COSTS

Labor Cost	$44,824.19	Labor Burden @	49.7%	$0.00	$44,824.19
Material Cost	$6,723.63	Material Tax @	7.8%	$521.08	$7,244.71
Equipment Cost	$16,156.75	Equipment Tax @	0.0%	$0.00	$16,156.75
Subcontractors	$22,635.60				$22,635.60
DIRECT COST SUBTOTALS	$90,340			$521	DIRECT COST SUBTOTALS $90,861

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$68,225.65	$10,233.85
Installing Contractors Profit@	8.0%				$68,225.65	$5,458.05
GC Markup on Subs @	5.0%				$22,635.60	$1,131.78
					TOTAL MARKUP COSTS	$16,823.68
General Contractors Insurance @	1.0%		on		$107,684.92	$1,077
Bond @	1.0%		on		$107,684.92	$1,077
Contingency @	0.0%		on		$109,838.62	$0
					TOTAL COST for pay item	**$109,839**

Additional Pay Item Notes :

Assumed the process of removing 108" butterfly valves is done in around 6 days by 2 crew formed of 1 foreman, 2 journeymen, 2 steelworkers ;We dispose cradles with 1 trucks per day for each crew. Assumed contains paint with heavy metals 50% of the total lbs, 85.6 miles from Copco lake to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, excavator and welding machine.

PAY ITEM COST DETAIL WORKSHEET — **1.086 Remove & Dispose Gate, Stem and Frame**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.086		Project	: JCBOYLE		
Description	: Remove & Dispose Gate, Stem and Frame					
Quantity	: 28,000.00 LBS					
Daily Production	: 18,500.00 LBS per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 1.5 Days		Estimator	: Mihaela Tomulescu		
				LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $0.71 per LBS		Probable Low Cost Parameter	20350	$17,895	$0.64
Total Cost	: $19,883		Probable High Cost Parameter	14800	$23,860	$0.85

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.5	8	12.00	L	$46.27	$0.00		$555.24
Electrician	Active	1.00	1.5	8	12.00	L	$45.23	$0.00		$542.76
Steelworker	Active	6.00	1.5	8	72.00	L	$65.52	$0.00		$4,717.44
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.5	8	12.00	E	$221.50	$221.50		$2,658.00
Truck Driver (heavy)	Active	2.00	1.5	8	24.00	L	$57.59	$0.00		$1,382.16
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	1.5	8	24.00	E	$31.90	$31.90		$765.60
Hydraulic Crane (120tn)	Active	1.00	1.5	8	12.00	E	$239.06	$239.06		$2,868.72
Welder	Active	2.00	1.5	8	24.00	L	$7.84	$0.00		$188.10
Gas Welding Machine	Active	2.00	1.5	8	24.00	E	$2.88	$2.88		$69.05
Equipment Operator (medium)	Active	1.00	1.5	8	12.00	L	$66.28	$0.00		$795.36
Equipment Operator (crane)	Active	1.00	1.5	8	12.00	L	$68.41	$0.00		$820.92
				Labor Hours	168				TOTAL LABOR	$9,001.98
				Equipment Hours	72				TOTAL EQUIPMENT	$6,361.37

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$450.10	$450.10
					TOTAL MATERIAL	$450.10

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$9,001.98	Labor Burden @	49.7%	$0.00		$9,001.98
Material Cost	$450.10	Material Tax @	7.8%	$34.88		$484.98
Equipment Cost	$6,361.37	Equipment Tax @	0.0%	$0.00		$6,361.37
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$15,813			$35	DIRECT COST SUBTOTALS	$15,848

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$15,848.33		$2,377.25
Installing Contractors Profit@	8.0%				$15,848.33		$1,267.87
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$3,645.12
General Contractors Insurance @	1.0%			on	$19,493.45		$195
Bond @	1.0%			on	$19,493.45		$195
Contingency @	0.0%			on	$19,883.31		$0
						TOTAL COST for pay item	$19,883

Additional Pay Item Notes :

The removal of gate, frame and stem is done by one 9-men crew (1 foreman, 6 steelworkers, 1 welder, 1 electrician and 2 equipment operators). Based on the current production rate and the fact that we dispose big pieces of steel we use 2 trucks per day.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.087		Project	: JC Boyle		
Description	: Remove & Dispose of Steel Transition Manifolds on Upstream and Downstream					
Quantity	: 250,000.00 LBS					
Daily Production	: 30,000.00 LBS per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 8.3 Days		Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $0.64 per LBS		Probable Low Cost Parameter		34500	$136,734	$0.55
Total Cost	: $160,863		Probable High Cost Parameter		21000	$209,122	$0.84

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	8.3	8	132.80	L	$48.27	incl. in rate	incl. in rate	$6,410.26
Millwright	Active	6.00	8.3	8	398.40	L	$69.46	incl. in rate	incl. in rate	$27,672.86
Equipment Operator (crane)	Active	1.00	8.3	8	66.40	L	$68.41	incl. in rate	incl. in rate	$4,542.42
Crawler Crane (130tn)	Active	1.00	8.3	8	66.40	E	$258.66	incl. in rate	incl. in rate	$17,175.02
Electrician	Active	1.00	8.3	8	66.40	L	$45.23	incl. in rate	incl. in rate	$3,003.27
Equipment Operator (medium)	Active	1.00	8.3	8	66.40	L	$66.28	incl. in rate	incl. in rate	$4,400.99
Hydraulic Excavator (6.0cy)	Active	1.00	8.3	8	66.40	E	$322.48	incl. in rate	incl. in rate	$21,412.67
Truck Driver (heavy)	Active	2.00	8.3	8	132.80	L	$57.59	incl. in rate	incl. in rate	$7,647.95
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	8.3	8	132.80	E	$111.64	incl. in rate	incl. in rate	$14,825.79
Hydraulic Excavator (5.0cy)	Active	1.00	8.3	8	66.40	E	$274.63	incl. in rate	incl. in rate	$18,235.43
				Labor Hours	863.2				TOTAL LABOR	$53,677.76
				Equipment Hours	332				TOTAL EQUIPMENT	$71,648.92

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$2,683.89	$2,683.89
					TOTAL MATERIAL	$2,683.89

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$53,677.76	Labor Burden @	49.7%	$0.00		$53,677.76
Material Cost	$2,683.89	Material Tax @	7.8%	$208.00		$2,891.89
Equipment Cost	$71,648.92	Equipment Tax @	0.0%	$0.00		$71,648.92
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$128,011			$208	DIRECT COST SUBTOTALS	$128,219

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$128,218.57		$19,232.79
Installing Contractors Profit@	8.0%				$128,218.57		$10,257.49
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$29,490.27
General Contractors Insurance @	1.0%			on	$157,708.84		$1,577
Bond @	1.0%			on	$157,708.84		$1,577
Contingency @	0.0%			on	$160,863.02		$0
						TOTAL COST for pay item	$160,863

Additional Pay Item Notes :

Removal of steel transition manifolds using E-19 crews for demolition. 2 Crews formed from 1 Forman, 3 millwright.3 equipment operators 1 for the crane, 2 excavators. 2 truck driver to drive off road truck

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.087a	Project	: JCBOYLE		
Description	:	Remove petroleum products from Mechanical Equipment				
Quantity	:	380.00 GAL				
Daily Production	:	350.00 GAL per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	1.1 Days	Estimator	: Mihaela Tomulescu	GAL per	Total Cost	Unit Price Per GAL
Unit Price	:	$16.54 per GAL	Probable Low Cost Parameter		402.5	$5,342	$14.06
Total Cost	:	$6,284	Probable High Cost Parameter		245	$8,169	$21.50

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.1	8	8.80	L	$46.27	incl. in rate	incl. in rate	$407.18
Electrician	Active	1.00	1.1	8	8.80	L	$45.23	incl. in rate	incl. in rate	$398.02
Laborer	Active	5.00	1.1	8	44.00	L	$45.80	incl. in rate	incl. in rate	$2,015.20
Truck Driver (heavy)	Active	1.00	1.1	8	8.80	L	$57.59	incl. in rate	incl. in rate	$506.79

Labor Hours	70.4	TOTAL LABOR	$3,327.19
Equipment Hours	0	TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$166.36	$166.36
					TOTAL MATERIAL	$166.36

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
pickup, vacuum truck, stainless steel tank, 5000 gallons, minimum charge, 4 hours, 2 compartment	8.80	hour	1.000	$200.00	$1,760.00
				TOTAL SUBCONTRACTS	$1,760.00

SUMMARY OF COSTS

Labor Cost	$3,327.19	Labor Burden @	49.7%	$0.00	$3,327.19
Material Cost	$166.36	Material Tax @	7.8%	$12.89	$179.25
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00	$0.00
Subcontractors	$1,760.00				$1,760.00
DIRECT COST SUBTOTALS	$5,254			$13	DIRECT COST SUBTOTALS $5,266

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,506.44	$525.97
Installing Contractors Profit@	8.0%				$3,506.44	$280.52
GC Markup on Subs @	5.0%				$1,760.00	$88.00
					TOTAL MARKUP COSTS	$894.48
General Contractors Insurance @	1.0%		on		$6,160.93	$62
Bond @	1.0%		on		$6,160.93	$62
Contingency @	0.0%		on		$6,284.15	$0
					TOTAL COST for pay item	**$6,284**

Additional Pay Item Notes :

Petroleum-based products, ranging from fuel oil and hydraulic fluid to lubricating greases and oils, are found throughout every type of power generating plant or system. Lubrication supports bearings and moving parts in all sorts of equipment: pumps, conveyors, feeders, scrubbers, cranes, turbines, and more. A good oil/water separation system will result in a flow of concentrated waste oil to a collection area and a flow of oil-free water ready for secondary processing or discharge. Once an oil layer has been separated from free water, it must be removed for recycling or disposal. Many plants use one or more of these oil removal methods, but each has costly limitations:

1. Absorbent materials. Absorbent mats or materials are frequently used to dam up and absorb excess oils and greases resulting from accidents or the routine operation of machinery. These materials are very effective for preventing the spread of a source leak and very efficient in terms of oil pickup. Yet, their use on large volumes of waste oil results in multiple, recurring costs that can make them impractical as an everyday solution:

- the costs of the materials themselves
- the labor costs for ordering, stocking, application, and removal
- the costs of used-media collection, disposal, or re-processing/recycling.

2. Manually operated "slotted pipes." Many separators feature a "slotted pipe," a pipe located near the top of the vessel that has a horizontal opening. Oil is removed by turning the horizontal opening downward until it meets the floating oil layer, which drains through the pipe to a collection receptacle. These pipes work well on thick layers of oil, but cannot drain off a sheen of oil without draining off a large amount of water as well.

AECOM assumed the best is Vacuum truck removal method .Used a crew formed of 1 Forman, 5 Laborers to takeout the petroleum waste, 1 Electrician to unplug the power and to assure the temporary power at the construction site. Vacuum-equipped tank trucks are used to remove waste oil from collection points at plants so that it can be transported to recycling or disposal locations. If the waste oil has been thoroughly separated, highly concentrated, and stored in an appropriate receptacle, this service can be used very efficiently. However, vacuum disposal units are often used to pump oil layers directly off of water. This results in the intake of a significant amount free water along with the waste oil – and a significantly higher cost.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.097	Project	: JC Boyle
Description	: Clear and Grub Disposal Area (Embankment)		
Quantity	: 10.00 AC		
Daily Production	: 1.00 AC per 8 hour shift	Project #	: 1
Work Days	: 10.0 Days	Estimator	: Eric Jones
Unit Price	: $12,954.90 per AC		
Total Cost	: $129,549		

	AC per	Total Cost	Unit Price Per AC
Probable Low Cost Parameter	1.1	$116,594	$11,659.41
Probable High Cost Parameter	0.9	$142,504	$14,250.39

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	10.0	8	80.00	L	$46.27	incl. in rate	incl. in rate	$3,701.60
Laborer	Active	2.00	10.0	8	160.00	L	$45.80	incl. in rate	incl. in rate	$7,328.00
Equipment Operator (medium)	Active	4.00	10.0	8	320.00	L	$66.28	incl. in rate	incl. in rate	$21,209.60
Truck Driver (heavy)	Active	1.00	10.0	8	80.00	L	$57.59	incl. in rate	incl. in rate	$4,607.20
Loader, FE Rubber Tire (5.25cy)	Active	2.00	10.0	8	160.00	E	$75.42	incl. in rate	incl. in rate	$12,067.20
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	10.0	8	80.00	E	$70.35	incl. in rate	incl. in rate	$5,628.00
Hydraulic Excavator (5.0cy)	Active	2.00	10.0	8	160.00	E	$274.63	incl. in rate	incl. in rate	$43,940.80
0		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
0		2.00	10.0	8	160.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
				Labor Hours	640				TOTAL LABOR	$36,846.40
				Equipment Hours	400				TOTAL EQUIPMENT	$61,636.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$36,846.40	Labor Burden @	0.0%		$36,846.40
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$61,636.00	Equipment Tax @	7.75%	$4,776.79	$66,412.79
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$98,482			$4,777	DIRECT COST SUBTOTALS $103,259

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$103,259.19	$15,488.88
Installing Contractors Profit@	8.0%				$103,259.19	$8,260.74
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$23,749.61
General Contractors Insurance @	1.0%		on		$127,008.80	$1,270
Bond @	1.0%		on		$127,008.80	$1,270
Contingency @	0.0%		on		$129,548.98	$0
					TOTAL COST for pay item	$129,549

Additional Pay Item Notes :

Hauling material to 1/2 mile onsite dump location, 2 excavators clearing trees and brush, 2 loaders loading dump trucks, laborers will be directing trucks, foreman will oversee operation.

PAY ITEM COST DETAIL WORKSHEET

1.098 Clear and Grub, 40' width

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.098	**Project**	: JC Boyle		
Description	:	Clear and Grub, 40' width				
Quantity	:	2.40 AC				
Daily Production	:	1.00 AC per 8 hour shift	**Project #**	: 1		
Work Days	:	2.4 Days	**Estimator**	: Eric Jones	**AC per**	**Total Cost**	**Unit Price Per AC**
Unit Price	:	$12,954.90 per AC	**Probable Low Cost Parameter**		**1.1**	**$27,983**	**$11,659.41**
Total Cost	:	$31,092	**Probable High Cost Parameter**		**0.9**	**$34,201**	**$14,250.39**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.4	8	19.20	L	$46.27	incl. in rate	incl. in rate	$888.38
Laborer	Active	2.00	2.4	8	38.40	L	$45.80	incl. in rate	incl. in rate	$1,758.72
Equipment Operator (medium)	Active	4.00	2.4	8	76.80	L	$66.28	incl. in rate	incl. in rate	$5,090.30
Truck Driver (heavy)	Active	1.00	2.4	8	19.20	L	$57.59	incl. in rate	incl. in rate	$1,105.73
Loader, FE Rubber Tire (5.25cy)	Active	2.00	2.4	8	38.40	E	$75.42	incl. in rate	incl. in rate	$2,896.13
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	2.4	8	19.20	E	$70.35	incl. in rate	incl. in rate	$1,350.72
Hydraulic Excavator (5.0cy)	Active	2.00	2.4	8	38.40	E	$274.63	incl. in rate	incl. in rate	$10,545.79
0		1.00	2.4	8	19.20	0	$0.00	$0.00		$0.00
0		2.00	2.4	8	38.40	0	$0.00	$0.00		$0.00
		1.00	2.4	8	19.20	0	$0.00	$0.00		$0.00
		1.00	2.4	8	19.20	0	$0.00	$0.00		$0.00
		1.00	2.4	8	19.20	0	$0.00	$0.00		$0.00
			2.4	8	0.00					$0.00
			2.4	8	0.00					$0.00
			2.4	8	0.00					$0.00
			2.4	8	0.00					$0.00
			2.4	8	0.00					$0.00
				Labor Hours	**153.6**				**TOTAL LABOR**	**$8,843.14**
				Equipment Hours	**96**				**TOTAL EQUIPMENT**	**$14,792.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$8,843.14	Labor Burden @	0.0%			$8,843.14
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$14,792.64	Equipment Tax @	7.75%	$1,146.43		$15,939.07
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$23,636**			**$1,146**	**DIRECT COST SUBTOTALS**	**$24,782**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$24,782.21		$3,717.33
Installing Contractors Profit@	8.0%				$24,782.21		$1,982.58
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$5,699.91**
General Contractors Insurance @	1.0%		on		$30,482.11		$305
Bond @	1.0%		on		$30,482.11		$305
Contingency @	0.0%		on		$31,091.76		$0
						TOTAL COST for pay item	**$31,092**

Additional Pay Item Notes :

Hauling material to 1/2 mile onsite dump location, 2 excavators clearing trees and brush, 2 loaders loading dump trucks, laborers will be directing trucks, foreman will oversee operation.

PAY ITEM COST DETAIL WORKSHEET

1.099 4" thick gravel surfacing

PAY ITEM INFORMATION

PAY ITEM NUMBER :	1.099	**Project** : JC Boyle				
Description :	4" thick gravel surfacing					
Quantity :	2,150.00 TN					
Daily Production :	430.00 TN per 8 hour shift	**Project #** : 1				
Work Days :	5.0 Days	**Estimator** : Eric Jones		**TN per**	**Total Cost**	**Unit Price Per TN**
Unit Price :	$29.66 per TN	**Probable Low Cost Parameter**		**473**	**$57,386**	**$26.69**
Total Cost :	$63,762	**Probable High Cost Parameter**		**387**	**$70,139**	**$32.62**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (125hp)(CATD6)	Active	2.00	5.0	8	80.00	E	$82.17	incl. in rate	incl. in rate	$6,573.60
Loader, FE Rubber Tire (5.25cy)	Active	1.00	5.0	8	40.00	E	$75.42	incl. in rate	incl. in rate	$3,016.80
Truck, On-Highway Dump (6x4, 12cy)	Active	4.00	5.0	8	160.00	E	$70.35	incl. in rate	incl. in rate	$11,256.00
Roller, Single Drum (steel wheel, 12.0 - 14.9 MTn)	Active	1.00	5.0	8	40.00	E	$72.79	incl. in rate	incl. in rate	$2,911.60
Equipment Operator (light)	Active	2.00	5.0	8	80.00	L	$64.90	incl. in rate	incl. in rate	$5,192.00
Equipment Operator (medium)	Active	2.00	5.0	8	80.00	L	$66.28	incl. in rate	incl. in rate	$5,302.40
Truck Driver (heavy)	Active	4.00	5.0	8	160.00	L	$57.59	incl. in rate	incl. in rate	$9,214.40
Labor Foreman (out)	Active	1.00	5.0	8	40.00	L	$46.27	incl. in rate	incl. in rate	$1,850.80
Laborer	Active	2.00	5.0	8	80.00	L	$45.80	incl. in rate	incl. in rate	$3,664.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
				Labor Hours	**440**				**TOTAL LABOR**	**$25,223.60**
				Equipment Hours	**320**				**TOTAL EQUIPMENT**	**$23,758.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$25,223.60	Labor Burden @	0.0%			$25,223.60
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$23,758.00	Equipment Tax @	7.75%	$1,841.25		$25,599.25
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$48,982**			**$1,841**	**DIRECT COST SUBTOTALS**	**$50,823**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$50,822.85	$7,623.43
Installing Contractors Profit@	8.0%				$50,822.85	$4,065.83
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$11,689.25**
General Contractors Insurance @	1.0%		on		$62,512.10	$625
Bond @	1.0%		on		$62,512.10	$625
Contingency @	0.0%		on		$63,762.34	$0
					TOTAL COST for pay item	**$63,762**

Additional Pay Item Notes :

Production is based off of a total of 2150 total tons of material, each truck can haul 18 tons per load. Roughly 119 loads of stone hauled with 4 trucks would be 30 loads per truck. Operation lasting 5 days would mean each of the 4 trucks would have to deliver 6 loads a day or 430 tons. 1 dozer will be used to place the initial material as it is dumped from the truck, 1 dozer will be used to fine grade in sequence with the compaction roller that is stabilizing the surface coarse. Loader will be assisting operation by scooping up loose material as needed and placing it back in to the surface foot print.

PAY ITEM COST DETAIL WORKSHEET — **1.103 Soil Cover Over Concrete Rubble (Scour Hole)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.103		**Project**	: JC Boyle		
Description	:	Soil Cover Over Concrete Rubble (Scour Hole)					
Quantity	:	13,000.00	cy				
Daily Production	:	865.00	cy per 8 hour shift	**Project #**	: 1		
Work Days	:	15.0	Days	**Estimator**	: Michael Barba	**cy per**	**Total Cost** / **Unit Price Per cy**
Unit Price	:	$8.64	per cy	**Probable Low Cost Parameter**		951.5	$101,113 / $7.78
Total Cost	:	$112,348		**Probable High Cost Parameter**		692	$134,818 / $10.37

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (235hp)(CATD7)	Active	2.00	15.0	8	240.00	E	$165.11	$165.11		$39,626.40
Loader, FE Rubber Tire (5.25cy)	Active	1.00	15.0	8	120.00	E	$75.42	$75.42		$9,050.40
Equipment Operator (medium)	Active	3.00	15.0	8	360.00	L	$66.28	$0.00		$23,860.80
Laborer	Active	1.00	15.0	8	120.00	L	$45.80	$0.00		$5,496.00
Labor Foreman (out)	Active	1.00	15.0	8	120.00	L	$46.27	$0.00		$5,552.40
Truck, Pickup (4x4, 3/4tn)	Active	1.00	15.0	8	120.00	E	$16.94	$16.94		$2,032.80
	Active	1.00	15.0	8	120.00	0	$0.00	$0.00		$0.00
	Active	1.00	15.0	8	120.00	0	$0.00	$0.00		$0.00
	Active	1.00	15.0	8	120.00	0	$0.00	$0.00		$0.00
		1.00	15.0	8	120.00	0	$0.00	$0.00		$0.00
		1.00	15.0	8	120.00	0	$0.00	$0.00		$0.00
		1.00	15.0	8	120.00	0	$0.00	$0.00		$0.00
			15.0	8	0.00					$0.00
			15.0	8	0.00					$0.00
			15.0	8	0.00					$0.00
			15.0	8	0.00					$0.00
			15.0	8	0.00					$0.00
				Labor Hours	**600**				**TOTAL LABOR**	**$34,909.20**
				Equipment Hours	**480**				**TOTAL EQUIPMENT**	**$50,709.60**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
	0.00	cy	1.300	0.00	$30.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ls	1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$34,909.20	Labor Burden @	49.7%	$0.00		$34,909.20
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$50,709.60	Equipment Tax @	7.75%	$3,929.99		$54,639.59
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$85,619**			**$3,930**	**DIRECT COST SUBTOTALS**	**$89,549**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$89,548.79		$13,432.32
Installing Contractors Profit@	8.0%				$89,548.79		$7,163.90
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$20,596.22**
General Contractors Insurance @	1.0%			on	$110,145.02		$1,101
Bond @	1.0%			on	$110,145.02		$1,101
Contingency @	0.0%			on	$112,347.92		$0
						TOTAL COST for pay item	**$112,348**

Additional Pay Item Notes :

This activity will be for excavating bolders and placing soil over concrete demo material at the scour hole location.

PAY ITEM COST DETAIL WORKSHEET

1.107 Embankment Fill in Waste way (Fore bay) Scour Hole

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.107	**Project**	: JC Boyle			
Description	:	Embankment Fill in Waste way (Fore bay) Scour Hole					
Quantity	:	55,900.00 CY					
Daily Production	:	400.00 CY per 8 hour shift	**Project #**	: 1			
Work Days	:	139.8 Days	**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$77.16 per CY	**Probable Low Cost Parameter**		**440**	**$3,882,075**	**$69.45**
Total Cost	:	$4,313,417	**Probable High Cost Parameter**		**360**	**$4,744,759**	**$84.88**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (125hp)(CATD6)	Active	1.00	139.8	8	1,118.40	E	$82.17	incl. in rate	incl. in rate	$91,898.93
Hydraulic Excavator (5.0cy)	Active	3.00	139.8	8	3,355.20	E	$274.63	incl. in rate	incl. in rate	$921,438.58
Truck, On-Highway Dump (6x4, 12cy)	Active	8.00	139.8	8	8,947.20	E	$70.35	incl. in rate	incl. in rate	$629,435.52
Loader, FE Rubber Tire (5.25cy)	Active	1.00	139.8	8	1,118.40	E	$75.42	incl. in rate	incl. in rate	$84,349.73
Crawler Crane (270tn)	Active	1.00	***69.9***	8	559.20	E	$399.50	incl. in rate	incl. in rate	$223,400.40
Equipment Operator (medium)	Active	3.00	139.8	8	3,355.20	L	$66.28	incl. in rate	incl. in rate	$222,382.66
Truck Driver (heavy)	Active	10.00	139.8	8	11,184.00	L	$57.59	incl. in rate	incl. in rate	$644,086.56
Labor Foreman (out)	Active	1.00	139.8	8	1,118.40	L	$46.27	incl. in rate	incl. in rate	$51,748.37
Laborer	Active	6.00	139.8	8	6,710.40	L	$45.80	incl. in rate	incl. in rate	$307,336.32
Equipment Operator (light)	Active	1.00	139.8	8	1,118.40	L	$64.90	incl. in rate	incl. in rate	$72,584.16
Equipment Operator (crane)	Active	1.00	***69.9***	8	559.20	L	$68.41	incl. in rate	incl. in rate	$38,254.87
		1.00	139.8	8	1,118.40	0	$0.00	$0.00		$0.00
			139.8	8	0.00					$0.00
			139.8	8	0.00					$0.00
			139.8	8	0.00					$0.00
			139.8	8	0.00					$0.00
			139.8	8	0.00					$0.00
				Labor Hours	**24045.6**				**TOTAL LABOR**	**$1,336,392.94**
				Equipment Hours	**15098.4**				**TOTAL EQUIPMENT**	**$1,950,523.15**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,336,392.94	Labor Burden @	0.0%			$1,336,392.94
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$1,950,523.15	Equipment Tax @	7.75%	$151,165.54		$2,101,688.70
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$3,286,916**			**$151,166**	**DIRECT COST SUBTOTALS**	**$3,438,082**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,438,081.63	$515,712.24
Installing Contractors Profit@	8.0%				$3,438,081.63	$275,046.53
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$790,758.78**
General Contractors Insurance @	1.0%		on		$4,228,840.41	$42,288
Bond @	1.0%		on		$4,228,840.41	$42,288
Contingency @	0.0%		on		$4,313,417.22	$0
					TOTAL COST for pay item	**$4,313,417**

Additional Pay Item Notes :

Each dump truck will be able to haul 10 CY per load which will be 5590 loads of material. 8 trucks will be hauling 5 loads a day or 500 CY per day. Production is lower than usual due to placing material in a critical area that will need extra safety observation. A crane will need to be mobilized to fly excavators to bottom of scour hole and to fly them out once filled. 1 excavators and 1 dozer will be placed up top to manage the delivery of the material and 2 excavators will be placed at the bottom managing material placement. Laborers will directing truck traffic and spotting in critical areas at the top and the bottom.

PAY ITEM INFORMATION

PAY ITEM NUMBER :	1.108	Project : JC Boyle			
Description :	Topsy Recreational Area - Concrete total				
Quantity :	68.00 CY				
Daily Production :	34.00 CY per 8 hour shift	Project # : 1			
Work Days :	2.0 Days	Estimator : Eric Jones	CY per	Total Cost	Unit Price Per CY
Unit Price :	$454.68 per CY	Probable Low Cost Parameter	35.7	$29,372	$431.94
Total Cost :	$30,918	Probable High Cost Parameter	30.6	$34,010	$500.14

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	2.00	2.0	8	32.00	E	$274.63	incl. in rate	incl. in rate	$8,788.16
Loader, FE Rubber Tire (5.25cy)	Active	1.00	2.0	8	16.00	E	$75.42	incl. in rate	incl. in rate	$1,206.72
Truck, On-Highway Dump (6x4, 12cy)	Active	3.00	2.0	8	48.00	E	$70.35	incl. in rate	incl. in rate	$3,376.80
Truck, Pickup (4x4, 3/4tn)	Active	1.00	2.0	8	16.00	E	$16.94	incl. in rate	incl. in rate	$271.04
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	2.0	8	16.00	E	$62.72	incl. in rate	incl. in rate	$1,003.52
Truck Driver (heavy)	Active	3.00	2.0	8	48.00	L	$57.59	incl. in rate	incl. in rate	$2,764.32
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Laborer	Active	3.00	2.0	8	48.00	L	$45.80	incl. in rate	incl. in rate	$2,198.40
Equipment Operator (light)	Active	1.00	2.0	8	16.00	L	$64.90	incl. in rate	incl. in rate	$1,038.40
Equipment Operator (medium)	Active	2.00	2.0	8	32.00	L	$66.28	incl. in rate	incl. in rate	$2,120.96
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
				Labor Hours	160				TOTAL LABOR	$8,862.40
				Equipment Hours	128				TOTAL EQUIPMENT	$14,646.24

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$8,862.40	Labor Burden @	0.0%			$8,862.40
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$14,646.24	Equipment Tax @	7.75%	$1,135.08		$15,781.32
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$23,509			$1,135	DIRECT COST SUBTOTALS	$24,644

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$24,643.72	$3,696.56
Installing Contractors Profit@	8.0%				$24,643.72	$1,971.50
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$5,668.06
General Contractors Insurance @	1.0%		on		$30,311.78	$303
Bond @	1.0%		on		$30,311.78	$303
Contingency @	0.0%		on		$30,918.02	$0
					TOTAL COST for pay item	$30,918

Additional Pay Item Notes :

1 excavator and breaker will be used to break up the concrete items, 1 excavator will stock pile the broken material, 1 FE loader will assist in loading trucks and maintain haul road, laborers will direct truck/ equipment traffic and assist the equipment for demolition, foreman will oversee operation. Material produced will be 7 loads of material, 3 trucks will be used to ensure the demolition team always has a truck to load in to.

PAY ITEM COST DETAIL WORKSHEET **1.109 Topsy Recreational Area - 6'x80' Floating dock made of lumber and composite decking**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.109	**Project**	: JC Boyle			
Description	:	Topsy Recreational Area - 6'x80' Floating dock made of lumber and composite decking					
Quantity	:	1.00 EA					
Daily Production	:	1.00 EA per 8 hour shift	**Project #**	: 1			
Work Days	:	1.0 Days	**Estimator**	: Eric Jones	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$8,816.20 per EA	**Probable Low Cost Parameter**		**1.05**	**$8,375**	**$8,375.39**
Total Cost	:	$8,816	**Probable High Cost Parameter**		**0.95**	**$9,257**	**$9,257.01**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (80tn)	Active	1.00	1.0	8	8.00	E	$190.46	incl. in rate	incl. in rate	$1,523.68
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	1.0	8	24.00	E	$31.90	incl. in rate	incl. in rate	$765.60
Truck Driver (heavy)	Active	3.00	1.0	8	24.00	L	$57.59	incl. in rate	incl. in rate	$1,382.16
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Laborer	Active	3.00	1.0	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Carpenters	Active	2.00	1.0	8	16.00	L	$72.60	incl. in rate	incl. in rate	$1,161.60
0		2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**80**				**TOTAL LABOR**	**$4,560.40**
				Equipment Hours	**32**				**TOTAL EQUIPMENT**	**$2,289.28**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$4,560.40	Labor Burden @	0.0%				$4,560.40
Material Cost	$0.00	Material Tax @	7.75%	$0.00			$0.00
Equipment Cost	$2,289.28	Equipment Tax @	7.75%	$177.42			$2,466.70
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	**$6,850**			**$177**		**DIRECT COST SUBTOTALS**	**$7,027**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$7,027.10		$1,054.06
Installing Contractors Profit@	8.0%				$7,027.10		$562.17
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$1,616.23**
General Contractors Insurance @	1.0%		on		$8,643.33		$86
Bond @	1.0%		on		$8,643.33		$86
Contingency @	0.0%		on		$8,816.20		$0
						TOTAL COST for pay item	**$8,816**

Additional Pay Item Notes :

Carpenters and laborers will be on ground disassembling the dock and rigging dock pieces to crane. Crane will load floating dock on to truck to haul off. Figured 3 trucks 1 load per truck.

PAY ITEM COST DETAIL WORKSHEET **1.110 Topsy Recreational Area - 5'x20' Walkway leading to hex fishing platform**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.110	**Project**	: JC Boyle		
Description	:	Topsy Recreational Area - 5'x20' Walkway leading to hex fishing platform				
Quantity	:	200.00 SF				
Daily Production	:	400.00 SF per 8 hour shift	**Project #**	: 1		
Work Days	:	0.5 Days	**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$10.02 per SF	**Probable Low Cost Parameter**		**420**	**$1,904**	**$9.52**
Total Cost	:	$2,005	**Probable High Cost Parameter**		**380**	**$2,105**	**$10.52**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	0.5	8	4.00	E	$54.70	incl. in rate	incl. in rate	$218.80
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.5	8	4.00	E	$31.90	incl. in rate	incl. in rate	$127.60
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	incl. in rate	incl. in rate	$259.60
Labor Foreman (out)	Active	1.00	0.5	8	4.00	L	$46.27	incl. in rate	incl. in rate	$185.08
Laborer	Active	3.00	0.5	8	12.00	L	$45.80	incl. in rate	incl. in rate	$549.60
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		2.00	0.5	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
				Labor Hours	**24**				**TOTAL LABOR**	**$1,224.64**
				Equipment Hours	**8**				**TOTAL EQUIPMENT**	**$346.40**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,224.64	Labor Burden @	0.0%			$1,224.64
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$346.40	Equipment Tax @	7.75%	$26.85		$373.25
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,571**			**$27**	**DIRECT COST SUBTOTALS**	**$1,598**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,597.89	$239.68
Installing Contractors Profit@	8.0%				$1,597.89	$127.83
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$367.51**
General Contractors Insurance @	1.0%		on		$1,965.40	$20
Bond @	1.0%		on		$1,965.40	$20
Contingency @	0.0%		on		$2,004.71	$0
					TOTAL COST for pay item	**$2,005**

Additional Pay Item Notes :

Laborers will assist equipment operator with loading walkway on truck. Forklift will load truck and take walk way to disposal area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.111	Project	: JC Boyle			
Description	: Topsy Recreational Area - Regrade to natural contour					
Quantity	: 300.00 SF					
Daily Production	: 300.00 SF per 8 hour shift	Project #	: 1			
Work Days	: 1.0 Days	Estimator	: Eric Jones	SF per	Total Cost	Unit Price Per SF
Unit Price	: $14.63 per SF	Probable Low Cost Parameter		315	$4,171	$13.90
Total Cost	: $4,390	Probable High Cost Parameter		270	$4,829	$16.10

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (125hp)(CATD6)	Active	1.00	1.0	8	8.00	E	$82.17	incl. in rate	incl. in rate	$657.36
Roller, Single Drum (steel wheel, 12.0 - 14.9 MTn)	Active	1.00	1.0	8	8.00	E	$72.79	incl. in rate	incl. in rate	$582.32
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
	Active	0.00	1.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	0.00	1.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	40				TOTAL LABOR	$2,163.44
				Equipment Hours	16				TOTAL EQUIPMENT	$1,239.68

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,163.44	Labor Burden @		0.0%			$2,163.44
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$1,239.68	Equipment Tax @		7.75%	$96.08		$1,335.76
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$3,403				$96	DIRECT COST SUBTOTALS	$3,499
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$3,499.20		$524.88
Installing Contractors Profit@	8.0%				$3,499.20		$279.94
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$804.81
General Contractors Insurance @	1.0%			on	$4,304.01		$43
Bond @	1.0%			on	$4,304.01		$43
Contingency @	0.0%			on	$4,390.09		$0
						TOTAL COST for pay item	$4,390

Additional Pay Item Notes :

It will take 1 day using 1 dozer and 1 roller to regrade area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.112	Project	: JC Boyle		
Description	:	Pioneer Park - Picnic tables to be removed and hauled away				
Quantity	:	12.00 EA				
Daily Production	:	24.00 EA per 8 hour shift	Project #	: 1		
Work Days	:	0.5 Days	Estimator	: Eric Jones		
				EA per	Total Cost	Unit Price Per EA
Unit Price	:	$156.62 per EA	Probable Low Cost Parameter	25.2	$1,785	$148.79
Total Cost	:	$1,879	Probable High Cost Parameter	22.8	$1,973	$164.45

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	0.5	8	4.00	E	$54.70	incl. in rate	incl. in rate	$218.80
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.5	8	4.00	E	$31.90	incl. in rate	incl. in rate	$127.60
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	incl. in rate	incl. in rate	$259.60
Roller, Single Drum (steel wheel, 12.0 - 14.9 MTn)	Active	1.00	0.5	8	4.00	E	$72.79	incl. in rate	incl. in rate	$291.16
Labor Foreman (out)	Active	1.00	0.5	8	4.00	L	$46.27	incl. in rate	incl. in rate	$185.08
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
				Labor Hours	16				TOTAL LABOR	$811.08
				Equipment Hours	12				TOTAL EQUIPMENT	$637.56

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$811.08	Labor Burden @	0.0%			$811.08
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$637.56	Equipment Tax @	7.75%	$49.41		$686.97
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$1,449			$49	DIRECT COST SUBTOTALS	$1,498

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,498.05	$224.71
Installing Contractors Profit@	8.0%				$1,498.05	$119.84
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$344.55
General Contractors Insurance @	1.0%		on		$1,842.60	$18
Bond @	1.0%		on		$1,842.60	$18
Contingency @	0.0%		on		$1,879.45	$0
					TOTAL COST for pay item	$1,879

Additional Pay Item Notes :

Fork lift to place table on truck, Laborers to rig tables to forklift and to guide during the lift, Foreman to run the crew.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.113	**Project**	: JC Boyle		
Description	:	Pioneer Park - 12 Concrete fire rings				
Quantity	:	5.00 CY				
Daily Production	:	15.00 CY per 8 hour shift	**Project #**	: 1		
Work Days	:	0.3 Days	**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$353.89 per CY	**Probable Low Cost Parameter**		**15.75**	**$1,681**	**$336.20**
Total Cost	:	$1,769	**Probable High Cost Parameter**		**14.25**	**$1,858**	**$371.59**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	1.00	0.3	8	2.40	E	$274.63	incl. in rate	incl. in rate	$659.11
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	0.3	8	2.40	E	$70.35	incl. in rate	incl. in rate	$168.84
Equipment Operator (medium)	Active	1.00	0.3	8	2.40	L	$66.28	incl. in rate	incl. in rate	$159.07
Labor Foreman (out)	Active	1.00	0.3	8	2.40	L	$46.27	incl. in rate	incl. in rate	$111.05
Laborer	Active	1.00	0.3	8	2.40	L	$45.80	incl. in rate	incl. in rate	$109.92
Truck Driver (heavy)	Active	1.00	0.3	8	2.40	L	$57.59	incl. in rate	incl. in rate	$138.22
0		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
0		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
0		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
				Labor Hours	**9.6**				**TOTAL LABOR**	**$518.26**
				Equipment Hours	**4.8**				**TOTAL EQUIPMENT**	**$827.95**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$518.26	Labor Burden @	0.0%			$518.26
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$827.95	Equipment Tax @	7.75%	$64.17		$892.12
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,346**			**$64**	**DIRECT COST SUBTOTALS**	**$1,410**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,410.37	$211.56
Installing Contractors Profit@	8.0%				$1,410.37	$112.83
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$324.39**

General Contractors Insurance @	1.0%	on	$1,734.76	$17
Bond @	1.0%	on	$1,734.76	$17
Contingency @	0.0%	on	$1,769.46	$0
			TOTAL COST for pay item	**$1,769**

Additional Pay Item Notes :

The concrete fire rings will be removed to during the regrading of the area. Figured it would have a few hours to coordinate equipment and load debris in truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.114	Project	: JC Boyle		
Description	:	Pioneer Park - Portable toilets to be removed and hauled away				
Quantity	:	2.00 EA				
Daily Production	:	4.00 EA per 8 hour shift	Project #	: 1		
Work Days	:	0.5 Days	Estimator	: Eric Jones		
				EA per	Total Cost	Unit Price Per EA
Unit Price	:	$1,002.35 per EA	Probable Low Cost Parameter	4.2	$1,904	$952.24
Total Cost	:	$2,005	Probable High Cost Parameter	3.8	$2,105	$1,052.47

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	0.5	8	4.00	E	$54.70	incl. in rate	incl. in rate	$218.80
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.5	8	4.00	E	$31.90	incl. in rate	incl. in rate	$127.60
Labor Foreman (out)	Active	1.00	0.5	8	4.00	L	$46.27	incl. in rate	incl. in rate	$185.08
Laborer	Active	3.00	0.5	8	12.00	L	$45.80	incl. in rate	incl. in rate	$549.60
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	incl. in rate	incl. in rate	$259.60
		2.00	0.5	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
				Labor Hours	24				TOTAL LABOR	$1,224.64
				Equipment Hours	8				TOTAL EQUIPMENT	$346.40

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,224.64	Labor Burden @	0.0%			$1,224.64
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$346.40	Equipment Tax @	7.75%	$26.85		$373.25
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$1,571			$27	DIRECT COST SUBTOTALS	$1,598

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,597.89	$239.68
Installing Contractors Profit@	8.0%				$1,597.89	$127.83
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$367.51
General Contractors Insurance @	1.0%		on		$1,965.40	$20
Bond @	1.0%		on		$1,965.40	$20
Contingency @	0.0%		on		$2,004.71	$0
					TOTAL COST for pay item	$2,005

Additional Pay Item Notes :

Laborers will assist equipment operator with loading toilets on truck. Forklift will load truck and take walk way to disposal area.

PAY ITEM COST DETAIL WORKSHEET

1.115 Pioneer Park - Signs to be removed and hauled away

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.115	**Project**	: JC Boyle			
Description	:	Pioneer Park - Signs to be removed and hauled away					
Quantity	:	6.00 EA					
Daily Production	:	32.00 EA per 8 hour shift	**Project #**	: 1			
Work Days	:	0.2 Days	**Estimator**	: Eric Jones	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$141.12 per EA	**Probable Low Cost Parameter**		**33.6**	**$804**	**$134.06**
Total Cost	:	$847	**Probable High Cost Parameter**		**30.4**	**$889**	**$148.17**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (5.25cy)	Active	1.00	0.2	8	1.60	E	$75.42	incl. in rate	incl. in rate	$120.67
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.2	8	1.60	E	$31.90	incl. in rate	incl. in rate	$51.04
Labor Foreman (out)	Active	1.00	0.2	8	1.60	L	$46.27	incl. in rate	incl. in rate	$74.03
Laborer	Active	3.00	0.2	8	4.80	L	$45.80	incl. in rate	incl. in rate	$219.84
Truck Driver (heavy)	Active	1.00	0.2	8	1.60	L	$57.59	incl. in rate	incl. in rate	$92.14
Equipment Operator (light)	Active	1.00	0.2	8	1.60	L	$64.90	incl. in rate	incl. in rate	$103.84
		2.00	0.2	8	3.20	0	$0.00	$0.00		$0.00
0		1.00	0.2	8	1.60	0	$0.00	$0.00		$0.00
		1.00	0.2	8	1.60	0	$0.00	$0.00		$0.00
		1.00	0.2	8	1.60	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	0.2	8	1.60	0	$0.00	$0.00		$0.00
			0.2	8	0.00					$0.00
			0.2	8	0.00					$0.00
			0.2	8	0.00					$0.00
			0.2	8	0.00					$0.00
			0.2	8	0.00					$0.00
				Labor Hours	**9.6**				**TOTAL LABOR**	**$489.86**
				Equipment Hours	**3.2**				**TOTAL EQUIPMENT**	**$171.71**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$489.86	Labor Burden @	0.0%			$489.86
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$171.71	Equipment Tax @	7.75%	$13.31		$185.02
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$662**			**$13**	**DIRECT COST SUBTOTALS**	**$675**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$674.88		$101.23
Installing Contractors Profit@	8.0%				$674.88		$53.99
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$155.22**
General Contractors Insurance @	1.0%		on		$830.10		$8
Bond @	1.0%		on		$830.10		$8
Contingency @	0.0%		on		$846.70		$0
						TOTAL COST for pay item	**$847**

Additional Pay Item Notes :

It will take the above crew just under 2 hours to remove, load, and dispose existing signs.

PAY ITEM COST DETAIL WORKSHEET — **1.116 Pioneer Park - Dumpster to be removed and hauled away**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	1.116	**Project**	: JC Boyle			
Description	:	Pioneer Park - Dumpster to be removed and hauled away					
Quantity	:	1.00 EA					
Daily Production	:	2.00 EA per 8 hour shift	**Project #**	: 1			
Work Days	:	0.5 Days	**Estimator**	: Eric Jones	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$2,971.02 per EA	**Probable Low Cost Parameter**		**2.2**	**$2,674**	**$2,673.92**
Total Cost	:	$2,971	**Probable High Cost Parameter**		**1.7**	**$3,417**	**$3,416.68**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	1.00	0.5	8	4.00	E	$274.63	incl. in rate	incl. in rate	$1,098.52
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.5	8	4.00	E	$31.90	incl. in rate	incl. in rate	$127.60
Labor Foreman (out)	Active	1.00	0.5	8	4.00	L	$46.27	incl. in rate	incl. in rate	$185.08
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Equipment Operator (medium)	Active	1.00	0.5	8	4.00	L	$66.28	incl. in rate	incl. in rate	$265.12
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
		2.00	0.5	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
				Labor Hours	**20**				**TOTAL LABOR**	**$1,046.96**
				Equipment Hours	**8**				**TOTAL EQUIPMENT**	**$1,226.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA	**RSM**	$1,035.95	$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,046.96	Labor Burden @	0.0%			$1,046.96
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$1,226.12	Equipment Tax @	7.75%	$95.02		$1,321.14
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$2,273**			**$95**	**DIRECT COST SUBTOTALS**	**$2,368**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,368.10	$355.22
Installing Contractors Profit@	8.0%				$2,368.10	$189.45
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$544.66**
General Contractors Insurance @	1.0%		on		$2,912.77	$29
Bond @	1.0%		on		$2,912.77	$29
Contingency @	0.0%		on		$2,971.02	$0
					TOTAL COST for pay item	**$2,971**

Additional Pay Item Notes :

Excavator will be used to place existing dumpster on flat bed truck, laborers will assist equipment operator in the loading operation.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 1.118		Project	: JC Boyle			
Description	: Pioneer Park - Regrade to natural contour						
Quantity	: 0.50	AC					
Daily Production	: 0.25	AC per 8 hour shift	Project #	: 1			
Work Days	: 2.0	Days	Estimator	: Eric Jones	AC per	Total Cost	Unit Price Per AC
Unit Price	: $17,560.36	per AC	Probable Low Cost Parameter		0.275	$7,902	$15,804.33
Total Cost	: $8,780		Probable High Cost Parameter		0.225	$9,658	$19,316.40

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (125hp)(CATD6)	Active	1.00	2.0	8	16.00	E	$82.17	incl. in rate	incl. in rate	$1,314.72
Roller, Single Drum (steel wheel, 12.0 - 14.9 MTn)	Active	1.00	2.0	8	16.00	E	$72.79	incl. in rate	incl. in rate	$1,164.64
Equipment Operator (medium)	Active	2.00	2.0	8	32.00	L	$66.28	incl. in rate	incl. in rate	$2,120.96
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
0	Active	0.00	2.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	0.00	2.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
0		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
0		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
0		1.00	80.0	8	640.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
				Labor Hours	80				TOTAL LABOR	$4,326.88
				Equipment Hours	32				TOTAL EQUIPMENT	$2,479.36

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$4,326.88	Labor Burden @	0.0%		$4,326.88
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$2,479.36	Equipment Tax @	7.75%	$192.15	$2,671.51
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$6,806			$192	DIRECT COST SUBTOTALS $6,998

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,998.39	$1,049.76
Installing Contractors Profit@	8.0%				$6,998.39	$559.87
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,609.63
General Contractors Insurance @	1.0%		on		$8,608.02	$86
Bond @	1.0%		on		$8,608.02	$86
Contingency @	0.0%		on		$8,780.18	$0
					TOTAL COST for pay item	$8,780

Additional Pay Item Notes :

Duration is based off of grading cut to fill with dozer the first day, using roller to stabilize area.

PAY ITEM COST DETAIL WORKSHEET — **2.001 Furnish, Install, and Remove Barge-Mounted Crane in Reservoir for Dam Removal**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.001	Project	: Copco 1			
Description	: Furnish, Install, and Remove Barge-Mounted Crane in Reservoir for Dam Removal					
Quantity	: 1.00 ls					
Daily Production	: 0.10 ls per 8 hour shift	Project #	: 2			
Work Days	: 10.0 Days	Estimator	: Michael Barba	ls per	Total Cost	Unit Price Per ls
Unit Price	: $191,823.14 per ls	Probable Low Cost Parameter		0.11	$172,641	$172,640.83
Total Cost	: $191,823	Probable High Cost Parameter		0.075	$239,779	$239,778.92

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Barge (400T)	Active	1.00	10.0	8	80.00	E	$99.50	incl. in rate	incl. in rate	$7,960.00
Crawler Crane (130tn)	Active	1.00	10.0	8	80.00	E	$258.66	incl. in rate	incl. in rate	$20,692.80
Crawler Crane (270tn)	Active	1.00	10.0	8	80.00	E	$399.50	incl. in rate	incl. in rate	$31,960.00
Tugboat (250hp)	Active	1.00	10.0	8	80.00	E	$88.74	incl. in rate	incl. in rate	$7,099.20
Equipment Operator (crane)	Active	2.00	10.0	8	160.00	L	$68.41	incl. in rate	incl. in rate	$10,945.60
Equipment Operator (oiler)	Active	2.00	10.0	8	160.00	L	$62.94	incl. in rate	incl. in rate	$10,070.40
Tugboat Captain	Active	1.00	10.0	8	80.00	L	$67.76	incl. in rate	incl. in rate	$5,420.80
Tugboat Hand	Active	1.00	10.0	8	80.00	L	$45.80	incl. in rate	incl. in rate	$3,664.00
Laborer	Active	2.00	10.0	8	160.00	L	$45.80	incl. in rate	incl. in rate	$7,328.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
				Labor Hours	640				TOTAL LABOR	$37,428.80
				Equipment Hours	320				TOTAL EQUIPMENT	$67,712.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Barge Rental 3 Months	3.00	month	1.000	3.00	$9,600.00	$28,800.00
Tug Boat Rental 3 Months	3.00	month	1.000	3.00	$3,550.00	$10,650.00
	0.00	ea	1.000	0.00		$0.00
	0.00	ea	1.000	0.00		$0.00
	0.00	ls	1.000	0.00		$0.00
					TOTAL MATERIAL	$39,450.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$37,428.80	Labor Burden @	49.7%	$0.00		$37,428.80
Material Cost	$39,450.00	Material Tax @	7.75%	$3,057.38		$42,507.38
Equipment Cost	$67,712.00	Equipment Tax @	7.75%	$5,247.68		$72,959.68
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$144,591			$8,305	DIRECT COST SUBTOTALS	$152,896

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$152,895.86	$22,934.38
Installing Contractors Profit@	8.0%				$152,895.86	$12,231.67
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$35,166.05
General Contractors Insurance @	1.0%			on	$188,061.90	$1,881
Bond @	1.0%			on	$188,061.90	$1,881
Contingency @	0.0%			on	$191,823.14	$0
					TOTAL COST for pay item	$191,823

Additional Pay Item Notes :

270 TN Crane is to lift 130 TN crane onto and off of barge. 10 work days total.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.002		Project	: Copco 1		
Description	: Remove Sediment from Diversion Tunnel Intake to provide access					
Quantity	: 30.00 CY					
Daily Production	: 5.00 CY per 8 hour shift		Project #	: 2		
Work Days	: 6.0 Days		Estimator	: Eric Jones		
				CY per	Total Cost	Unit Price Per CY
Unit Price	: $3,434.68 per CY		Probable Low Cost Parameter	5.5	$92,736	$3,091.21
Total Cost	: $103,040		Probable High Cost Parameter	4	$123,649	$4,121.62

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	6.0	8	48.00	L	$46.27	incl. in rate	incl. in rate	$2,220.96
Barge Operator	Active	1.00	6.0	8	48.00	L	$40.30	incl. in rate	incl. in rate	$1,934.40
Diver, Wet	Active	4.00	6.0	8	192.00	L	$124.57	incl. in rate	incl. in rate	$23,917.44
Barge (400T)	Active	1.00	6.0	8	48.00	E	$99.50	incl. in rate	incl. in rate	$4,776.00
Laborer	Active	2.00	6.0	8	96.00	L	$45.80	incl. in rate	incl. in rate	$4,396.80
Barge, Deck Engineer, Winch Operator	Active	1.00	6.0	8	48.00	L	$64.26	incl. in rate	incl. in rate	$3,084.48
Barge (400T)	Active	4.00	6.0	8	192.00	E	$99.50	incl. in rate	incl. in rate	$19,104.00
Pump, Trash Pump, 6"+	Active	1.00	6.0	8	48.00	E	$16.11	incl. in rate	incl. in rate	$773.28
Loader, FE Rubber Tire (5.25cy)	Active	1.00	6.0	8	48.00	E	$75.42	incl. in rate	incl. in rate	$3,620.16
Equipment Operator (medium)	Active	1.00	6.0	8	48.00	L	$66.28	incl. in rate	incl. in rate	$3,181.44
		1.00	6.0	8	48.00	0	$0.00	$0.00		$0.00
		1.00	6.0	8	48.00	0	$0.00	$0.00		$0.00
6" Suction Hose	Active	1.00	6.0	8	48.00	E	$250.00	incl. in rate	incl. in rate	$12,000.00
			6.0	8	0.00					$0.00
			6.0	8	0.00					$0.00
			6.0	8	0.00					$0.00
			6.0	8	0.00					$0.00
				Labor Hours	480				TOTAL LABOR	$38,735.52
				Equipment Hours	384				TOTAL EQUIPMENT	$40,273.44

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$38,735.52	Labor Burden @		0.0%			$38,735.52
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$40,273.44	Equipment Tax @		7.75%	$3,121.19		$43,394.63
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$79,009				$3,121	DIRECT COST SUBTOTALS	$82,130
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$82,130.15		$12,319.52
Installing Contractors Profit@	8.0%				$82,130.15		$6,570.41
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$18,889.93
General Contractors Insurance @	1.0%		on		$101,020.09		$1,010
Bond @	1.0%		on		$101,020.09		$1,010
Contingency @	0.0%		on		$103,040.49		$0
						TOTAL COST for pay item	$103,040

Additional Pay Item Notes :

Using suction dredge operation and divers. Figuring 6 days to mobilize, clean diversion tunnel 115' down and then demobilize. Barge for suction dredging equipment. Trash Pump for suction of sediment. Loader to manage 30 CY of fill material. Duration is for restriction of divers being under water actually working 15 mins on bottom at a time 4 divers total giving 45 mins of rest for each diver.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.003		Project	: Copco 1		
Description	:	Furnish, Install, and Remove Large Crane on Right Abutment					
Quantity	:	1.00 LS					
Daily Production	:	1.00 LS per 8 hour shift		Project #	: 2		
Work Days	:	1.0 Days		Estimator	: Eric Jones	LS per	Total Cost	Unit Price Per LS
Unit Price	:	$566,865.71 per LS		Probable Low Cost Parameter		1.15	$481,836	$481,835.85
Total Cost	:	$566,866		Probable High Cost Parameter		0.85	$651,896	$651,895.57

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Crawler Crane (270tn)	Active	1.00	*122.0*	8	976.00	E	$399.50	incl. in rate	incl. in rate	$389,912.00
0		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
0		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
0		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
0		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
0		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
0		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
0		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
		0.00	1.0	8	0.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	0				TOTAL LABOR	$0.00
				Equipment Hours	976				TOTAL EQUIPMENT	$389,912.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Crane Mobilization	1	EA	**RSM Data Base**	$18,566.94	$18,566.94
Crane Demobilization	1	EA	**RSM Data Base**	$18,566.94	$18,566.94
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$37,133.88

SUMMARY OF COSTS

Labor Cost	$0.00	Labor Burden @	0.0%			$0.00
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$389,912.00	Equipment Tax @	7.75%	$30,218.18		$420,130.18
Subcontractors	$37,133.88					$37,133.88
DIRECT COST SUBTOTALS	$427,046			$30,218	DIRECT COST SUBTOTALS	$457,264

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$420,130.18	$63,019.53
Installing Contractors Profit@	8.0%				$420,130.18	$33,610.41
GC Markup on Subs @	5.0%				$37,133.88	$1,856.69
					TOTAL MARKUP COSTS	$98,486.64
General Contractors Insurance @	1.0%			on	$555,750.70	$5,558
Bond @	1.0%			on	$555,750.70	$5,558
Contingency @	0.0%			on	$566,865.71	$0

TOTAL COST for pay item **$566,866**

Additional Pay Item Notes :

Crane on site for 4 months, also includes the mobilization and demobilization

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.004	Project	: Copco 1
Description	: Remove Water from behind Tailrace Cofferdam		
Quantity	: 200,000.00 GAL		
Daily Production	: 153,120.00 GAL per 8 hour shift	Project #	: 2
Work Days	: 1.3 Days	Estimator	: Eric Jones
Unit Price	: $0.01 per GAL		
Total Cost	: $2,091		

	GAL per	Total Cost	Unit Price Per GAL
Probable Low Cost Parameter	168432	$1,882	$0.01
Probable High Cost Parameter	130152	$2,405	$0.01

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.3	8	10.40	L	$46.27	incl. in rate	incl. in rate	$481.21
Laborer	Active	2.00	1.3	8	20.80	L	$45.80	incl. in rate	incl. in rate	$952.64
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	1.3	8	10.40	E	$3.87	incl. in rate	incl. in rate	$40.25
Truck, Pickup (4x4, 3/4tn)	Active	1.00	1.3	8	10.40	E	$16.94	incl. in rate	incl. in rate	$176.18
		1.00	1.3	8	10.40	0	$0.00	$0.00		$0.00
0		1.00	1.3	8	10.40	0	$0.00	$0.00		$0.00
0		1.00	1.3	8	10.40	0	$0.00	$0.00		$0.00
0		1.00	1.3	8	10.40	0	$0.00	$0.00		$0.00
0		1.00	1.3	8	10.40	0	$0.00	$0.00		$0.00
		1.00	1.3	8	10.40	0	$0.00	$0.00		$0.00
		1.00	1.3	8	10.40	0	$0.00	$0.00		$0.00
		1.00	1.3	8	10.40	0	$0.00	$0.00		$0.00
Intake and Discharge Hose, 3" 20' lengths	Active	5.00	1.3	8	52.00		$2.50	incl. in rate	incl. in rate	$130.00
			1.3	8	0.00					$0.00
			1.3	8	0.00					$0.00
			1.3	8	0.00					$0.00
			1.3	8	0.00					$0.00
				Labor Hours	31.2				TOTAL LABOR	$1,433.85
				Equipment Hours	20.8				TOTAL EQUIPMENT	$216.42

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,433.85	Labor Burden @	0.0%			$1,433.85
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$216.42	Equipment Tax @	7.75%	$16.77		$233.20
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$1,650			$17	DIRECT COST SUBTOTALS	$1,667

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,667.04	$250.06
Installing Contractors Profit@	8.0%				$1,667.04	$133.36
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$383.42
General Contractors Insurance @	1.0%			on	$2,050.47	$21
Bond @	1.0%			on	$2,050.47	$21
Contingency @	0.0%			on	$2,091.47	$0

TOTAL COST for pay item **$2,091**

Additional Pay Item Notes :

Figured you would have 1 foreman with a truck and 2 laborers managing pump for gas and other maintenance. Figured 100' of discharge pipe. Based on a 3" pump being to pump 153,120 gallons per shift it will take 1.3 days to dewater area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.005		Project	: Copco 1			
Description	: Riprap Protection on Cofferdam						
Quantity	: 260.00 CY						
Daily Production	: 87.00 CY per	8 hour shift	Project #	: 2			
Work Days	: 3.0 Days		Estimator	: Eric Jones	CY per	Total Cost	Unit Price Per CY
Unit Price	: $148.31 per CY		Probable Low Cost Parameter		100.05	$32,777	$126.06
Total Cost	: $38,561		Probable High Cost Parameter		69.6	$46,273	$177.97

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.0	8	24.00	L	$46.27	incl. in rate	incl. in rate	$1,110.48
Laborer	Active	2.00	3.0	8	48.00	L	$45.80	incl. in rate	incl. in rate	$2,198.40
Equipment Operator (medium)	Active	2.00	3.0	8	48.00	L	$66.28	incl. in rate	incl. in rate	$3,181.44
Truck Driver (heavy)	Active	2.00	3.0	8	48.00	L	$57.59	incl. in rate	incl. in rate	$2,764.32
Hydraulic Excavator (5.0cy)	Active	2.00	3.0	8	48.00	E	$274.63	incl. in rate	incl. in rate	$13,182.24
Truck, On-Highway Dump (6x4, 12cy)	Active	4.00	3.0	8	96.00	E	$70.35	incl. in rate	incl. in rate	$6,753.60
0		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
0		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
0		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
		1.00	3.0	8	24.00	0	$0.00	$0.00		$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
				Labor Hours	168				TOTAL LABOR	$9,254.64
				Equipment Hours	144				TOTAL EQUIPMENT	$19,935.84

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$9,254.64	Labor Burden @	0.0%		$9,254.64
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$19,935.84	Equipment Tax @	7.75%	$1,545.03	$21,480.87
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$29,190			$1,545	DIRECT COST SUBTOTALS $30,736

	%	Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$30,735.51	$4,610.33
Installing Contractors Profit@	8.0%				$30,735.51	$2,458.84
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$7,069.17
General Contractors Insurance @	1.0%		on		$37,804.67	$378
Bond @	1.0%		on		$37,804.67	$378
Contingency @	0.0%		on		$38,560.77	$0

TOTAL COST for pay item $38,561

Additional Pay Item Notes :

Riprap is to protect temporary cofferdam during diversion tunnel releases. Riprap material is assumed to come from Iron Gate Dam removal. Two trucks will run material to stock pile, 1 excavator will supply 2nd excavator with material for placement, Each truck will be abled to haul roughly 10 CY a truck which will be 13 loads per truck, Each truck is expected to get roughly 3 loads per day for 4 days.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.006	**Project**	: Copco 1			
Description	:	Provide Dewatering behind Tailrace Cofferdam					
Quantity	:	1.00 LS					
Daily Production	:	1.00 LS per 8 hour shift	**Project #**	: 2			
Work Days	:	1.0 Days	**Estimator**	: Eric Jones	**LS per**	**Total Cost**	**Unit Price Per LS**
Unit Price	:	$89,882.80 per LS	**Probable Low Cost Parameter**		**1.1**	**$80,895**	**$80,894.52**
Total Cost	:	$89,883	**Probable High Cost Parameter**		**0.8**	**$107,859**	**$107,859.37**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	***23.0***	8	184.00	L	$46.27	incl. in rate	incl. in rate	$8,513.68
Laborer	Active	3.00	***46.0***	8	1,104.00	L	$45.80	incl. in rate	incl. in rate	$50,563.20
Pump, Submersible Trash Pump, 3" & 4"	Active	3.00	***92.0***	8	2,208.00	E	$3.87	incl. in rate	incl. in rate	$8,544.96
Truck, Pickup (4x4, 3/4tn)	Active	1.00	***23.0***	8	184.00	E	$16.94	incl. in rate	incl. in rate	$3,116.96
	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
Intake and Discharge Hose, 3" (20' lengths)	Active	5.00	***92.0***	8	3,680.00		$2.50	incl. in rate	incl. in rate	$9,200.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**1288**				**TOTAL LABOR**	**$59,076.88**
				Equipment Hours	**2392**				**TOTAL EQUIPMENT**	**$11,661.92**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$59,076.88	Labor Burden @	0.0%			$59,076.88
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$11,661.92	Equipment Tax @	7.75%	$903.80		$12,565.72
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$70,739**			**$904**	**DIRECT COST SUBTOTALS**	**$71,643**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$71,642.60		$10,746.39
Installing Contractors Profit@	8.0%				$71,642.60		$5,731.41
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$16,477.80**
General Contractors Insurance @	1.0%			on	$88,120.40		$881
Bond @	1.0%			on	$88,120.40		$881
Contingency @	0.0%			on	$89,882.80		$0
						TOTAL COST for pay item	**$89,883**

Additional Pay Item Notes :

3 pumps will be used 1 day, 1 night, and 1 back up on hand to ensure the dewatering continues during maintenance. 3 laborers to be used half of the pump time of 3 months to maintain pump (gas/maintenance). 1.5 laborers during the day and 1.5 laborers during the night shift. (1 laborer will be doing a split shift). 1 foreman 1/4 of the time to manage laborer and coordinate reposition of pumps. 100' of discharge pipe used for the entire duration of operation.

PAY ITEM COST DETAIL WORKSHEET **2.013 Install Diversion Tunnel Plugs**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.013		Project	: Copco 1		
Description	: Install Diversion Tunnel Plugs					
Quantity	: 30.00 CY					
Daily Production	: 6.00 CY per 8 hour shift		Project #	: 2		
Work Days	: 5.0 Days		Estimator	: Eric Jones	CY per	Total Cost	Unit Price Per CY
Unit Price	: $1,330.24 per CY		Probable Low Cost Parameter		6.6	$35,916	$1,197.21
Total Cost	: $39,907		Probable High Cost Parameter		5.1	$45,893	$1,529.77

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	5.0	8	40.00	L	$46.27	incl. in rate	incl. in rate	$1,850.80
Laborer	Active	2.00	5.0	8	80.00	L	$45.80	incl. in rate	incl. in rate	$3,664.00
Carpenters	Active	2.00	5.0	8	80.00	L	$72.60	incl. in rate	incl. in rate	$5,808.00
Diver, Tender	Active	2.00	5.0	8	80.00	L	$79.22	incl. in rate	incl. in rate	$6,337.60
Carpenters, Journeyman	Active	2.00	5.0	8	80.00	L	$65.37	incl. in rate	incl. in rate	$5,229.60
Equipment Operator (medium)	Active	1.00	*2.5*	8	20.00	L	$66.28	incl. in rate	incl. in rate	$1,325.60
Conc Pump (small)	Active	1.00	*2.5*	8	20.00	E	$61.43	incl. in rate	incl. in rate	$1,228.60
Truck, Pickup (4x4, 3/4tn)	Active	1.00	5.0	8	40.00	E	$16.94	incl. in rate	incl. in rate	$677.60
0		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
			5.0	8	0.00		$2.50			$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
				Labor Hours	380				TOTAL LABOR	$24,215.60
				Equipment Hours	60				TOTAL EQUIPMENT	$1,906.20

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Concrete	30.00	ea	1.050	31.50	$144.13	$4,540.10
Concrete blocks for backing	400.00	ea	1.050	420.00	$1.43	$600.60
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$5,140.70

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$24,215.60	Labor Burden @	0.0%			$24,215.60
Material Cost	$5,140.70	Material Tax @	7.75%	$398.40		$5,539.10
Equipment Cost	$1,906.20	Equipment Tax @	7.75%	$147.73		$2,053.93
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$31,262			$546	DIRECT COST SUBTOTALS	$31,809

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$31,808.63	$4,771.29
Installing Contractors Profit@	8.0%				$31,808.63	$2,544.69
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$7,315.98
General Contractors Insurance @	1.0%			on	$39,124.61	$391
Bond @	1.0%			on	$39,124.61	$391
Contingency @	0.0%			on	$39,907.11	$0
					TOTAL COST for pay item	$39,907

Additional Pay Item Notes :

Diversion plug to be installed in the dry using CMU back and concrete. Carpenters to perform work.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.014	Project	: Copco 1			
Description	: Remove Diversion Tunnel Control Structure Concrete					
Quantity	: 350.00 CY					
Daily Production	: 70.00 CY per 8 hour shift	Project #	: 2			
Work Days	: 5.0 Days	Estimator	: Eric Jones	CY per	Total Cost	Unit Price Per CY
Unit Price	: $231.13 per CY	Probable Low Cost Parameter		77	$72,805	$208.01
Total Cost	: $80,895	Probable High Cost Parameter		56	$97,074	$277.35

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	5.0	8	40.00	L	$46.27	incl. in rate	incl. in rate	$1,850.80
Laborer	Active	3.00	5.0	8	120.00	L	$45.80	incl. in rate	incl. in rate	$5,496.00
Equipment Operator (medium)	Active	3.00	5.0	8	120.00	L	$66.28	incl. in rate	incl. in rate	$7,953.60
Truck Driver (heavy)	Active	4.00	5.0	8	160.00	L	$57.59	incl. in rate	incl. in rate	$9,214.40
Truck, On-Highway Dump (6x4, 12cy)	Active	3.00	5.0	8	120.00	E	$70.35	incl. in rate	incl. in rate	$8,442.00
Hydraulic Excavator (5.0cy)	Active	2.00	5.0	8	80.00	E	$274.63	incl. in rate	incl. in rate	$21,970.40
Loader, FE Rubber Tire (5.25cy)	Active	1.00	5.0	8	40.00	E	$75.42	incl. in rate	incl. in rate	$3,016.80
Truck, Pickup (4x4, 3/4tn)	Active	1.00	5.0	8	40.00	E	$16.94	incl. in rate	incl. in rate	$677.60
Water Tanker (5,000gal)	Active	1.00	5.0	8	40.00	E	$74.56	incl. in rate	incl. in rate	$2,982.40
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
			5.0	8	0.00		$2.50			$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
				Labor Hours	440				TOTAL LABOR	$24,514.80
				Equipment Hours	320				TOTAL EQUIPMENT	$37,089.20

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$150.00	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$24,514.80	Labor Burden @		0.0%			$24,514.80
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$37,089.20	Equipment Tax @		7.75%	$2,874.41		$39,963.61
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$61,604				$2,874	DIRECT COST SUBTOTALS	$64,478
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$64,478.41		$9,671.76
Installing Contractors Profit@	8.0%				$64,478.41		$5,158.27
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$14,830.03
General Contractors Insurance @	1.0%			on	$79,308.45		$793
Bond @	1.0%			on	$79,308.45		$793
Contingency @	0.0%			on	$80,894.62		$0
						TOTAL COST for pay item	$80,895

Additional Pay Item Notes :

1 excavator for demolition operation, 1 excavator for loading trucks/ piling material, 1 Loader at demo site to manage material stockpile, 3 trucks to haul material from demo site to dump site, 3 laborers 2 to flag and 1 to support operators, 1 foreman going back an forth between demo and dump site, 1 water truck to keep dust down during hauling operation. There will be 350 CY of material hauled with three trucks which will equal 12 load per truck. Each truck is expected to haul 3 loads per day for 5 days.

PAY ITEM COST DETAIL WORKSHEET — **2.024 Remove Powerhouse Concrete down to top of rock under the Powerhouse**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.024		Project	: COPCO 1		
Description	:	Remove Powerhouse Concrete down to top of rock under the Powerhouse					
Quantity	:	3,100.00	cy				
Daily Production	:	60.00	cy per 8 hour shift	Project #	: 1		
Work Days	:	51.7	Days	Estimator	: Felipe Poletto	cy per	Total Cost	Unit Price Per cy
Unit Price	:	$387.53	per cy	Probable Low Cost Parameter		69	$1,021,133	$329.40
Total Cost	:	$1,201,333		Probable High Cost Parameter		45	$1,501,667	$484.41

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	51.7	8	827.20	L	$48.27	incl. in rate	incl. in rate	$39,928.94
Laborer	Active	8.00	51.7	8	3,308.80	L	$45.80	incl. in rate	incl. in rate	$151,543.04
Equipment Operator (medium)	Active	3.00	51.7	8	1,240.80	L	$66.28	incl. in rate	incl. in rate	$82,240.22
Truck Driver (heavy)	Active	2.00	51.7	8	827.20	L	$57.59	incl. in rate	incl. in rate	$47,638.45
Carpenters	Active	2.00	51.7	8	827.20	L	$72.60	incl. in rate	incl. in rate	$60,054.72
Equipment Operator (crane)	Active	1.00	*20.0*	8	160.00	L	$68.41	incl. in rate	incl. in rate	$10,945.60
Crawler Crane (90tn)	Active	1.00	*20.0*	8	160.00	E	$208.09	incl. in rate	incl. in rate	$33,294.40
Hydraulic Excavator (5.0cy)	Active	3.00	51.7	8	1,240.80	E	$274.63	incl. in rate	incl. in rate	$340,760.90
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	2.00	51.7	8	827.20	E	$62.72	incl. in rate	incl. in rate	$51,881.98
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	51.7	8	827.20	E	$70.35	incl. in rate	incl. in rate	$58,193.52
Truck, Pickup (4x4, 3/4tn)	Active	2.00	51.7	8	827.20	E	$16.94	incl. in rate	incl. in rate	$14,012.77
Hydraulic Thumbs/Shear Attachment	Active	1.00	51.7	8	413.60	E	$16.39	incl. in rate	incl. in rate	$6,778.90
			51.7	8	0.00					$0.00
			51.7	8	0.00					$0.00
			51.7	8	0.00					$0.00
			51.7	8	0.00					$0.00
			51.7	8	0.00					$0.00
				Labor Hours	7,191				TOTAL LABOR	$392,350.98
				Equipment Hours	4,296				TOTAL EQUIPMENT	$504,922.48

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$19,617.55	$19,617.55
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	$19,617.55

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$392,350.98	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$392,350.98
Material Cost	$19,617.55	Material Tax @	7.75%	$1,520.36		$21,137.91
Equipment Cost	$504,922.48	Equipment Tax @	7.75%	$39,131.49		$544,053.97
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$916,891			$40,652	DIRECT COST SUBTOTALS	$957,543

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$957,542.86	$143,631.43
Installing Contractors Profit@	8.0%				$957,542.86	$76,603.43
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$220,234.86
General Contractors Insurance @	1.0%			on	$1,177,777.71	$11,778
Bond @	1.0%			on	$1,177,777.71	$11,778
Contingency @	0.0%			on	$1,201,333.27	$0
					TOTAL COST for pay item	$1,201,333

Additional Pay Item Notes :

Above production is based on having two crews working simultaneously. 1 excavator will be loading material in to dump trucks, two excavators with breakers/ shears will be demolishing concrete, Laborers and Carpenters will support truck and equipment operations, 2 foremans with trucks will oversee operation. Crane will be used half of the time to support demolition as needed, Figuring the use of 2 dump trucks due to the access restrictions from the haul road size, This would mean that each dump truck will have to get 3 loads a day and with the dump site being a short distance this should be achieveable.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.012	Project	: COPCO 1
Description	: Remove Structural Steel from Spillway		
Quantity	: 55,000.00 LBS		
Daily Production	: 11,000.00 LBS per 8 hour shift	Project #	: 2
Work Days	: 5.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $1.27 per LBS		
Total Cost	: $69,659		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	12650	$59,210	$1.08
Probable High Cost Parameter	8250	$87,074	$1.58

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	5.0	8	40.00	L	$46.27	incl. in rate	incl. in rate	$1,850.80
Electrician	Active	1.00	5.0	8	40.00	L	$45.23	incl. in rate	incl. in rate	$1,809.20
Steelworker	Active	4.00	5.0	8	160.00	L	$65.52	incl. in rate	incl. in rate	$10,483.20
Laborer	Active	4.00	5.0	8	160.00	L	$45.80	incl. in rate	incl. in rate	$7,328.00
Truck Driver (heavy)	Active	2.00	5.0	8	80.00	L	$57.59	incl. in rate	incl. in rate	$4,607.20
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	5.0	8	80.00	E	$111.64	incl. in rate	incl. in rate	$8,931.20
Crawler Crane (130tn)	Active	1.00	5.0	8	40.00	E	$258.66	incl. in rate	incl. in rate	$10,346.40
Welder	Active	1.00	5.0	8	40.00	L	$7.84	incl. in rate	incl. in rate	$313.50
Gas Welding Machine	Active	1.00	5.0	8	40.00	E	$2.88	incl. in rate	incl. in rate	$115.08
Equipment Operator (crane)	Active	1.00	5.0	8	40.00	L	$68.41	incl. in rate	incl. in rate	$2,736.40
Barge, Deck Engineer, Winch Operator	Active	1.00	5.0	8	40.00	L	$64.26	incl. in rate	incl. in rate	$2,570.40
Barge, Sectional, 40'x10', includes ramp	Active	1.00	5.0	8	40.00	E	$16.48	incl. in rate	incl. in rate	$659.20

Labor Hours	600	TOTAL LABOR	$31,698.70
Equipment Hours	200	TOTAL EQUIPMENT	$20,051.88

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,584.94	$1,584.94

TOTAL MATERIAL $1,584.94

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Mobilization, barge by tug boat, small	30.00	Mile	1.000	$80.62	$2,418.60

TOTAL SUBCONTRACTS $2,418.60

SUMMARY OF COSTS

Labor Cost	$31,698.70	Labor Burden @	49.7%	$0.00	$31,698.70
Material Cost	$1,584.94	Material Tax @	7.8%	$122.83	$1,707.77
Equipment Cost	$20,051.88	Equipment Tax @	0.0%	$0.00	$20,051.88
Subcontractors	$2,418.60				$2,418.60
DIRECT COST SUBTOTALS	$55,754			$123	DIRECT COST SUBTOTALS $55,877

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$53,458.35	$8,018.75
Installing Contractors Profit@	8.0%				$53,458.35	$4,276.67
GC Markup on Subs @	5.0%				$2,418.60	$120.93

TOTAL MARKUP COSTS $12,416.35

General Contractors Insurance @	1.0%	on	$68,293.30	$683
Bond @	1.0%	on	$68,293.30	$683
Contingency @	0.0%	on	$69,659.16	$0

TOTAL COST for pay item $69,659

Additional Pay Item Notes :

Includes rails. Crews: E-19 for metals demolition, E-12 and E-25 for cutting steel and A-3H for equipment disposal using a barge and a crane.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.015	Project	: COPCO 1			
Description	: Remove & Dispose of Hand Rails at dam					
Quantity	: 11,000.00 LBS					
Daily Production	: 11,000.00 LBS per 8 hour shift	Project #	: 2			
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $1.36 per LBS	Probable Low Cost Parameter		12650	$12,681	$1.15
Total Cost	: $14,919	Probable High Cost Parameter		8800	$17,903	$1.63

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (80tn)	Active	1.00	1.0	8	8.00	E	$190.46	incl. in rate	incl. in rate	$1,523.68
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Truck Driver (light)	Active	1.00	1.0	8	8.00	L	$56.29	incl. in rate	incl. in rate	$450.32
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Millwright	Active	6.00	1.0	8	48.00	L	$69.46	incl. in rate	incl. in rate	$3,334.08
Labor Foreman	Active	2.00	1.0	8	16.00	L	$48.27	incl. in rate	incl. in rate	$772.32
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Barge Operator	Active	1.00	1.0	8	8.00	L	$40.30	incl. in rate	incl. in rate	$322.40
	Active	1.00	1.0	8	8.00	L	$64.26	incl. in rate	incl. in rate	$514.08

Labor Hours	112	TOTAL LABOR	$6,832.56
Equipment Hours	24	TOTAL EQUIPMENT	$4,188.80

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$341.63	$341.63
					TOTAL MATERIAL	$341.63

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	0.55	ton	1.000	0.55	$595.00	$327.25
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	36.00	mile	1.000	36.00	$7.25	$261.00
					TOTAL SUBCONTRACTS	$588.25

SUMMARY OF COSTS

Labor Cost	$6,832.56	Labor Burden @	49.7%	$0.00	$6,832.56
Material Cost	$341.63	Material Tax @	7.8%	$26.48	$368.10
Equipment Cost	$4,188.80	Equipment Tax @	0.0%	$0.00	$4,188.80
Subcontractors	$588.25				$588.25
DIRECT COST SUBTOTALS	$11,951			$26	DIRECT COST SUBTOTALS $11,978

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead @	15.0%				$11,389.46	$1,708.42
Installing Contractors Profit @	8.0%				$11,389.46	$911.16
GC Markup on Subs @	5.0%				$588.25	$29.41
					TOTAL MARKUP COSTS	$2,648.99
General Contractors Insurance @	1.0%		on		$14,626.70	$146
Bond @	1.0%		on		$14,626.70	$146
Contingency @	0.0%		on		$14,919.24	$0
					TOTAL COST for pay item	$14,919

Additional Pay Item Notes :

Using a barge and a crane work is done in 1 day by 2 crews (1 forman and 3 millwright). Assumed hazardous waste 10% of the total lbs, calculated 36 miles from Copco1 to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.016	Project	: COPCO 1
Description	: Remove & Dispose of Radial Gates		
Quantity	: 140,500.00 LBS		
Daily Production	: 15,000.00 LBS per 8 hour shift	Project #	: 2
Work Days	: 9.4 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $1.11 per LBS		
Total Cost	: $156,117		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	16500	$140,505	$1.00
Probable High Cost Parameter	11250	$195,146	$1.39

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (120tn)	Active	2.00	9.4	8	150.40	E	$239.06	incl. in rate	incl. in rate	$35,954.62
Millwright	Active	2.00	9.4	8	150.40	L	$69.46	incl. in rate	incl. in rate	$10,446.78
Barge (400T)	Active	1.00	9.4	8	75.20	E	$99.50	incl. in rate	incl. in rate	$7,482.40
Barge Operator	Active	1.00	9.4	8	75.20	L	$40.30	incl. in rate	incl. in rate	$3,030.56
Loader, FE Rubber Tire (5.25cy)	Active	2.00	9.4	8	150.40	E	$75.42	incl. in rate	incl. in rate	$11,343.17
Diver, Wet	Active	2.00	9.4	8	150.40	L	$124.57	incl. in rate	incl. in rate	$18,735.33
Truck, Tractor (400hp)	Active	1.00	9.4	8	75.20	E	$69.30	incl. in rate	incl. in rate	$5,211.36
Truck Driver (heavy)	Active	1.00	9.4	8	75.20	L	$57.59	incl. in rate	incl. in rate	$4,330.77
Equipment Operator (medium)	Active	4.00	9.4	8	300.80	L	$66.28	incl. in rate	incl. in rate	$19,937.02
				Labor Hours	752				TOTAL LABOR	$56,480.46
				Equipment Hours	451.2				TOTAL EQUIPMENT	$59,991.55

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Anchor Systems	4.00	ea	1.000	4.00	$215.00	$860.00
Tow Bridles	4.00	ea	1.000	4.00	$50.00	$200.00
Consumables 5% labor (saw blades, drill bits, etc)	1.00	ls	1.000	1.00	$2,824.02	$2,824.02
					TOTAL MATERIAL	$3,884.02

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	7.03	ton	1.000	7.03	$595.00	$4,179.88
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	34.00	$7.25	$246.50
					TOTAL SUBCONTRACTS	$4,426.38

SUMMARY OF COSTS

Labor Cost	$56,480.46	Labor Burden @	49.7%	$0.00		$56,480.46
Material Cost	$3,884.02	Material Tax @	7.8%	$301.01		$4,185.03
Equipment Cost	$59,991.55	Equipment Tax @	0.0%	$0.00		$59,991.55
Subcontractors	$4,426.38					$4,426.38
DIRECT COST SUBTOTALS	$124,782			$301	DIRECT COST SUBTOTALS	$125,083

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead @	15.0%				$120,657.05		$18,098.56
Installing Contractors Profit @	8.0%				$120,657.05		$9,652.56
GC Markup on Subs @	5.0%				$4,426.38		$221.32
						TOTAL MARKUP COSTS	$27,972.44
General Contractors Insurance @	1.0%		on		$153,055.87		$1,531
Bond @	1.0%		on		$153,055.87		$1,531
Contingency @	0.0%		on		$156,116.98		$0
						TOTAL COST for pay item	$156,117

Additional Pay Item Notes :

13 radial gates, wall and silplates and 3-hoists, by barge and crane. Assumed contains paint with heavy metals 10% of the total lbs, 34 miles from Copco lake to Yreka transfer recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.017		Project	: COPCO 1		
Description	:	Remove & Dispose Radial Gate Stop logs					
Quantity	:	18,000.00 LBS					
Daily Production	:	20,000.00 LBS per 8 hour shift		Project #	: 2		
Work Days	:	0.9 Days		Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.06 per LBS		Probable Low Cost Parameter		22000	$17,214	$0.96
Total Cost	:	$19,126		Probable High Cost Parameter		15000	$23,908	$1.33

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Crawler Crane (90tn)	Active	1.00	0.9	8	7.20	E	$208.09	incl. in rate	incl. in rate	$1,498.25
Equipment Operator (medium)	Active	1.00	0.9	8	7.20	L	$66.28	incl. in rate	incl. in rate	$477.22
Equipment Operator (oiler)	Active	1.00	0.9	8	7.20	L	$62.94	incl. in rate	incl. in rate	$453.17
Carpenters, Journeyman	Active	5.00	0.9	8	36.00	L	$65.37	incl. in rate	incl. in rate	$2,353.32
Truck Driver (heavy)	Active	2.00	0.9	8	14.40	L	$57.59	incl. in rate	incl. in rate	$829.30
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	0.9	8	14.40	E	$31.90	incl. in rate	incl. in rate	$459.36
Hydraulic Impact Breaker Attachment (3k-4k ft-lb)	Active	1.00	0.9	8	7.20	E	$36.58	incl. in rate	incl. in rate	$263.38
Hydraulic Excavator (6.0cy)	Active	1.00	0.9	8	7.20	E	$322.48	incl. in rate	incl. in rate	$2,321.86
Steelworker	Active	6.00	0.9	8	43.20	L	$65.52	incl. in rate	incl. in rate	$2,830.46
Laborer	Active	5.00	0.9	8	36.00	L	$45.80	incl. in rate	incl. in rate	$1,648.80
Barge Operator	Active	1.00	0.9	8	7.20	L	$40.30	incl. in rate	incl. in rate	$290.16
Barge, Deck Engineer, Winch Operator	Active	1.00	0.9	8	7.20	L	$64.26	incl. in rate	incl. in rate	$462.67
				Labor Hours	158.4				TOTAL LABOR	$9,345.10
				Equipment Hours	36				TOTAL EQUIPMENT	$4,542.84

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$467.25	$467.25
					TOTAL MATERIAL	$467.25

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Stop log lifter - Rent per day	1.00	day	1.000	1.00	$1,000.00	$1,000.00
					TOTAL SUBCONTRACTS	$1,000.00

SUMMARY OF COSTS

Labor Cost	$9,345.10	Labor Burden @	49.7%	$0.00		$9,345.10
Material Cost	$467.25	Material Tax @	7.8%	$36.21		$503.47
Equipment Cost	$4,542.84	Equipment Tax @	0.0%	$0.00		$4,542.84
Subcontractors	$1,000.00					$1,000.00
DIRECT COST SUBTOTALS	$15,355			$36	DIRECT COST SUBTOTALS	$15,391

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead @	15.0%				$14,391.40		$2,158.71
Installing Contractors Profit @	8.0%				$14,391.40		$1,151.31
GC Markup on Subs @	5.0%				$1,000.00		$50.00
						TOTAL MARKUP COSTS	$3,360.02
General Contractors Insurance @	1.0%		on		$18,751.43		$188
Bond @	1.0%		on		$18,751.43		$188
Contingency @	0.0%		on		$19,126.45		$0
						TOTAL COST for pay item	$19,126

Additional Pay Item Notes :

The process of removing toplogs is not manual, but done with hydraulic stop log lifters and hoists and is done by one 11-men crew (6 steelworkers, 4 journeymen and 4 equipment operators). Based on the current production rate and the fact that we dispose big pieces of material we use 2 trucks per day. The gate side guides and invert shall have a minimum weight of 4 lbs./ft. for wall mounted and 3 lbs./ft. for embedded in concrete that we assume we have The gate invert should contain a removable neoprene seal. Including stop log grooves, lifter, 13 set of guides - weight around 18000 lbs.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.018		Project	: COPCO 1			
Description	:	Remove & Dispose Stop log hoist, track and supports						
Quantity	:	26,000.00 LBS						
Daily Production	:	13,000.00 LBS per	8 hour shift	Project #	: 2			
Work Days	:	2.0 Days		Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.03 per LBS		Probable Low Cost Parameter		14300	$24,158	$0.93
Total Cost	:	$26,842		Probable High Cost Parameter		9750	$33,552	$1.29

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Steelworker	Active	6.00	2.0	8	96.00	L	$65.52	incl. in rate	incl. in rate	$6,289.92
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.0	8	16.00	E	$221.50	incl. in rate	incl. in rate	$3,544.00
Truck Driver (heavy)	Active	2.00	2.0	8	32.00	L	$57.59	incl. in rate	incl. in rate	$1,842.88
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	2.0	8	32.00	E	$31.90	incl. in rate	incl. in rate	$1,020.80
Hydraulic Crane (120tn)	Active	1.00	2.0	8	16.00	E	$239.06	incl. in rate	incl. in rate	$3,824.96
Welder	Active	2.00	2.0	8	32.00	L	$7.84	incl. in rate	incl. in rate	$250.80
Gas Welding Machine	Active	2.00	2.0	8	32.00	E	$2.88	incl. in rate	incl. in rate	$92.06
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	incl. in rate	incl. in rate	$1,094.56
Barge, Sectional, 40'x10', includes ramp	Active	1.00	2.0	8	16.00	E	$16.48	incl. in rate	incl. in rate	$263.68

Labor Hours	224	TOTAL LABOR	$12,002.64
Equipment Hours	112	TOTAL EQUIPMENT	$8,745.50

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$600.13	$600.13
					TOTAL MATERIAL	$600.13

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$12,002.64	Labor Burden @	49.7%	$0.00		$12,002.64
Material Cost	$600.13	Material Tax @	7.8%	$46.51		$646.64
Equipment Cost	$8,745.50	Equipment Tax @	0.0%	$0.00		$8,745.50
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$21,348			$47	DIRECT COST SUBTOTALS	$21,395

		TRUE	TRUE	FALSE	Cost Basis	
Installing Contractors Overhead @	15.0%				$21,394.79	$3,209.22
Installing Contractors Profit @	8.0%				$21,394.79	$1,711.58
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$4,920.80
General Contractors Insurance @	1.0%		on		$26,315.59	$263
Bond @	1.0%		on		$26,315.59	$263
Contingency @	0.0%		on		$26,841.90	$0
					TOTAL COST for pay item	$26,842

Additional Pay Item Notes :

The removal of stoplog hoist, track and supports is done by barge and crane with one 9-men crew (1 foreman, 6 steelworkers, 1 welder, 1 electrician and 2 equipment operators). Based on the current production rate and the fact that we dispose big pieces of steel we use 2 trucks per day.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.019	Project	: COPCO1			
Description	: Remove & Dispose of 3 sections of 23' of 72" Dia. steel lining (embedded)					
Quantity	: 54,000.00 lbs					
Daily Production	: 30,000.00 lbs per 8 hour shift	Project #	: 2			
Work Days	: 1.8 Days	Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	: $1.04 per lbs	Probable Low Cost Parameter		34500	$47,906	$0.89
Total Cost	: $56,361	Probable High Cost Parameter		24000	$67,633	$1.25

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.8	8	14.40	L	$47.23	incl. in rate	incl. in rate	$680.11
Electrician	Active	7.00	1.8	8	100.80	L	$45.23	incl. in rate	incl. in rate	$4,559.18
Ironworkers	Active	6.00	1.8	8	86.40	L	$63.95	incl. in rate	incl. in rate	$5,525.28
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.8	8	14.40	E	$221.50	incl. in rate	incl. in rate	$3,189.60
Truck Driver (heavy)	Active	2.00	1.8	8	28.80	L	$57.59	incl. in rate	incl. in rate	$1,658.59
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.8	8	28.80	E	$111.64	incl. in rate	incl. in rate	$3,215.23
Hydraulic Crane (120tn)	Active	2.00	1.8	8	28.80	E	$239.06	incl. in rate	incl. in rate	$6,884.93
Welder	Active	1.00	1.8	8	14.40	L	$7.84	incl. in rate	incl. in rate	$112.86
Gas Welding Machine	Active	1.00	1.8	8	14.40	E	$2.88	incl. in rate	incl. in rate	$41.43
Equipment Operator (medium)	Active	1.00	1.8	8	14.40	L	$66.28	incl. in rate	incl. in rate	$954.43
Equipment Operator (crane)	Active	2.00	1.8	8	28.80	L	$68.41	incl. in rate	incl. in rate	$1,970.21
				Labor Hours	288				TOTAL LABOR	$15,460.67
				Equipment Hours	86.4				TOTAL EQUIPMENT	$13,331.19

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$773.03	$773.03
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	1,000.00	LF	1.000	1,000.00	$0.85	$850.00
					TOTAL MATERIAL	$1,623.03

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (100%)	27.00	ton	1.000	27.00	$595.00	$16,065.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	108.00	mile	1.000	108.00	$7.25	$783.00
					TOTAL SUBCONTRACTS	$16,848.00

SUMMARY OF COSTS

Labor Cost	$15,460.67	Labor Burden @	49.7%	$0.00		$15,460.67
Material Cost	$1,623.03	Material Tax @	7.8%	$125.79		$1,748.82
Equipment Cost	$13,331.19	Equipment Tax @	0.0%	$0.00		$13,331.19
Subcontractors	$16,848.00					$16,848.00
DIRECT COST SUBTOTALS	$47,263			$126	DIRECT COST SUBTOTALS	$47,389

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead @	15.0%				$30,540.68		$4,581.10
Installing Contractors Profit @	8.0%				$30,540.68		$2,443.25
GC Markup on Subs @	5.0%				$16,848.00		$842.40
						TOTAL MARKUP COSTS	$7,866.76
General Contractors Insurance @	1.0%		on		$55,255.43		$553
Bond @	1.0%		on		$55,255.43		$553
Contingency @	0.0%		on		$56,360.54		$0
						TOTAL COST for pay item	$56,361

Additional Pay Item Notes :

Waste tunnel: Crews E-19 for metals demolition; E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal Assumed hazardous waste 100% of the total lbs, calculated 34 miles from Copco1 to Yreka Transfer Recycling

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.020	Project	: COPCO 1
Description	: Remove & Dispose of 3 - 72" butterfly valves (embedded)		
Quantity	: 55,000.00 lbs		
Daily Production	: 25,000.00 lbs per 8 hour shift	Project #	: 2
Work Days	: 2.2 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $1.10 per lbs		
Total Cost	: $60,293		

	lbs per	Total Cost	Unit Price Per lbs
Probable Low Cost Parameter	27500	$54,264	$0.99
Probable High Cost Parameter	21250	$69,337	$1.26

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	4.00	2.2	8	70.40	L	$48.27	incl. in rate	incl. in rate	$3,398.21
Ironworkers	Active	8.00	2.2	8	140.80	L	$63.95	incl. in rate	incl. in rate	$9,004.16
Crawler Crane (270tn)	Active	2.00	2.2	8	35.20	E	$399.50	incl. in rate	incl. in rate	$14,062.40
Equipment Operator (medium)	Active	2.00	2.2	8	35.20	L	$66.28	incl. in rate	incl. in rate	$2,333.06
Welder	Active	4.00	2.2	8	70.40	L	$7.84	incl. in rate	incl. in rate	$551.76
Gas Welding Machine	Active	4.00	2.2	8	70.40	E	$2.88	incl. in rate	incl. in rate	$202.54
Electrician	Active	2.00	2.2	8	35.20	L	$45.23	incl. in rate	incl. in rate	$1,592.10
Millwright	Active	4.00	2.2	8	70.40	L	$69.46	incl. in rate	incl. in rate	$4,889.98
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.2	8	17.60	E	$111.64	incl. in rate	incl. in rate	$1,964.86
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.2	8	17.60	E	$221.50	incl. in rate	incl. in rate	$3,898.40
Truck Driver (heavy)	Active	1.00	2.2	8	17.60	L	$57.59	incl. in rate	incl. in rate	$1,013.58
Equipment Operator (oiler)	Active	1.00	2.2	8	17.60	L	$62.94	incl. in rate	incl. in rate	$1,107.74
				Labor Hours	457.6				TOTAL LABOR	$23,890.59
				Equipment Hours	140.8				TOTAL EQUIPMENT	$20,128.20

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$2,389.06	$2,389.06
					TOTAL MATERIAL	$2,389.06

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	2.75	ton	1.000	2.75	$595.00	$1,636.25
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	11.00	mile	1.000	11.00	$7.25	$79.75
					TOTAL SUBCONTRACTS	$1,716.00

SUMMARY OF COSTS

Labor Cost	$23,890.59	Labor Burden @	49.7%	$0.00		$23,890.59
Material Cost	$2,389.06	Material Tax @	7.8%	$185.15		$2,574.21
Equipment Cost	$20,128.20	Equipment Tax @	0.0%	$0.00		$20,128.20
Subcontractors	$1,716.00					$1,716.00
DIRECT COST SUBTOTALS	$48,124			$185	DIRECT COST SUBTOTALS	$48,309

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$46,593.01	$6,988.95
Installing Contractors Profit@	8.0%				$46,593.01	$3,727.44
GC Markup on Subs @	5.0%				$1,716.00	$85.80
					TOTAL MARKUP COSTS	$10,802.19
General Contractors Insurance @	1.0%		on		$59,111.20	$591
Bond @	1.0%		on		$59,111.20	$591
Contingency @	0.0%		on		$60,293.42	$0
					TOTAL COST for pay item	$60,293

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal.Assumed hazardous waste 10% of the total lbs, calculated 34 miles from Copco1 to Yreka Transfer Recycling. Plan to open valves for diversion tunnel bypass. Once water is drawndown the valves will be removed in the dry.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.021		Project	: COPCO 1		
Description	: Remove & Dispose of 3 - 72" flapper valves with remote mechanical					
Quantity	: 78,000.00 LBS					
Daily Production	: 5,200.00 LBS per 8 hour shift		Project #	: 2		
Work Days	: 15.0 Days		Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $5.54 per LBS		Probable Low Cost Parameter		5720	$388,894	$4.99
Total Cost	: $432,104		Probable High Cost Parameter		4420	$496,920	$6.37

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	15.0	8	240.00	L	$48.27	incl. in rate	incl. in rate	$11,584.80
Crawler Crane (270tn)	Active	2.00	15.0	8	240.00	E	$399.50	incl. in rate	incl. in rate	$95,880.00
Equipment Operator (crane)	Active	2.00	15.0	8	240.00	L	$68.41	incl. in rate	incl. in rate	$16,418.40
Diver, Wet	Active	6.00	15.0	8	720.00	L	$124.57	incl. in rate	incl. in rate	$89,690.40
Diver, Tender	Active	6.00	15.0	8	720.00	L	$79.22	incl. in rate	incl. in rate	$57,038.40
Barge, Sectional, 40'x10', includes ramp	Active	1.00	15.0	8	120.00	E	$16.48	incl. in rate	incl. in rate	$1,977.60
Barge Operator	Active	1.00	15.0	8	120.00	L	$40.30	incl. in rate	incl. in rate	$4,836.00
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	15.0	8	360.00	E	$31.90	incl. in rate	incl. in rate	$11,484.00
Gas Welding Machine	Active	3.00	15.0	8	360.00	E	$2.88	incl. in rate	incl. in rate	$1,035.72
Barge, Deck Engineer, Winch Operator	Active	1.00	15.0	8	120.00	L	$64.26	incl. in rate	incl. in rate	$7,711.20
Equipment Operator (oiler)	Active	2.00	15.0	8	240.00	L	$62.94	incl. in rate	incl. in rate	$15,105.60
Truck Driver (heavy)	Active	1.00	15.0	8	120.00	L	$57.59	incl. in rate	incl. in rate	$6,910.80
				Labor Hours	2520				TOTAL LABOR	$209,295.60
				Equipment Hours	1080				TOTAL EQUIPMENT	$110,377.32

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$20,929.56	$20,929.56
					TOTAL MATERIAL	$20,929.56

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	3.90	ton	1.000	3.90	$595.00	$2,320.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	34.00	$7.25	$246.50
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	$2,567.00

SUMMARY OF COSTS

Labor Cost	$209,295.60	Labor Burden @	49.7%	$0.00		$209,295.60
Material Cost	$20,929.56	Material Tax @	7.8%	$1,622.04		$22,551.60
Equipment Cost	$110,377.32	Equipment Tax @	0.0%	$0.00		$110,377.32
Subcontractors	$2,567.00					$2,567.00
DIRECT COST SUBTOTALS	$343,169			$1,622	DIRECT COST SUBTOTALS	$344,792

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$342,224.52		$51,333.68
Installing Contractors Profit@	8.0%				$342,224.52		$27,377.96
GC Markup on Subs @	5.0%				$2,567.00		$128.35
						TOTAL MARKUP COSTS	$78,839.99
General Contractors Insurance @	1.0%			on	$423,631.51		$4,236
Bond @	1.0%			on	$423,631.51		$4,236
Contingency @	0.0%			on	$432,104.14		$0
						TOTAL COST for pay item	$432,104

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal Assumed hazardous waste 10% of the total lbs, calculated 34 miles from Copco1 to Yreka Transfer Recycling. Figuring divers will disassemble existing Flap Gates 124' underwater.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.022	Project	: COPCO 1			
Description	: Remove & Dispose of Spillway gate motor & control panel					
Quantity	: 1.00 EA					
Daily Production	: 1.00 EA per 8 hour shift	Project #	: 2			
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $1,318.63 per EA	Probable Low Cost Parameter		1.1	$1,187	$1,186.77
Total Cost	: $1,319	Probable High Cost Parameter		0.85	$1,516	$1,516.43

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
				Labor Hours	16				TOTAL LABOR	$732.80
				Equipment Hours	0				TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 0.5% labor (Side Cutter, Sharp-Nose Pliers, Sharp Tip Tweezers PCB Clamp, etc)	4.03	LS	1.000	4.03	$73.28	$295.35
					TOTAL MATERIAL	$295.35

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$732.80	Labor Burden @		49.7%	$0.00		$732.80
Material Cost	$295.35	Material Tax @		7.8%	$22.89		$318.24
Equipment Cost	$0.00	Equipment Tax @		0.0%	$0.00		$0.00
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$1,028				$23	DIRECT COST SUBTOTALS	$1,051
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,051.04		$157.66
Installing Contractors Profit@	8.0%				$1,051.04		$84.08
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$241.74
General Contractors Insurance @	1.0%		on		$1,292.78		$13
Bond @	1.0%		on		$1,292.78		$13
Contingency @	0.0%		on		$1,318.63		$0
						TOTAL COST for pay item	$1,319

Additional Pay Item Notes :

Assumed that two workers will work one day to unconnect and remove the control panel and the gate motor. They will discharge the control panel and the gate motor in an available truck used for the other scope of work on the construction site.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.023		Project	: COPCO 1		
Description	: Remove & Dispose Distribution equipment, panelboards					
Quantity	: 1.00 EA					
Daily Production	: 0.50 EA per 8 hour shift		Project #	: 2		
Work Days	: 2.0 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $5,877.55 per EA		Probable Low Cost Parameter	0.55	$5,290	$5,289.80
Total Cost	: $5,878		Probable High Cost Parameter	0.4	$7,053	$7,053.06

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.0	8	16.00	L	$47.23	incl. in rate	incl. in rate	$755.68
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Hydraulic Crane (17tn)	Active	1.00	2.0	8	16.00	E	$81.52	incl. in rate	incl. in rate	$1,304.32

Labor Hours	48	TOTAL LABOR	$2,487.36
Equipment Hours	24	TOTAL EQUIPMENT	$2,197.44

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 0.5% labor (Side Cutter, Sharp-Nose Pliers, Sharp Tip Tweezers PCB Clamp, etc)	0.00	LS	1.000	0.00	$124.37	$0.00

TOTAL MATERIAL $0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS $0.00

SUMMARY OF COSTS

Labor Cost	$2,487.36	Labor Burden @	49.7%	$0.00	$2,487.36
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$2,197.44	Equipment Tax @	0.0%	$0.00	$2,197.44
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$4,685			$0	DIRECT COST SUBTOTALS $4,685

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$4,684.80	$702.72
Installing Contractors Profit@	8.0%	☑	☑	☐	$4,684.80	$374.78
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	$1,077.50
General Contractors Insurance @	1.0%		on		$5,762.30	$58
Bond @	1.0%		on		$5,762.30	$58
Contingency @	0.0%		on		$5,877.55	$0

TOTAL COST for pay item $5,878

Additional Pay Item Notes :

Assumed that electrical crew formed of 1 Forman and 1 Electricians will work two days to unconnect and remove the distribution panels. They are going to use same crane and a truck for disposal of spillway intake, trashrake and radial motor & control panel.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.025	Project	: COPCO 1
Description	: Remove Powerhouse Structural Steel		
Quantity	: 110,000.00 lbs		
Daily Production	: 25,000.00 lbs per 8 hour shift	Project #	: 2
Work Days	: 4.4 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $1.02 per lbs		
Total Cost	: $112,188		

	lbs per	Total Cost	Unit Price Per lbs
Probable Low Cost Parameter	28750	$95,360	$0.87
Probable High Cost Parameter	20000	$134,625	$1.22

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	4.00	4.4	8	140.80	L	$48.27	incl. in rate	incl. in rate	$6,796.42
Ironworkers	Active	4.00	4.4	8	140.80	L	$63.95	incl. in rate	incl. in rate	$9,004.16
Crawler Crane (270tn)	Active	2.00	4.4	8	70.40	E	$399.50	incl. in rate	incl. in rate	$28,124.80
Equipment Operator (medium)	Active	2.00	4.4	8	70.40	L	$66.28	incl. in rate	incl. in rate	$4,666.11
Welder	Active	4.00	4.4	8	140.80	L	$7.84	incl. in rate	incl. in rate	$1,103.52
Gas Welding Machine	Active	4.00	4.4	8	140.80	E	$2.88	incl. in rate	incl. in rate	$405.08
Electrician	Active	2.00	4.4	8	70.40	L	$45.23	incl. in rate	incl. in rate	$3,184.19
Millwright	Active	4.00	4.4	8	140.80	L	$69.46	incl. in rate	incl. in rate	$9,779.97
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	4.4	8	35.20	E	$111.64	incl. in rate	incl. in rate	$3,929.73
Loader, FE Rubber Tire (8.6cy)	Active	1.00	4.4	8	35.20	E	$221.50	incl. in rate	incl. in rate	$7,796.80
Truck Driver (heavy)	Active	1.00	4.4	8	35.20	L	$57.59	incl. in rate	incl. in rate	$2,027.17
Equipment Operator (oiler)	Active	1.00	4.4	8	35.20	L	$62.94	incl. in rate	incl. in rate	$2,215.49

Labor Hours	774.4	TOTAL LABOR	$38,777.02
Equipment Hours	281.6	TOTAL EQUIPMENT	$40,256.41

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$3,877.70	$3,877.70
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	3,500.00	LF	1.000	3,500.00	$0.85	$2,975.00
					TOTAL MATERIAL	$6,852.70

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	5.50	ton	1.000	5.50	$595.00	$3,272.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	34.00	$7.25	$246.50
					TOTAL SUBCONTRACTS	$3,519.00

SUMMARY OF COSTS

Labor Cost	$38,777.02	Labor Burden @	49.7%	$0.00	$38,777.02
Material Cost	$6,852.70	Material Tax @	7.8%	$531.08	$7,383.79
Equipment Cost	$40,256.41	Equipment Tax @	0.0%	$0.00	$40,256.41
Subcontractors	$3,519.00				$3,519.00
DIRECT COST SUBTOTALS	$89,405			$531	DIRECT COST SUBTOTALS $89,936

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead @	15.0%				$86,417.22	$12,962.58
Installing Contractors Profit @	8.0%				$86,417.22	$6,913.38
GC Markup on Subs @	5.0%				$3,519.00	$175.95
					TOTAL MARKUP COSTS	$20,051.91

General Contractors Insurance @	1.0%	on	$109,988.13	$1,100
Bond @	1.0%	on	$109,988.13	$1,100
Contingency @	0.0%	on	$112,187.89	$0
			TOTAL COST for pay item	$112,188

Additional Pay Item Notes :

Includes columns, beems, crane girders, bracing, misc. shapes, roof trusses, purlins, etc. Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed hazardous waste 10% of the total lbs, calculated 34 miles from Copco1 to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.026		Project	: COPCO 1		
Description	:	Remove & Dispose of 2 - Governor Oil Systems					
Quantity	:	38,000.00 lbs					
Daily Production	:	25,000.00 lbs per 8 hour shift		Project #	: 2		
Work Days	:	1.5 Days		Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$1.07 per lbs		Probable Low Cost Parameter		27500	$36,469	$0.96
Total Cost	:	$40,521		Probable High Cost Parameter		18750	$50,651	$1.33

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	1.5	8	24.00	L	$48.27	incl. in rate	incl. in rate	$1,158.48
Ironworkers	Active	4.00	1.5	8	48.00	L	$63.95	incl. in rate	incl. in rate	$3,069.60
Crawler Crane (270tn)	Active	1.00	1.5	8	12.00	E	$399.50	incl. in rate	incl. in rate	$4,794.00
Equipment Operator (medium)	Active	1.00	1.5	8	12.00	L	$66.28	incl. in rate	incl. in rate	$795.36
Welder	Active	3.00	1.5	8	36.00	L	$7.84	incl. in rate	incl. in rate	$282.15
Gas Welding Machine	Active	3.00	1.5	8	36.00	E	$2.88	incl. in rate	incl. in rate	$103.57
Electrician	Active	2.00	1.5	8	24.00	L	$45.23	incl. in rate	incl. in rate	$1,085.52
Millwright	Active	4.00	1.5	8	48.00	L	$69.46	incl. in rate	incl. in rate	$3,334.08
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.5	8	12.00	E	$111.64	incl. in rate	incl. in rate	$1,339.68
Hydraulic Excavator (6.0cy)	Active	1.00	1.5	8	12.00	E	$322.48	incl. in rate	incl. in rate	$3,869.76
Truck Driver (heavy)	Active	1.00	1.5	8	12.00	L	$57.59	incl. in rate	incl. in rate	$691.08
Hydraulic Impact Breaker Attachment (2k-3k ft-lb)	Active	1.00	1.5	8	12.00	E	$30.85	incl. in rate	incl. in rate	$370.20
				Labor Hours	204				TOTAL LABOR	$10,416.27
				Equipment Hours	84				TOTAL EQUIPMENT	$10,477.21

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,041.63	$1,041.63
					TOTAL MATERIAL	$1,041.63

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	19.00	ton	1.000	19.00	$595.00	$11,305.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	3.000	102.00	$7.25	$739.50
					TOTAL SUBCONTRACTS	$12,044.50

SUMMARY OF COSTS

Labor Cost	$10,416.27	Labor Burden @		49.7%	$0.00		$10,416.27
Material Cost	$1,041.63	Material Tax @		7.8%	$80.73		$1,122.35
Equipment Cost	$10,477.21	Equipment Tax @		0.0%	$0.00		$10,477.21
Subcontractors	$12,044.50						$12,044.50
DIRECT COST SUBTOTALS	$33,980				$81	DIRECT COST SUBTOTALS	$34,060
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$22,015.83		$3,302.38
Installing Contractors Profit@	8.0%				$22,015.83		$1,761.27
GC Markup on Subs @	5.0%				$12,044.50		$602.23
						TOTAL MARKUP COSTS	$5,665.87
General Contractors Insurance @	1.0%		on		$39,726.20		$397
Bond @	1.0%		on		$39,726.20		$397
Contingency @	0.0%		on		$40,520.73		$0
						TOTAL COST for pay item	$40,521

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Using hydraulic impact breaker because of the sytems that are encased in concrete.Assumed hazardous waste 100% of the total lbs, calculated 34 miles from Copco1 to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.027	Project	: COPCO 1
Description	: Remove & Dispose of Cooling water and bearing oil systems		
Quantity	: 11,000.00 lbs		
Daily Production	: 11,000.00 lbs per 8 hour shift	Project #	: 2
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $3.16 per lbs		
Total Cost	: $34,710		

	lbs per	Total Cost	Unit Price Per lbs
Probable Low Cost Parameter	12100	$31,239	$2.84
Probable High Cost Parameter	8800	$41,652	$3.79

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	4.00	1.0	8	32.00	L	$48.27	incl. in rate	incl. in rate	$1,544.64
Ironworkers	Active	8.00	1.0	8	64.00	L	$63.95	incl. in rate	incl. in rate	$4,092.80
Crawler Crane (270tn)	Active	2.00	1.0	8	16.00	E	$399.50	incl. in rate	incl. in rate	$6,392.00
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Welder	Active	4.00	1.0	8	32.00	L	$7.84	incl. in rate	incl. in rate	$250.80
Gas Welding Machine	Active	4.00	1.0	8	32.00	E	$2.88	incl. in rate	incl. in rate	$92.06
Electrician	Active	2.00	1.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Millwright	Active	6.00	1.0	8	48.00	L	$69.46	incl. in rate	incl. in rate	$3,334.08
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Equipment Operator (oiler)	Active	1.00	1.0	8	8.00	L	$62.94	incl. in rate	incl. in rate	$503.52

Labor Hours	224	TOTAL LABOR	$11,970.72
Equipment Hours	64	TOTAL EQUIPMENT	$9,149.18

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,197.07	$1,197.07
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00
					TOTAL MATERIAL	$2,897.07

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	5.50	ton	1.000	5.50	$595.00	$3,272.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	3.000	102.00	$7.25	$739.50
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	$4,012.00

SUMMARY OF COSTS

Labor Cost	$11,970.72	Labor Burden @	49.7%	$0.00		$11,970.72
Material Cost	$2,897.07	Material Tax @	7.8%	$224.52		$3,121.60
Equipment Cost	$9,149.18	Equipment Tax @	0.0%	$0.00		$9,149.18
Subcontractors	$4,012.00					$4,012.00
DIRECT COST SUBTOTALS	$28,029			$225	DIRECT COST SUBTOTALS	$28,253

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$24,241.50	$3,636.22
Installing Contractors Profit@	8.0%				$24,241.50	$1,939.32
GC Markup on Subs @	5.0%				$4,012.00	$200.60
					TOTAL MARKUP COSTS	$5,776.14
General Contractors Insurance @	1.0%		on		$34,029.64	$340
Bond @	1.0%		on		$34,029.64	$340
Contingency @	0.0%		on		$34,710.24	$0
					TOTAL COST for pay item	$34,710

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 4040 LF of 1 1/2" oil pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 3 Laborers to load the pipes in the truck.The cooling and lubrication systems for the Hydroelectric Barge turbine, speed increaser and generator will be a combination of water and oil. These systems will be isolated from the water passages so that no contamination of passing water will occur.The following is a list of hazardous materials, substances, chemicals, and wastes normally found at a hydropower facility that may require disposal actions if not recycled or reused for their intended purpose:

1. Polychlorinated Biphenyls (PCBs)
2. Asbestos
3. Paint/abrasive blast grit (red lead paint)
4. Oil
5. Mercury
6. Antifreeze
7. Halogenated and non-halogenated solvents
8. Greases
9. Pesticides (includes herbicides, insecticides, and wood preservatives)
10. Petroleum contaminated
11. Chlorinated fluorocarbons (CFCs) Freon/Halon
12. Gasoline/diesel (includes product and sludge in tanks)
13. Batteries (includes acid)
14. Water treatment sludge (septic tanks/wastewater treatment) Based on the hazardous materials above assumed hazardous waste 100% of the total lbs

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.028	Project	: COPCO 1			
Description	: Remove & Dispose of 4 - Horizontal Tandem Francis Turbines					
Quantity	: 452,000.00 lbs					
Daily Production	: 30,000.00 lbs per 8 hour shift	Project #	: 2			
Work Days	: 15.1 Days	Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	: $0.80 per lbs	Probable Low Cost Parameter		33000	$325,922	$0.72
Total Cost	: $362,135	Probable High Cost Parameter		24000	$434,562	$0.96

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	15.1	8	120.80	L	$47.23	incl. in rate	incl. in rate	$5,705.38
Ironworkers	Active	5.00	15.1	8	604.00	L	$63.95	incl. in rate	incl. in rate	$38,625.80
Crawler Crane (270tn)	Active	2.00	15.1	8	241.60	E	$399.50	incl. in rate	incl. in rate	$96,519.20
Equipment Operator (crane)	Active	2.00	15.1	8	241.60	L	$68.41	incl. in rate	incl. in rate	$16,527.86
Welder	Active	4.00	15.1	8	483.20	L	$7.84	incl. in rate	incl. in rate	$3,787.08
Gas Welding Machine	Active	4.00	15.1	8	483.20	E	$2.88	incl. in rate	incl. in rate	$1,390.16
Electrician	Active	2.00	15.1	8	241.60	L	$45.23	incl. in rate	incl. in rate	$10,927.57
Millwright	Active	5.00	15.1	8	604.00	L	$69.46	incl. in rate	incl. in rate	$41,953.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	6.0	8	96.00	E	$31.90	incl. in rate	incl. in rate	$3,062.40
Loader, FE Rubber Tire (8.6cy)	Active	1.00	15.1	8	120.80	E	$221.50	incl. in rate	incl. in rate	$26,757.20
Truck Driver (heavy)	Active	1.00	15.1	8	120.80	L	$57.59	incl. in rate	incl. in rate	$6,956.87
Equipment Operator (medium)	Active	1.00	15.1	8	120.80	L	$66.28	incl. in rate	incl. in rate	$8,006.62
				Labor Hours	2536.8				TOTAL LABOR	$132,491.02
				Equipment Hours	941.6				TOTAL EQUIPMENT	$127,728.96

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$13,249.10	$13,249.10
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00
					TOTAL MATERIAL	$14,949.10

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	22.60	ton	1.000	22.60	$595.00	$13,447.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	90.40	mile	1.500	135.60	$7.25	$983.10
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	$14,430.10

SUMMARY OF COSTS

Labor Cost	$132,491.02	Labor Burden @	49.7%	$0.00		$132,491.02
Material Cost	$14,949.10	Material Tax @	7.8%	$1,158.56		$16,107.66
Equipment Cost	$127,728.96	Equipment Tax @	0.0%	$0.00		$127,728.96
Subcontractors	$14,430.10					$14,430.10
DIRECT COST SUBTOTALS	$289,599			$1,159	DIRECT COST SUBTOTALS	$290,758

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$276,327.64	$41,449.15
Installing Contractors Profit@	8.0%				$276,327.64	$22,106.21
GC Markup on Subs @	5.0%				$14,430.10	$721.51
					TOTAL MARKUP COSTS	$64,276.86

General Contractors Insurance @	1.0%	on	$355,034.61	$3,550
Bond @	1.0%	on	$355,034.61	$3,550
Contingency @	0.0%	on	$362,135.30	$0
			TOTAL COST for pay item	$362,135

Additional Pay Item Notes :

Working with a crew formed of 1 El.Forman 2 Electrician starting to disconnect power and take care of the temporay electrical power they need at the site. The crew of 5 Ironworker and 5 Millwright open the engine side panels, and remove the nacelle access panels. Disconnect the engine thermocouple leads at the terminal board. Before disconnecting any lines all fuel, oil, and hydraulic fluid valves are closed. Plug all lines as they are disconnected to prevent entrance of foreign material.Remove the clamps securing the bleed-air ducts at the firewall. Then, disconnect the electrical connector plugs, engine breather and vent lines, and fuel, oil, and hydraulic lines.Disconnect the engine power lever and propeller control rods or cables. Remove the covers from the lift points, attach the sling, and remove slack from the cables using a suitable hoist. The sling must be adjusted to position. Remove the engine mount bolts. The engine ready to be removed. Move the engine forward, out of the nacelle structure, until it clears the aircraft. Lower the into position on the stand, and secure it prior to removing the engine sling. The crew of 4 Welder are going to cut in pieces the big parts of the turbine to be able to load them in the truck using a loader and dispose.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.029		Project	: COPCO 1
Description	: Remove & Dispose of 2 - 40 Ton indoor cranes			
Quantity	: 140,000.00 LBS			
Daily Production	: 24,000.00 LBS per 8 hour shift		Project #	: 2
Work Days	: 5.8 Days		Estimator	: Mihaela Tomulescu
Unit Price	: $0.74 per LBS			
Total Cost	: $103,941			

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	27600	$88,350	$0.63
Probable High Cost Parameter	19200	$124,729	$0.89

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (80tn)	Active	2.00	5.8	8	92.80	E	$190.46	incl. in rate	incl. in rate	$17,674.69
Equipment Operator (crane)	Active	2.00	5.8	8	92.80	L	$68.41	incl. in rate	incl. in rate	$6,348.45
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	5.8	8	92.80	E	$31.90	incl. in rate	incl. in rate	$2,960.32
Equipment Operator (medium)	Active	1.00	5.8	8	46.40	L	$66.28	incl. in rate	incl. in rate	$3,075.39
Truck Driver (heavy)	Active	2.00	5.8	8	92.80	L	$57.59	incl. in rate	incl. in rate	$5,344.35
Electrician	Active	2.00	5.8	8	92.80	L	$45.23	incl. in rate	incl. in rate	$4,197.34
Millwright	Active	8.00	5.8	8	371.20	L	$69.46	incl. in rate	incl. in rate	$25,783.55
Labor Foreman	Active	2.00	5.8	8	92.80	L	$48.27	incl. in rate	incl. in rate	$4,479.46
Welder	Active	2.00	5.8	8	92.80	L	$7.84	incl. in rate	incl. in rate	$727.32
Gas Welding Machine	Active	2.00	5.8	8	92.80	E	$2.88	incl. in rate	incl. in rate	$266.98
Carpenters	Active	2.00	5.8	8	92.80	L	$72.60	incl. in rate	incl. in rate	$6,737.28
				Labor Hours	974.4				TOTAL LABOR	$56,693.14
				Equipment Hours	278.4				TOTAL EQUIPMENT	$20,901.99

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$2,834.66	$2,834.66
					TOTAL MATERIAL	$2,834.66

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (5% of total weight)	3.50	ton	1.000	3.50	$595.00	$2,082.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	2.000	68.00	$7.25	$493.00
					TOTAL SUBCONTRACTS	$2,575.50

SUMMARY OF COSTS

Labor Cost	$56,693.14	Labor Burden @	49.7%	$0.00		$56,693.14
Material Cost	$2,834.66	Material Tax @	7.8%	$219.69		$3,054.34
Equipment Cost	$20,901.99	Equipment Tax @	0.0%	$0.00		$20,901.99
Subcontractors	$2,575.50					$2,575.50
DIRECT COST SUBTOTALS	$83,005			$220	DIRECT COST SUBTOTALS	$83,225

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$80,649.48	$12,097.42
Installing Contractors Profit@	8.0%				$80,649.48	$6,451.96
GC Markup on Subs @	5.0%				$2,575.50	$128.78
					TOTAL MARKUP COSTS	$18,678.16
General Contractors Insurance @	1.0%		on		$101,903.14	$1,019
Bond @	1.0%		on		$101,903.14	$1,019
Contingency @	0.0%		on		$103,941.20	$0
					TOTAL COST for pay item	$103,941

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed hazardous waste 2% of the total lbs, calculated 34 miles from Copco1 to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.030	Project	: COPCO 1			
Description	: Remove & Dispose of Compressed Air System					
Quantity	: 1,000.00 LBS					
Daily Production	: 6,000.00 LBS per 8 hour shift	Project #	: 2			
Work Days	: 0.2 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $1.00 per LBS	Probable Low Cost Parameter		6600	$897	$0.90
Total Cost	: $997	Probable High Cost Parameter		5100	$1,147	$1.15

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.2	8	1.60	E	$64.23	incl. in rate	incl. in rate	$102.77
Laborer	Active	3.00	0.2	8	4.80	L	$45.80	incl. in rate	incl. in rate	$219.84
Truck Driver (light)	Active	1.00	0.2	8	1.60	L	$56.29	incl. in rate	incl. in rate	$90.06
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	incl. in rate	incl. in rate	$178.62
Steelworker	Active	1.00	0.2	8	1.60	L	$65.52	incl. in rate	incl. in rate	$104.83
Electrician	Active	1.00	0.2	8	1.60	L	$45.23	incl. in rate	incl. in rate	$72.37

Labor Hours	9.6	TOTAL LABOR	$487.10
Equipment Hours	3.2	TOTAL EQUIPMENT	$281.39

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$24.36	$24.36
					TOTAL MATERIAL	$24.36

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$487.10	Labor Burden @		49.7%	$0.00		$487.10
Material Cost	$24.36	Material Tax @		7.8%	$1.89		$26.24
Equipment Cost	$281.39	Equipment Tax @		0.0%	$0.00		$281.39
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$793				$2	DIRECT COST SUBTOTALS	$795
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$794.74		$119.21
Installing Contractors Profit@	8.0%				$794.74		$63.58
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$182.79
General Contractors Insurance @	1.0%		on		$977.53		$10
Bond @	1.0%		on		$977.53		$10
Contingency @	0.0%		on		$997.08		$0
						TOTAL COST for pay item	$997

Additional Pay Item Notes :

Used RS Means . assumption for "Pipe, metal pipe, to 1-1/2" diam., selective demolition, 370 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Steelworkers to cut the pipes and 3 Laborers for hauling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.031	Project	: COPCO 1		
Description	:	Remove & Dispose of 2 - CO2 Systems				
Quantity	:	3,100.00 LBS				
Daily Production	:	6,000.00 LBS per 8 hour shift	Project #	: 2		
Work Days	:	0.5 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.05 per LBS	Probable Low Cost Parameter		6600	$2,927	$0.94
Total Cost	:	$3,252	Probable High Cost Parameter		5100	$3,739	$1.21

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.5	8	4.00	L	$48.27	incl. in rate	incl. in rate	$193.08
Steelworker	Active	2.00	0.5	8	8.00	L	$65.52	incl. in rate	incl. in rate	$524.16
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56
Truck Driver (light)	Active	1.00	0.5	8	4.00	L	$56.29	incl. in rate	incl. in rate	$225.16
Electrician	Active	1.00	0.5	8	4.00	L	$45.23	incl. in rate	incl. in rate	$180.92
Loader, FE Rubber Tire (5.25cy)	Active	1.00	0.5	8	4.00	E	$75.42	incl. in rate	incl. in rate	$301.68
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	incl. in rate	incl. in rate	$259.60
				Labor Hours	32				TOTAL LABOR	$1,749.32
				Equipment Hours	8				TOTAL EQUIPMENT	$748.24

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$87.47	$87.47
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$87.47

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,749.32	Labor Burden @		49.7%	$0.00		$1,749.32
Material Cost	$87.47	Material Tax @		7.8%	$6.78		$94.24
Equipment Cost	$748.24	Equipment Tax @		0.0%	$0.00		$748.24
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$2,585				$7	DIRECT COST SUBTOTALS	$2,592
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead @	15.0%				$2,591.80		$388.77
Installing Contractors Profit @	8.0%				$2,591.80		$207.34
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$596.12
General Contractors Insurance @	1.0%		on		$3,187.92		$32
Bond @	1.0%		on		$3,187.92		$32
Contingency @	0.0%		on		$3,251.68		$0
						TOTAL COST for pay item	$3,252

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 1140 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 2 Laborers to load the pipes in the truck, 1 electrician for tools.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.032	Project	: COPCO 1			
Description	:	Remove & Dispose of Plant Water and Fire Protection					
Quantity	:	2,600.00 LBS					
Daily Production	:	6,000.00 LBS per 8 hour shift	Project #	: 2			
Work Days	:	0.4 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.35 per LBS	Probable Low Cost Parameter		6600	$3,160	$1.22
Total Cost	:	$3,511	Probable High Cost Parameter		4800	$4,214	$1.62

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	0.4	8	6.40	L	$48.27	incl. in rate	incl. in rate	$308.93
Laborer	Active	4.00	0.4	8	12.80	L	$45.80	incl. in rate	incl. in rate	$586.24
Steelworker	Active	4.00	0.4	8	12.80	L	$65.52	incl. in rate	incl. in rate	$838.66
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.4	8	3.20	E	$111.64	incl. in rate	incl. in rate	$357.25
Truck Driver (light)	Active	1.00	0.4	8	3.20	L	$56.29	incl. in rate	incl. in rate	$180.13
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.4	8	3.20	E	$64.23	incl. in rate	incl. in rate	$205.54
Equipment Operator (light)	Active	1.00	0.4	8	3.20	L	$64.90	incl. in rate	incl. in rate	$207.68
				Labor Hours	38.4				TOTAL LABOR	$2,121.63
				Equipment Hours	6.4				TOTAL EQUIPMENT	$562.78

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$106.08	$106.08
					TOTAL MATERIAL	$106.08

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,121.63	Labor Burden @		49.7%	$0.00		$2,121.63
Material Cost	$106.08	Material Tax @		7.8%	$8.22		$114.30
Equipment Cost	$562.78	Equipment Tax @		0.0%	$0.00		$562.78
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$2,790				$8	**DIRECT COST SUBTOTALS**	$2,799
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$2,798.72		$419.81
Installing Contractors Profit@	8.0%				$2,798.72		$223.90
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$643.71
General Contractors Insurance @	1.0%		on		$3,442.42		$34
Bond @	1.0%		on		$3,442.42		$34
Contingency @	0.0%		on		$3,511.27		$0
						TOTAL COST for pay item	**$3,511**

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 960 LF of 1 1/2" pipes at 2.72 Lbs. Used 2 Forman, 4 Steelworkers to cut the pipes and 4 Laborers to load the pipes in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.033		Project	: COPCO 1		
Description	:	Remove & Dispose of Transformer Oil Fire Protection					
Quantity	:	5,400.00 LBS					
Daily Production	:	6,000.00 LBS per 8 hour shift		Project #	: 2		
Work Days	:	0.9 Days		Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.22 per LBS		Probable Low Cost Parameter		6600	$5,927	$1.10
Total Cost	:	$6,586		Probable High Cost Parameter		4800	$7,903	$1.46

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Steelworker	Active	2.00	0.9	8	14.40	L	$65.52	incl. in rate	incl. in rate	$943.49
Labor Foreman	Active	1.00	0.9	8	7.20	L	$48.27	incl. in rate	incl. in rate	$347.54
Laborer	Active	2.00	0.9	8	14.40	L	$45.80	incl. in rate	incl. in rate	$659.52
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.9	8	7.20	E	$31.90	incl. in rate	incl. in rate	$229.68
Truck Driver (light)	Active	1.00	0.9	8	7.20	L	$56.29	incl. in rate	incl. in rate	$405.29
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.9	8	7.20	E	$64.23	incl. in rate	incl. in rate	$462.46
Equipment Operator (light)	Active	1.00	0.9	8	7.20	L	$64.90	incl. in rate	incl. in rate	$467.28
				Labor Hours	50.4				TOTAL LABOR	$2,823.12
				Equipment Hours	14.4				TOTAL EQUIPMENT	$692.14

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$141.16	$141.16
					TOTAL MATERIAL	$141.16

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	2.70	ton	1.000	2.70	$595.00	$1,606.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	34.00	$7.25	$246.50
					TOTAL SUBCONTRACTS	$1,853.00

SUMMARY OF COSTS

Labor Cost	$2,823.12	Labor Burden @	49.7%	$0.00		$2,823.12
Material Cost	$141.16	Material Tax @	7.8%	$10.94		$152.10
Equipment Cost	$692.14	Equipment Tax @	0.0%	$0.00		$692.14
Subcontractors	$1,853.00					$1,853.00
DIRECT COST SUBTOTALS	$5,509			$11	DIRECT COST SUBTOTALS	$5,520

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,667.35	$550.10
Installing Contractors Profit@	8.0%				$3,667.35	$293.39
GC Markup on Subs @	5.0%				$1,853.00	$92.65
					TOTAL MARKUP COSTS	$936.14
General Contractors Insurance @	1.0%		on		$6,456.49	$65
Bond @	1.0%		on		$6,456.49	$65
Contingency @	0.0%		on		$6,585.62	$0
					TOTAL COST for pay item	$6,586

Additional Pay Item Notes :

Based on RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition. 1985 LF of 1 1/2" fire protection pipes at 2.72 Lbs. Used 1 Forman and 1 Laborers to load in drums and put them in the truck.Calculated 34 miles from Copco 1 to Yreka Transfer Recycling. Each hydropower facility has at least 150,000 gallons to 250,000 gallon of oil currently in use. This oil would have to be properly disposed of in the event of decommissioning. Oil removed from the turbines and other equipment, including transformer oil, would be either a waste oil or used oil, depending on prior use and contaminants found in the oil. Containerized oil containing contaminants such as solvents are commonly encountered at hydropower facilities. Oil sludges are common in tanks. Oil disposal would likely be costly due to the large volumes found at hydropower facilities and the ease of contamination with other regulated hazardous wastes.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.034	Project	: COPCO 1
Description	: Remove & Dispose of Unwatering Piping		
Quantity	: 27,000.00 lbs		
Daily Production	: 18,000.00 lbs per 8 hour shift	Project #	: 2
Work Days	: 1.5 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $0.73 per lbs		
Total Cost	: $19,738		

	lbs per	Total Cost	Unit Price Per lbs
Probable Low Cost Parameter	20700	$16,777	$0.62
Probable High Cost Parameter	13500	$24,672	$0.91

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.5	8	12.00	L	$48.27	incl. in rate	incl. in rate	$579.24
Laborer	Active	4.00	1.5	8	48.00	L	$45.80	incl. in rate	incl. in rate	$2,198.40
Steelworker	Active	4.00	1.5	8	48.00	L	$65.52	incl. in rate	incl. in rate	$3,144.96
Equipment Operator (medium)	Active	1.00	1.5	8	12.00	L	$66.28	incl. in rate	incl. in rate	$795.36
Welder	Active	1.00	1.5	8	12.00	L	$7.84	incl. in rate	incl. in rate	$94.05
Gas Welding Machine	Active	1.00	1.5	8	12.00	E	$2.88	incl. in rate	incl. in rate	$34.52
Electrician	Active	1.00	1.5	8	12.00	L	$45.23	incl. in rate	incl. in rate	$542.76
Equipment Operator (light)	Active	1.00	1.5	8	12.00	L	$64.90	incl. in rate	incl. in rate	$778.80
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.5	8	12.00	E	$111.64	incl. in rate	incl. in rate	$1,339.68
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.5	8	12.00	E	$221.50	incl. in rate	incl. in rate	$2,658.00
Truck Driver (heavy)	Active	1.00	1.5	8	12.00	L	$57.59	incl. in rate	incl. in rate	$691.08

Labor Hours	168	TOTAL LABOR	$8,824.65
Equipment Hours	36	TOTAL EQUIPMENT	$4,032.20

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$882.47	$882.47
					TOTAL MATERIAL	$882.47

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (25% from total weight)	3.38	ton	1.000	3.38	$595.00	$2,008.13
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	34.00	$7.25	$246.50
					TOTAL SUBCONTRACTS	$2,254.63

SUMMARY OF COSTS

Labor Cost	$8,824.65	Labor Burden @	49.7%	$0.00		$8,824.65
Material Cost	$882.47	Material Tax @	7.8%	$68.39		$950.86
Equipment Cost	$4,032.20	Equipment Tax @	0.0%	$0.00		$4,032.20
Subcontractors	$2,254.63					$2,254.63
DIRECT COST SUBTOTALS	$15,994			$68	DIRECT COST SUBTOTALS	$16,062

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$13,807.71	$2,071.16
Installing Contractors Profit@	8.0%				$13,807.71	$1,104.62
GC Markup on Subs @	5.0%				$2,254.63	$112.73
					TOTAL MARKUP COSTS	$3,288.50

General Contractors Insurance @	1.0%	on	$19,350.84	$194
Bond @	1.0%	on	$19,350.84	$194
Contingency @	0.0%	on	$19,737.86	$0
			TOTAL COST for pay item	$19,738

Additional Pay Item Notes :

Used RS Means : Assumed Pipe, metal pipe, to 1-1/2" diam., selective demolition, around 9950 LF of 1 1/2" pipes at 2.72 Lbs. Used Crew formed of 1 Forman, 2 Steelworkers to cut the pipes, 1 Welder to cut steel in unaccesible places , 2 Laborers to haul the pipes in the truck with the loader, 1 electrician to unplug the power and to assure the temporaty power at the contruction site. Calculated 34 miles from JC Boyle to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.035		Project	: COPCO 1		
Description	:	Remove & Dispose of Drainage Piping					
Quantity	:	5,000.00 LBS					
Daily Production	:	4,450.00 LBS per 8 hour shift		Project #	: 2		
Work Days	:	1.1 Days		Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.04 per LBS		Probable Low Cost Parameter		5117.5	$4,422	$0.88
Total Cost	:	$5,202		Probable High Cost Parameter		3337.5	$6,503	$1.30

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (3.5cy)	Active	1.00	1.1	8	8.80	E	$64.23	incl. in rate	incl. in rate	$565.22
Equipment Operator (light)	Active	1.00	1.1	8	8.80	L	$64.90	incl. in rate	incl. in rate	$571.12
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.1	8	8.80	E	$111.64	incl. in rate	incl. in rate	$982.43
Truck Driver (light)	Active	1.00	1.1	8	8.80	L	$56.29	incl. in rate	incl. in rate	$495.35
Labor Foreman	Active	1.00	1.1	8	8.80	L	$48.27	incl. in rate	incl. in rate	$424.78
Electrician	Active	1.00	1.1	8	8.80	L	$45.23	incl. in rate	incl. in rate	$398.02
Steelworker	Active	1.00	1.1	8	8.80	L	$65.52	incl. in rate	incl. in rate	$576.58
				Labor Hours	44				TOTAL LABOR	$2,465.85
				Equipment Hours	17.6				TOTAL EQUIPMENT	$1,547.66

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$123.29	$123.29
					TOTAL MATERIAL	$123.29

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,465.85	Labor Burden @	49.7%	$0.00		$2,465.85
Material Cost	$123.29	Material Tax @	7.8%	$9.56		$132.85
Equipment Cost	$1,547.66	Equipment Tax @	0.0%	$0.00		$1,547.66
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$4,137			$10	DIRECT COST SUBTOTALS	$4,146

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$4,146.35		$621.95
Installing Contractors Profit@	8.0%				$4,146.35		$331.71
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$953.66
General Contractors Insurance @	1.0%		on		$5,100.01		$51
Bond @	1.0%		on		$5,100.01		$51
Contingency @	0.0%		on		$5,202.01		$0
						TOTAL COST for pay item	$5,202

Additional Pay Item Notes :

1370 LF of 1 " drainage pipes at 3.66 Lbs. Used 1 Loader and 1 Forman, 1 Steelworkers to cut the pipes and 1 Laborers to load the pipes in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.035a	Project	: COPCO 1			
Description	:	Remove petroleum products from mechanical equipment					
Quantity	:	1,250.00 GAL					
Daily Production	:	1,100.00 GAL per 8 hour shift	Project #	: 2			
Work Days	:	1.1 Days	Estimator	: Mihaela Tomulescu	GAL per	Total Cost	Unit Price Per GAL
Unit Price	:	$4.39 per GAL	Probable Low Cost Parameter		1210	$4,941	$3.95
Total Cost	:	$5,490	Probable High Cost Parameter		935	$6,313	$5.05

CREW COSTS

Description	Active / Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.1	8	8.80	L	$46.27	incl. in rate	incl. in rate	$407.18
Carpenters, Journeyman	Active	2.00	1.1	8	17.60	L	$65.37	incl. in rate	incl. in rate	$1,150.51
Laborer	Active	2.00	1.1	8	17.60	L	$45.80	incl. in rate	incl. in rate	$806.08

Labor Hours	44	TOTAL LABOR	$2,363.77
Equipment Hours	0	TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 20% labor (absorbant materials, drums, etc)	1.00	LS	1.000	1.00	$472.75	$472.75
					TOTAL MATERIAL	$472.75

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, liquid pickup, vacuum truck, stainless steel tank, 5000 gallons, minimum charge, 4 hours, 2 compartment	8.80	hour	1.000	$200.00	$1,760.00
				TOTAL SUBCONTRACTS	$1,760.00

SUMMARY OF COSTS

Labor Cost	$2,363.77	Labor Burden @	49.7%	$0.00		$2,363.77
Material Cost	$472.75	Material Tax @	7.8%	$36.64		$509.39
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$1,760.00					$1,760.00
DIRECT COST SUBTOTALS	$4,597			$37	DIRECT COST SUBTOTALS	$4,633

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead @	15.0%				$2,873.16	$430.97
Installing Contractors Profit @	8.0%				$2,873.16	$229.85
GC Markup on Subs @	5.0%				$1,760.00	$88.00
					TOTAL MARKUP COSTS	$748.83
General Contractors Insurance @	1.0%	FALSE		FALSE	$5,381.99	$54
Bond @	1.0%	ALSE		on	$5,381.99	$54
Contingency @	0.0%			on	$5,489.63	$0
					TOTAL COST for pay item	$5,490

Additional Pay Item Notes :

Petroleum-based products, ranging from fuel oil and hydraulic fluid to lubricating greases and oils, are found throughout every type of power generating plant or system. Lubrication supports bearings and moving parts in all sorts of equipment: pumps, conveyors, feeders, scrubbers, cranes, turbines, and more A good oil/water separation system will result in a flow of concentrated waste oil to a collection area and a flow of oil free water ready for secondary processing or discharge. Once an oil layer has been separated from free water, it must be removed for recycling or disposal. Many plants use one or more of these oil removal methods, but each has costly limitations:

1. Absorbent materials. Absorbent mats or materials are frequently used to dam up and absorb excess oils and greases resulting from accidents or the routine operation of machinery. These materials are very effective for preventing the spread of a source leak and very efficient in terms of oil pickup. Yet, their use on large volumes of waste oil results in multiple, recurring costs that can make them impractical as an everyday solution:

- the costs of the materials themselves
- the labor costs for ordering, stocking, application, and removal
- the costs of used-media collection, disposal, or re-processing/recycling

2. Manually operated "slotted pipes." Many separators feature a "slotted pipe," a pipe located near the top of the vessel that has a horizontal opening. Oil is removed by turning the horizontal opening downward until it meets the floating oil layer, which drains through the pipe to a collection receptacle. These pipes work well on thick layers of oil, but cannot drain off a sheen of oil without draining off a large amount of water as well.

AECOM assumed the best is Vacuum truck removal method to remove petroleum fromturbines, generator, oil sumps, tanks, etc. Used a crew formed of 1 Forman, 2 Laborers and 2 journemen to takeout the petroleum waste, Vacuum-equipped tank trucks are used to remove waste oil from collection points (assumed existing drums or tanks) so that it can be transported to recycling or disposal locations. If the waste oil has been thoroughly separated, highly concentrated, and stored in an appropriate receptacle, this service can be used very efficiently. However, vacuum disposal units are often used to pump oil layers directly off of water. This results in the intake of a significant amount free water along with the waste oil – and a significantly higher cost.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.036	Project	: COPCO 1				
Description	: Remove & Dispose of Horizontal AC Generator, Indoor Open Frame						
Quantity	: 2.00 EA						
Daily Production	: 0.40 EA per 8 hour shift	Project #	: 2				
Work Days	: 5.0 Days	Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	: $38,691.77 per EA	Probable Low Cost Parameter			0.46	$65,776	$32,888.00
Total Cost	: $77,384	Probable High Cost Parameter			0.32	$92,860	$46,430.12

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	5.0	8	40.00	L	$47.23	incl. in rate	incl. in rate	$1,889.20
Labor Foreman	Active	1.00	5.0	8	40.00	L	$48.27	incl. in rate	incl. in rate	$1,930.80
Electrician	Active	6.00	5.0	8	240.00	L	$45.23	incl. in rate	incl. in rate	$10,855.20
Steelworker	Active	6.00	5.0	8	240.00	L	$65.52	incl. in rate	incl. in rate	$15,724.80
Laborer	Active	2.00	5.0	8	80.00	L	$45.80	incl. in rate	incl. in rate	$3,664.00
Truck Driver (heavy)	Active	2.00	5.0	8	80.00	L	$57.59	incl. in rate	incl. in rate	$4,607.20
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	5.0	8	80.00	E	$31.90	incl. in rate	incl. in rate	$2,552.00
Gas Welding Machine	Active	2.00	5.0	8	80.00	E	$2.88	incl. in rate	incl. in rate	$230.16
Welder	Active	2.00	5.0	8	80.00	L	$7.84	incl. in rate	incl. in rate	$627.00
Equipment Operator (crane)	Active	1.00	5.0	8	40.00	L	$68.41	incl. in rate	incl. in rate	$2,736.40
Crawler Crane (130tn)	Active	1.00	5.0	8	40.00	E	$258.66	incl. in rate	incl. in rate	$10,346.40
				Labor Hours	840				TOTAL LABOR	$42,034.60
				Equipment Hours	200				TOTAL EQUIPMENT	$13,128.56

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$2,101.73	$2,101.73
					TOTAL MATERIAL	$2,101.73

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Disposal fee (for 115 tons)	1	EA	1.000	1.00	$4,488.00	$4,488.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	68.00	mile	1.000	68.00	$7.25	$493.00
					TOTAL SUBCONTRACTS	$4,981.00

SUMMARY OF COSTS

Labor Cost	$42,034.60	Labor Burden @	49.7%	$0.00		$42,034.60
Material Cost	$2,101.73	Material Tax @	7.8%	$162.88		$2,264.61
Equipment Cost	$13,128.56	Equipment Tax @	0.0%	$0.00		$13,128.56
Subcontractors	$4,981.00					$4,981.00
DIRECT COST SUBTOTALS	$62,246			$163	DIRECT COST SUBTOTALS	$62,409

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$57,427.77	$8,614.17
Installing Contractors Profit@	8.0%				$57,427.77	$4,594.22
GC Markup on Subs @	5.0%				$4,981.00	$249.05
					TOTAL MARKUP COSTS	$13,457.44
General Contractors Insurance @	1.0%		on		$75,866.21	$759
Bond @	1.0%		on		$75,866.21	$759
Contingency @	0.0%		on		$77,383.54	$0
					TOTAL COST for pay item	**$77,384**

Additional Pay Item Notes :

Assumed removal of 2 units, weight per unit around 125000 LBS (stator, rotor, base, exciter assembly). Used RS Means, 2 X R13 Crew formed of 1 Forman, 3 Electricians, 1 Oiler, 0.25 Equipment Crane, 3 Steelworkers to cut adjacent appurtenances and 1 Welder to cut pipes. Calculated 34 miles from JC Copco1 to Yreka Transfer Recycling (back and forth).

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.037	Project	: COPCO1			
Description	: Remove & Dispose of Excitation equipment for 12.5 MVA Generator					
Quantity	: 1.50 EA					
Daily Production	: 1.50 EA per 8 hour shift	Project #	: 2			
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $8,472.47 per EA	Probable Low Cost Parameter		1.725	$10,802	$7,201.60
Total Cost	: $12,709	Probable High Cost Parameter		1.125	$15,886	$10,590.59

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Hydraulic Crane (120tn)	Active	1.00	1.0	8	8.00	E	$239.06	incl. in rate	incl. in rate	$1,912.48
Welder	Active	1.00	1.0	8	8.00	L	$7.84	incl. in rate	incl. in rate	$62.70
Gas Welding Machine	Active	1.00	1.0	8	8.00	E	$2.88	incl. in rate	incl. in rate	$23.02
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
				Labor Hours	64				TOTAL LABOR	$3,073.42
				Equipment Hours	32				TOTAL EQUIPMENT	$4,600.62

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$153.67	$153.67
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	2,500.00	LF	1.000	2,500.00	$0.85	$2,125.00
					TOTAL MATERIAL	$2,278.67

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.00	ton	1.000	0.00	$595.00	$0.45
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	0.00	mile	1.000	0.00	$7.25	$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	$0.45

SUMMARY OF COSTS

Labor Cost	$3,073.42	Labor Burden @	49.7%	$0.00		$3,073.42
Material Cost	$2,278.67	Material Tax @	7.8%	$176.60		$2,455.27
Equipment Cost	$4,600.62	Equipment Tax @	0.0%	$0.00		$4,600.62
Subcontractors	$0.45					$0.45
DIRECT COST SUBTOTALS	$9,953			$177	DIRECT COST SUBTOTALS	$10,130

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$10,129.30		$1,519.40
Installing Contractors Profit@	8.0%				$10,129.30		$810.34
GC Markup on Subs @	5.0%				$0.45		$0.02
						TOTAL MARKUP COSTS	$2,329.76
General Contractors Insurance @	1.0%		on		$12,459.51		$125
Bond @	1.0%		on		$12,459.51		$125
Contingency @	0.0%		on		$12,708.70		$0
						TOTAL COST for pay item	$12,709

Additional Pay Item Notes :

Production based on 1 Forman, 1 Electrician, 1 Welder to cut to remove the electrical equipment and 1 laborer to haul. Equipment used 1 Loader and 1 Crane for disposal. Assumed 2 sections, weight 1000LBS.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.038	Project	: COPCO1				
Description	: Remove & Dispose of Surge protection equip. for 12.5 MVA Generator						
Quantity	: 2.00 EA						
Daily Production	: 2.00 EA per 8 hour shift	Project #	: 2				
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA	
Unit Price	: $2,504.46 per EA	Probable Low Cost Parameter		2.3	$4,258	$2,128.79	
Total Cost	: $5,009	Probable High Cost Parameter		1.4	$6,512	$3,255.80	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Ironworkers	Active	2.00	1.0	8	16.00	L	$63.95	incl. in rate	incl. in rate	$1,023.20
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
				Labor Hours	56				TOTAL LABOR	$2,940.40
				Equipment Hours	8				TOTAL EQUIPMENT	$893.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$147.02	$147.02
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	0.00	LF	1.000	0.00	$0.85	$0.00
					TOTAL MATERIAL	$147.02

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.00	ton	1.000	0.00	$595.00	$0.60
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	0.00	mile	1.000	0.00	$7.25	$0.00
					TOTAL SUBCONTRACTS	$0.60

SUMMARY OF COSTS

Labor Cost	$2,940.40	Labor Burden @	49.7%	$0.00		$2,940.40
Material Cost	$147.02	Material Tax @	7.8%	$11.39		$158.41
Equipment Cost	$893.12	Equipment Tax @	0.0%	$0.00		$893.12
Subcontractors	$0.60					$0.60
DIRECT COST SUBTOTALS	$3,981			$11	DIRECT COST SUBTOTALS	$3,993

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead @	15.0%				$3,991.93	$598.79
Installing Contractors Profit @	8.0%				$3,991.93	$319.35
GC Markup on Subs @	5.0%				$0.60	$0.03
					TOTAL MARKUP COSTS	$918.17
General Contractors Insurance @	1.0%		on		$4,910.70	$49
Bond @	1.0%		on		$4,910.70	$49
Contingency @	0.0%		on		$5,008.92	$0
					TOTAL COST for pay item	$5,009

Additional Pay Item Notes :

Assumption for Crew R3: 1 Forman, 1 Electrician, 1 Ironworker and 1 welder to cut rods, to remove the electrical equipment and 1 laborer to haul in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2039	Project	: COPCO1			
Description	:	Remove & Dispose of Neutral grounding equip. for 12.5 MVA Generator					
Quantity	:	2.00 EA					
Daily Production	:	2.00 EA per 8 hour shift	Project #	: 2			
Work Days	:	1.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$2,332.24 per EA	Probable Low Cost Parameter		2.2	$4,198	$2,099.01
Total Cost	:	$4,664	Probable High Cost Parameter		1.7	$5,364	$2,682.07

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Loader, FE Rubber Tire (3.5cy)	Active	2.00	0.5	8	8.00	E	$64.23	incl. in rate	incl. in rate	$513.84
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	incl. in rate	incl. in rate	$259.60
				Labor Hours	44				TOTAL LABOR	$2,192.80
				Equipment Hours	16				TOTAL EQUIPMENT	$1,406.96

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$109.64	$109.64
					TOTAL MATERIAL	$109.64

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,192.80	Labor Burden @	49.7%	$0.00		$2,192.80
Material Cost	$109.64	Material Tax @	7.8%	$8.50		$118.14
Equipment Cost	$1,406.96	Equipment Tax @	0.0%	$0.00		$1,406.96
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$3,709			$8	**DIRECT COST SUBTOTALS**	$3,718

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead @	15.0%				$3,717.90	$557.68
Installing Contractors Profit @	8.0%	☑	☑	☐	$3,717.90	$297.43
GC Markup on Subs @	5.0%			☑	$0.00	$0.00
					TOTAL MARKUP COSTS	$855.12

General Contractors Insurance @	1.0%	on	$4,573.01	$46
Bond @	1.0%	on	$4,573.01	$46
Contingency @	0.0%	on	$4,664.47	$0
			TOTAL COST for pay item	**$4,664**

Additional Pay Item Notes :

Assumption for Crew R3: 1 Forman, 1 Electrician, 1 Ironworker and 1 welder to cut rods, to remove the electrical equipment and 1 laborer to haul in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.040	Project	: COPCO1
Description	: Remove & Dispose of Generator Switchgear, 5kV-includes unit breakers		
Quantity	: 1.00 EA		
Daily Production	: 1.00 EA per 8 hour shift	Project #	: 2
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $20,666.10 per EA		
Total Cost	: $20,666		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	1.1	$18,599	$18,599.49
Probable High Cost Parameter	0.85	$23,766	$23,766.01

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	3.00	1.0	8	24.00	L	$47.23	incl. in rate	incl. in rate	$1,133.52
Electrician	Active	12.00	1.0	8	96.00	L	$45.23	incl. in rate	incl. in rate	$4,342.08
Laborer	Active	6.00	1.0	8	48.00	L	$45.80	incl. in rate	incl. in rate	$2,198.40
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	2.00	1.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Hydraulic Crane (120tn)	Active	1.00	1.0	8	8.00	E	$239.06	incl. in rate	incl. in rate	$1,912.48
Welder	Active	1.00	1.0	8	8.00	L	$7.84	incl. in rate	incl. in rate	$62.70
Gas Welding Machine	Active	1.00	1.0	8	8.00	E	$2.88	incl. in rate	incl. in rate	$23.02
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
				Labor Hours	208				TOTAL LABOR	$9,735.66
				Equipment Hours	40				TOTAL EQUIPMENT	$5,493.74

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$486.78	$486.78
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	0.00	LF	1.000	0.00	$0.85	$0.00
					TOTAL MATERIAL	$486.78

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.00	ton	1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	34.00	$7.25	$246.50
					TOTAL SUBCONTRACTS	$841.50

SUMMARY OF COSTS

Labor Cost	$9,735.66	Labor Burden @	49.7%	$0.00		$9,735.66
Material Cost	$486.78	Material Tax @	7.8%	$37.73		$524.51
Equipment Cost	$5,493.74	Equipment Tax @	0.0%	$0.00		$5,493.74
Subcontractors	$841.50					$841.50
DIRECT COST SUBTOTALS	$16,558			$38	DIRECT COST SUBTOTALS	$16,595

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead @	15.0%				$15,753.90	$2,363.09
Installing Contractors Profit @	8.0%				$15,753.90	$1,260.31
GC Markup on Subs @	5.0%				$841.50	$42.08
					TOTAL MARKUP COSTS	$3,665.47
General Contractors Insurance @	1.0%		on		$20,260.88	$203
Bond @	1.0%		on		$20,260.88	$203
Contingency @	0.0%		on		$20,666.10	$0
					TOTAL COST for pay item	$20,666

Additional Pay Item Notes :

Used 3 Crews (2 sections each weight around 800 LBS per crew) formed of 1 Forman, 3 Electrician, 2 laborer to haul with the crane in the truck. Assumed containing hazardous waste that will be disposed at 34 miles away from the construction site to Yreka Transfer Recycling . In normal circumstances, decontaminated residual components could be accepted at landfill sites but Polychlorinated biphenyl, otherwise known as PCB, is a synthetic chemical that is widely used for industrial and commercial use as dielectric fluid in transformers and capacitors because of its high resistance to decomposition, low electrical conductivity, low flammability and high heat capacity.Transformer repair, reconditioning and retro-filling facilities are the major industry sectors that contributes to the spread of PCB contamination.Types of PCB Wastes:
PCB wastes are discarded materials that contain PCB or have been contaminated with PCBs and that are without any commercial, industrial, or economic use. For the purpose of this Code of Practice, PCBs wastes are classified as follows:Liquid PCB wastes
o PCB-based dielectric fluids removed from transformers and other equipment
o PCB-based heat transfer and hydraulic fluidsMetallic solid wastes
o PCB equipment such as capacitors, transformers, **switchgears**, circuit breakers, heat transfer systems, etc.
o Contaminated components removed from electrical equipment such as windings; o PCB contaminated containers and equipment such as metal drums, tanks, pumps, metal filters, etc.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.041		Project	: COPCO1		
Description	: Remove & Dispose of Station Service Switchgear, 600 volt - (5 sections)					
Quantity	: 1.00 EA					
Daily Production	: 1.00 EA per 8 hour shift		Project #	: 2		
Work Days	: 1.0 Days		Estimator	: Mihaela Tomulescu		
				EA per	Total Cost	Unit Price Per EA
Unit Price	: $11,311.14 per EA		Probable Low Cost Parameter	1.1	$10,180	$10,180.03
Total Cost	: $11,311		Probable High Cost Parameter	0.85	$13,008	$13,007.81

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	3.00	1.0	8	24.00	L	$47.23	incl. in rate	incl. in rate	$1,133.52
Electrician	Active	6.00	1.0	8	48.00	L	$45.23	incl. in rate	incl. in rate	$2,171.04
Laborer	Active	4.00	1.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Welder	Active	1.00	1.0	8	8.00	L	$7.84	incl. in rate	incl. in rate	$62.70
Gas Welding Machine	Active	1.00	1.0	8	8.00	E	$2.88	incl. in rate	incl. in rate	$23.02
				Labor Hours	128				TOTAL LABOR	$5,823.82
				Equipment Hours	24				TOTAL EQUIPMENT	$2,688.14

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$291.19	$291.19
					TOTAL MATERIAL	$291.19

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	34.00	$7.25	$246.50
					TOTAL SUBCONTRACTS	$246.50

SUMMARY OF COSTS

Labor Cost	$5,823.82	Labor Burden @		49.7%	$0.00		$5,823.82
Material Cost	$291.19	Material Tax @		7.8%	$22.57		$313.76
Equipment Cost	$2,688.14	Equipment Tax @		0.0%	$0.00		$2,688.14
Subcontractors	$246.50						$246.50
DIRECT COST SUBTOTALS	$9,050				$23	DIRECT COST SUBTOTALS	$9,072
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead @	15.0%				$8,825.71		$1,323.86
Installing Contractors Profit @	8.0%				$8,511.96		$680.96
GC Markup on Subs @	5.0%				$246.50		$12.33
						TOTAL MARKUP COSTS	$2,017.14
General Contractors Insurance @	1.0%		on		$11,089.35		$111
Bond @	1.0%		on		$11,089.35		$111
Contingency @	0.0%		on		$11,311.14		$0
						TOTAL COST for pay item	$11,311

Additional Pay Item Notes :

Used 3 Crews (2 sections each, weight around 800Lbs per crew) formed of 1 Forman, 2 Electrician, 1welder to cut, 2 laborer to haul with the loader in the truck. Assumed containing hazardous waste that will be disposed . Calculated 34 miles from Copco 1 to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.042	Project	: COPCO1		
Description	: Remove & Dispose of Unit and plant control switchboard				
Quantity	: 1.00 EA				
Daily Production	: 1.00 EA per 8 hour shift	Project #	: 2		
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $6,110.32 per EA	Probable Low Cost Parameter		1.1	$5,499	$5,499.29
Total Cost	: $6,110	Probable High Cost Parameter		0.85	$7,027	$7,026.87

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	2.00	1.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12

Labor Hours	40	TOTAL LABOR	$2,092.48
Equipment Hours	16	TOTAL EQUIPMENT	$2,665.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$104.62	$104.62

TOTAL MATERIAL $104.62

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS $0.00

SUMMARY OF COSTS

Labor Cost	$2,092.48	Labor Burden @	49.7%	$0.00		$2,092.48
Material Cost	$104.62	Material Tax @	7.8%	$8.11		$112.73
Equipment Cost	$2,665.12	Equipment Tax @	0.0%	$0.00		$2,665.12
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$4,862			$8	DIRECT COST SUBTOTALS	$4,870

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,870.33	$730.55
Installing Contractors Profit@	8.0%				$4,870.33	$389.63
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,120.18
General Contractors Insurance @	1.0%		on		$5,990.51	$60
Bond @	1.0%		on		$5,990.51	$60
Contingency @	0.0%		on		$6,110.32	$0

TOTAL COST for pay item $6,110

Additional Pay Item Notes :

Assumed 1 day of work to dispose unit and plant control switchboard with R3 electrical crew and laborers for hauling with the loader in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.043		Project	: COPCO 1			
Description	: Remove & Dispose of Battery System						
Quantity	: 1.00 EA						
Daily Production	: 0.33 EA per	8 hour shift	Project #	: 2			
Work Days	: 3.0	Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $20,638.63 per EA		Probable Low Cost Parameter		0.363	$18,575	$18,574.76
Total Cost	: $20,639		Probable High Cost Parameter		0.2805	$23,734	$23,734.42

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	3.0	8	24.00	L	$48.27	incl. in rate	incl. in rate	$1,158.48
Electrician	Active	1.00	3.0	8	24.00	L	$45.23	incl. in rate	incl. in rate	$1,085.52
Equipment Operator (light)	Active	1.00	3.0	8	24.00	L	$64.90	incl. in rate	incl. in rate	$1,557.60
Loader, FE Rubber Tire (8.6cy)	Active	1.00	3.0	8	24.00	E	$221.50	incl. in rate	incl. in rate	$5,316.00
Truck Driver (heavy)	Active	1.00	3.0	8	24.00	L	$57.59	incl. in rate	incl. in rate	$1,382.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	3.0	8	24.00	E	$111.64	incl. in rate	incl. in rate	$2,679.36
Laborer	Active	2.00	3.0	8	48.00	L	$45.80	incl. in rate	incl. in rate	$2,198.40
Welder	Active	1.00	3.0	8	24.00	L	$7.84	incl. in rate	incl. in rate	$188.10
Gas Welding Machine	Active	1.00	3.0	8	24.00	E	$2.88	incl. in rate	incl. in rate	$69.05

Labor Hours	168	TOTAL LABOR	$7,570.26
Equipment Hours	72	TOTAL EQUIPMENT	$8,064.41

MATERIAL COSTS

Description	Item Quantity	Order Unit	onversion :tor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$757.03	$757.03

TOTAL MATERIAL $757.03

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS $0.00

SUMMARY OF COSTS

Labor Cost	$7,570.26	Labor Burden @	49.7%	$0.00	$7,570.26
Material Cost	$757.03	Material Tax @	7.8%	$58.67	$815.70
Equipment Cost	$8,064.41	Equipment Tax @	0.0%	$0.00	$8,064.41
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$16,392			$59	DIRECT COST SUBTOTALS $16,450

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$16,450.36	$2,467.55
Installing Contractors Profit@	8.0%				$16,450.36	$1,316.03
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$3,783.58

General Contractors Insurance @	1.0%	on	$20,233.95	$202
Bond @	1.0%	on	$20,233.95	$202
Contingency @	0.0%	on	$20,638.63	$0

TOTAL COST for pay item $20,639

Additional Pay Item Notes :

Assuming 3 days of work disposing around 60 batteries, racks and supports. Using Crews E-19 for metals demolition, E-12 and E-25 for cutting steel and A-3H for equipment disposal, B-34A for hauling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.044	Project	: COPCO1			
Description	:	Remove & Dispose of Raceways, Conduit and Cable					
Quantity	:	1.00 EA					
Daily Production	:	0.50 EA per 8 hour shift	Project #	: 2			
Work Days	:	2.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$17,082.48 per EA	Probable Low Cost Parameter		0.55	$15,374	$15,374.23
Total Cost	:	$17,082	Probable High Cost Parameter		0.425	$19,645	$19,644.85

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.0	8	16.00	L	$48.27	incl. in rate	incl. in rate	$772.32
Electrician	Active	2.00	2.0	8	32.00	L	$45.23	incl. in rate	incl. in rate	$1,447.36
Laborer	Active	4.00	2.0	8	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.0	8	16.00	E	$221.50	incl. in rate	incl. in rate	$3,544.00
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
				Labor Hours	144				TOTAL LABOR	$7,132.80
				Equipment Hours	32				TOTAL EQUIPMENT	$5,330.24

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,069.92	$1,069.92
					TOTAL MATERIAL	$1,069.92

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$7,132.80	Labor Burden @			49.7%	$0.00	$7,132.80
Material Cost	$1,069.92	Material Tax @			7.8%	$82.92	$1,152.84
Equipment Cost	$5,330.24	Equipment Tax @			0.0%	$0.00	$5,330.24
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$13,533					$83	DIRECT COST SUBTOTALS $13,616
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$13,615.88		$2,042.38
Installing Contractors Profit@	8.0%				$13,615.88		$1,089.27
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$3,131.65
General Contractors Insurance @	1.0%		on		$16,747.53		$167
Bond @	1.0%		on		$16,747.53		$167
Contingency @	0.0%		on		$17,082.48		$0
						TOTAL COST for pay item	$17,082

Additional Pay Item Notes :

Assumption for removal of control power cable, conduit (2000 LF) and cable tray (300 LF) - using R3 electrical crew and laborers for hauling with the loader.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.045	Project	: COPCO1
Description	: Remove & Dispose of Misc. power & control boards		
Quantity	: 1.00 EA		
Daily Production	: 1.00 EA per 8 hour shift	Project #	: 2
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $6,945.94 per EA		
Total Cost	: $6,946		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	1.1	$6,251	$6,251.35
Probable High Cost Parameter	0.85	$7,988	$7,987.83

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	incl. in rate	incl. in rate	$386.16
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24

Labor Hours	48	TOTAL LABOR	$2,471.76
Equipment Hours	16	TOTAL EQUIPMENT	$2,665.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$370.76	$370.76
					TOTAL MATERIAL	$370.76

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,471.76	Labor Burden @	49.7%	$0.00	$2,471.76
Material Cost	$370.76	Material Tax @	7.8%	$28.73	$399.50
Equipment Cost	$2,665.12	Equipment Tax @	0.0%	$0.00	$2,665.12
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$5,508			$29	DIRECT COST SUBTOTALS $5,536

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead @	15.0%				$5,536.38	$830.46
Installing Contractors Profit @	8.0%				$5,536.38	$442.91
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,273.37

General Contractors Insurance @	1.0%	on	$6,809.75	$68
Bond @	1.0%	on	$6,809.75	$68
Contingency @	0.0%	on	$6,945.94	$0
			TOTAL COST for pay item	$6,946

Additional Pay Item Notes :

Assumption for removal of 3' x 2' x 9" boards - 10 each using R3 electrical crew and laborers for hauling with the loader.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.046		Project	: COPCO 1		
Description	: Remove & Dispose of Step-up Transformers, indoor, oil-filled, 1-phase, 5000kVA					
Quantity	: 3.00 EA					
Daily Production	: 0.25 EA per 8 hour shift		Project #	: 2		
Work Days	: 12.0 Days		Estimator	: Mihaela Tomulescu		
				EA per	Total Cost	Unit Price Per EA
Unit Price	: $64,338.39 per EA		Probable Low Cost Parameter	0.275	$173,714	$57,904.55
Total Cost	: $193,015		Probable High Cost Parameter	0.2125	$221,967	$73,989.15

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	3.00	12.0	8	288.00	L	$47.23	incl. in rate	incl. in rate	$13,602.24
Electrician	Active	3.00	12.0	8	288.00	L	$45.23	incl. in rate	incl. in rate	$13,026.24
Laborer	Active	6.00	12.0	8	576.00	L	$45.80	incl. in rate	incl. in rate	$26,380.80
Hydraulic Excavator (6.0cy)	Active	1.00	12.0	8	96.00	E	$322.48	incl. in rate	incl. in rate	$30,958.08
Truck Driver (heavy)	Active	1.00	12.0	8	96.00	L	$57.59	incl. in rate	incl. in rate	$5,528.64
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	12.0	8	96.00	E	$31.90	incl. in rate	incl. in rate	$3,062.40
Crawler Crane (130tn)	Active	1.00	12.0	8	96.00	E	$258.66	incl. in rate	incl. in rate	$24,831.36
Truck, Utility, with Man-Basket	Active	1.00	12.0	8	96.00	E	$31.90	incl. in rate	incl. in rate	$3,062.40
Equipment Operator (medium)	Active	1.00	12.0	8	96.00	L	$66.28	incl. in rate	incl. in rate	$6,362.88
Equipment Operator (crane)	Active	1.00	12.0	8	96.00	L	$68.41	incl. in rate	incl. in rate	$6,567.36

Labor Hours	1440	TOTAL LABOR	$71,468.16
Equipment Hours	384	TOTAL EQUIPMENT	$61,914.24

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor	1.00	LS	1.000	1.00	$3,573.41	$3,573.41
					TOTAL MATERIAL	$3,573.41

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$500.00	$500.00
Remove oil from oil-filled step-up transformer (allowance for oil containers, filters, etc)	1	EA	1.000	1.00	$13,000.00	$13,000.00
Forklift crew, all-terrain forklift, 45' lift, 35' reach, 9000 lb. capacity, weekly use	1	week	1.000	1.00	$5,961.23	$5,961.23
					TOTAL SUBCONTRACTS	$19,461.23

SUMMARY OF COSTS

Labor Cost	$71,468.16	Labor Burden @	49.7%	$0.00		$71,468.16
Material Cost	$3,573.41	Material Tax @	7.8%	$276.94		$3,850.35
Equipment Cost	$61,914.24	Equipment Tax @	0.0%	$0.00		$61,914.24
Subcontractors	$19,461.23					$19,461.23
DIRECT COST SUBTOTALS	$156,417			$277	DIRECT COST SUBTOTALS	$156,694

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$137,232.75		$20,584.91
Installing Contractors Profit@	8.0%				$137,232.75		$10,978.62
GC Markup on Subs @	5.0%				$19,461.23		$973.06
						TOTAL MARKUP COSTS	$32,536.59
General Contractors Insurance @	1.0%		on		$189,230.57		$1,892
Bond @	1.0%		on		$189,230.57		$1,892
Contingency @	0.0%		on		$193,015.18		$0
						TOTAL COST for pay item	$193,015

Additional Pay Item Notes :

Weight and dimensions of the transformers have particular importance so transport vehicles must be adequate. A considerable proportion of the weight is due to the oil, so the direct consequence is that the big transformers have to be transported empty. During transport the transformers are filled either by dry air or nitrogen. Because of transportation, the auxiliaries have to be removed . For this reason the collaboration with all the people involved in the project is essential. AECOM best assumption for a 5000 kVA, 2300/72000 volt transformer removal- - 3 crew R3 formed of 1 Formen, 1 Electricians, 1 Utility man-backet truck, 1 crane for disposal of each transformer in the truck and 2 laboreres to remove the auxiliaries and the pad (1 excavator).

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.047	Project	: COPCO 1
Description	: Remove & Dispose of Step-up Transformers, indoor, oil-filled, 1-phase, 4165kVA		
Quantity	: 3.00 EA		
Daily Production	: 0.25 EA per 8 hour shift	Project #	: 2
Work Days	: 12.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $57,252.76 per EA		
Total Cost	: $171,758		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	0.275	$154,582	$51,527.49
Probable High Cost Parameter	0.2125	$197,522	$65,840.68

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	3.00	12.0	8	288.00	L	$47.23	incl. in rate	incl. in rate	$13,602.24
Electrician	Active	3.00	12.0	8	288.00	L	$45.23	incl. in rate	incl. in rate	$13,026.24
Laborer	Active	6.00	12.0	8	576.00	L	$45.80	incl. in rate	incl. in rate	$26,380.80
Hydraulic Excavator (6.0cy)	Active	1.00	12.0	8	96.00	E	$322.48	incl. in rate	incl. in rate	$30,958.08
Truck Driver (heavy)	Active	3.00	2.0	8	48.00	L	$57.59	incl. in rate	incl. in rate	$2,764.32
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	2.0	8	48.00	E	$31.90	incl. in rate	incl. in rate	$1,531.20
Crawler Crane (130tn)	Active	1.00	3.0	8	24.00	E	$258.66	incl. in rate	incl. in rate	$6,207.84
Equipment Operator (medium)	Active	1.00	12.0	8	96.00	L	$66.28	incl. in rate	incl. in rate	$6,362.88
Equipment Operator (crane)	Active	1.00	12.0	8	96.00	L	$68.41	incl. in rate	incl. in rate	$6,567.36
Truck, Utility, with Man-Basket	Active	3.00	12.0	8	288.00	E	$31.90	incl. in rate	incl. in rate	$9,187.20

Labor Hours	1392	TOTAL LABOR	$68,703.84
Equipment Hours	456	TOTAL EQUIPMENT	$47,884.32

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor	1.00	LS	1.000	1.00	$3,435.19	$3,435.19
					TOTAL MATERIAL	$3,435.19

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$500.00	$500.00
Remove oil from oil-filled step-up transformer (allowance for oil containers, filters, etc)	1	EA	1.000	1.00	$13,000.00	$13,000.00
Forklift crew, all-terrain forklift, 45' lift, 35' reach, 9000 lb. capacity, weekly use	1	week	1.000	1.00	$5,961.23	$5,961.23
					TOTAL SUBCONTRACTS	$19,461.23

SUMMARY OF COSTS

Labor Cost	$68,703.84	Labor Burden @	49.7%	$0.00	$68,703.84
Material Cost	$3,435.19	Material Tax @	7.8%	$266.23	$3,701.42
Equipment Cost	$47,884.32	Equipment Tax @	0.0%	$0.00	$47,884.32
Subcontractors	$19,461.23				$19,461.23
DIRECT COST SUBTOTALS	$139,485			$266	DIRECT COST SUBTOTALS $139,751

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$120,289.58	$18,043.44
Installing Contractors Profit@	8.0%				$120,289.58	$9,623.17
GC Markup on Subs @	5.0%				$19,461.23	$973.06
					TOTAL MARKUP COSTS	$28,639.66
General Contractors Insurance @	1.0%			on	$168,390.47	$1,684
Bond @	1.0%			on	$168,390.47	$1,684
Contingency @	0.0%			on	$171,758.28	$0
					TOTAL COST for pay item	$171,758

Additional Pay Item Notes :

Weight and dimensions of the transformers have particular importance so transport vehicles must be adequate. A considerable proportion of the weight is due to the oil, so the direct consequence is that the big transformers have to be transported empty. During transport the transformers are filled either by dry air or nitrogen. Because of transportation, the auxiliaries have to be removed . For this reason the collaboration with all the people involved in the project is essential. AECOM best assumption for a 4165 kVA, 2300/72000 volt transformer removal- 3 crew R3 formed of 1 Formen, 1 Electricians, 1 Utility man-backet truck, 1 crane for disposal of each transformer in the truck and 2 laboreres to remove the auxiliaries and the pad (1 excavator).

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.048		Project	: COPCO 1			
Description	: Remove & Dispose of Seven 40-Ton Travelling Crane motors - hoist						
Quantity	: 1.00 EA						
Daily Production	: 2.00 EA per 8 hour shift		Project #	: 2			
Work Days	: 0.5 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $3,306.69 per EA		Probable Low Cost Parameter		2.2	$2,976	$2,976.02
Total Cost	: $3,307		Probable High Cost Parameter		1.7	$3,803	$3,802.69

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56
Hydraulic Crane (80tn)	Active	1.00	0.5	8	4.00	E	$190.46	incl. in rate	incl. in rate	$761.84
Laborer	Active	1.00	0.5	8	4.00	L	$45.80	incl. in rate	incl. in rate	$183.20
Equipment Operator (crane)	Active	1.00	0.5	8	4.00	L	$68.41	incl. in rate	incl. in rate	$273.64
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
Steelworker	Active	1.00	0.5	8	4.00	L	$65.52	incl. in rate	incl. in rate	$262.08

Labor Hours	16	TOTAL LABOR	$949.28
Equipment Hours	8	TOTAL EQUIPMENT	$1,208.40

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$47.46	$47.46
					TOTAL MATERIAL	$47.46

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$500.00	$500.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	$500.00

SUMMARY OF COSTS

Labor Cost	$949.28	Labor Burden @	49.7%	$0.00		$949.28
Material Cost	$47.46	Material Tax @	7.8%	$3.68		$51.14
Equipment Cost	$1,208.40	Equipment Tax @	0.0%	$0.00		$1,208.40
Subcontractors	$500.00					$500.00
DIRECT COST SUBTOTALS	$2,705			$4	DIRECT COST SUBTOTALS	$2,709

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead @	15.0%				$2,208.82		$331.32
Installing Contractors Profit @	8.0%				$2,208.82		$176.71
GC Markup on Subs @	5.0%				$500.00		$25.00
						TOTAL MARKUP COSTS	$533.03
General Contractors Insurance @	1.0%		on		$3,241.85		$32
Bond @	1.0%		on		$3,241.85		$32
Contingency @	0.0%		on		$3,306.69		$0
						TOTAL COST for pay item	$3,307

Additional Pay Item Notes :

Assumed removal of hoist, hoist trolley, gantry: 1 Steelworker and 1 Laborers to load the overhead crane motors in the truck using the crane.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.049	Project	: COPCO 1				
Description	: Remove & Dispose of 40-Ton Travelling Crane control equipment						
Quantity	: 1.00 EA						
Daily Production	: 1.50 EA per 8 hour shift	Project #	: 2				
Work Days	: 0.7 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA	
Unit Price	: $4,364.61 per EA	Probable Low Cost Parameter		1.65	$3,928	$3,928.15	
Total Cost	: $4,365	Probable High Cost Parameter		1.275	$5,019	$5,019.30	

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	2.00	0.7	8	11.20	L	$45.80	incl. in rate	incl. in rate	$512.96
Electrician	Active	1.00	0.7	8	5.60	L	$45.23	incl. in rate	incl. in rate	$253.29
Hydraulic Crane (35tn)	Active	2.00	0.7	8	11.20	E	$116.30	incl. in rate	incl. in rate	$1,302.56
Equipment Operator (crane)	Active	1.00	0.7	8	5.60	L	$68.41	incl. in rate	incl. in rate	$383.10
Truck Driver (heavy)	Active	1.00	0.7	8	5.60	L	$57.59	incl. in rate	incl. in rate	$322.50
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.7	8	5.60	E	$111.64	incl. in rate	incl. in rate	$625.18
				Labor Hours	28				TOTAL LABOR	$1,471.85
				Equipment Hours	16.8				TOTAL EQUIPMENT	$1,927.74

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$73.59	$73.59
					TOTAL MATERIAL	$73.59

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,471.85	Labor Burden @	49.7%	$0.00	$1,471.85
Material Cost	$73.59	Material Tax @	7.8%	$5.70	$79.30
Equipment Cost	$1,927.74	Equipment Tax @	0.0%	$0.00	$1,927.74
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$3,473			$6	DIRECT COST SUBTOTALS $3,479

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead @	15.0%				$3,478.89	$521.83
Installing Contractors Profit @	8.0%				$3,478.89	$278.31
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$800.14
General Contractors Insurance @	1.0%		on		$4,279.03	$43
Bond @	1.0%		on		$4,279.03	$43
Contingency @	0.0%		on		$4,364.61	$0
					TOTAL COST for pay item	$4,365

Additional Pay Item Notes :

Assumed 5 cubicles; 2 Laborers and 1 Electrician will load in the truck with the crane the control equipment.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.050	Project	: COPCO 1		
Description	: Remove & Dispose of 40-Ton Travelling Crane Festoon Cable				
Quantity	: 1.00 EA				
Daily Production	: 2.00 EA per 8 hour shift	Project #	: 2		
Work Days	: 0.5 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $1,534.84 per EA	Probable Low Cost Parameter	2.2	$1,381	$1,381.36
Total Cost	: $1,535	Probable High Cost Parameter	1.6	$1,842	$1,841.81

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	incl. in rate	incl. in rate	$178.62
Laborer	Active	2.00	0.2	8	3.20	L	$45.80	incl. in rate	incl. in rate	$146.56
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.5	8	4.00	E	$64.23	incl. in rate	incl. in rate	$256.92
Equipment Operator (light)	Active	1.00	0.2	8	1.60	L	$64.90	incl. in rate	incl. in rate	$103.84
Truck Driver (heavy)	Active	1.00	0.2	8	1.60	L	$57.59	incl. in rate	incl. in rate	$92.14

Labor Hours	6.4	TOTAL LABOR	$342.54
Equipment Hours	5.6	TOTAL EQUIPMENT	$435.54

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$17.13	$17.13
					TOTAL MATERIAL	$17.13

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Disposal fee (Allowance)	1	EA	1.000	1.00	$500.00	$500.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	$500.00

SUMMARY OF COSTS

Labor Cost	$342.54	Labor Burden @	49.7%	$0.00		$342.54
Material Cost	$17.13	Material Tax @	7.8%	$1.33		$18.45
Equipment Cost	$435.54	Equipment Tax @	0.0%	$0.00		$435.54
Subcontractors	$500.00					$500.00
DIRECT COST SUBTOTALS	$1,295			$1	DIRECT COST SUBTOTALS	$1,297

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$796.54	$119.48
Installing Contractors Profit@	8.0%				$796.54	$63.72
GC Markup on Subs @	5.0%				$500.00	$25.00
					TOTAL MARKUP COSTS	$208.20
General Contractors Insurance @	1.0%		on		$1,504.75	$15
Bond @	1.0%		on		$1,504.75	$15
Contingency @	0.0%		on		$1,534.84	$0
					TOTAL COST for pay item	$1,535

Additional Pay Item Notes :

Assumed 200 LF of cable: 2 Laborers will load in the truck with the loader the overhead crane cable.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.051		**Project**	: COPCO 1			
Description	: Remove & Dispose of Four 15-Ton Overhead Crane Motors - hoist						
Quantity	: 1.00 EA						
Daily Production	: 8.00 EA per	8 hour shift	**Project #**	: 2			
Work Days	: 0.1	Days	**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	: $959.54 per EA		**Probable Low Cost Parameter**		**8.8**	**$864**	**$863.58**
Total Cost	: $960		**Probable High Cost Parameter**		**6.4**	**$1,151**	**$1,151.45**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.1	8	0.80	E	$111.64	incl. in rate	incl. in rate	$89.31
Hydraulic Crane (17tn)	Active	1.00	0.1	8	0.80	E	$81.52	incl. in rate	incl. in rate	$65.22
Laborer	Active	2.00	0.1	8	1.60	L	$45.80	incl. in rate	incl. in rate	$73.28
Equipment Operator (crane)	Active	1.00	0.1	8	0.80	L	$68.41	incl. in rate	incl. in rate	$54.73
Truck Driver (heavy)	Active	1.00	0.1	8	0.80	L	$57.59	incl. in rate	incl. in rate	$46.07
				Labor Hours	**3.2**				**TOTAL LABOR**	**$174.08**
				Equipment Hours	**1.6**				**TOTAL EQUIPMENT**	**$154.53**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$8.70	$8.70
					TOTAL MATERIAL	**$8.70**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$500.00	$500.00
					TOTAL SUBCONTRACTS	**$500.00**

SUMMARY OF COSTS

Labor Cost	$174.08	Labor Burden @	49.7%	$0.00		$174.08
Material Cost	$8.70	Material Tax @	7.8%	$0.67		$9.38
Equipment Cost	$154.53	Equipment Tax @	0.0%	$0.00		$154.53
Subcontractors	$500.00					$500.00
DIRECT COST SUBTOTALS	**$837**			**$1**	**DIRECT COST SUBTOTALS**	**$838**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$337.99	$50.70
Installing Contractors Profit@	8.0%				$337.99	$27.04
GC Markup on Subs @	5.0%				$500.00	$25.00
					TOTAL MARKUP COSTS	**$102.74**

General Contractors Insurance @	1.0%	on	$940.72	$9
Bond @	1.0%	on	$940.72	$9
Contingency @	0.0%	on	$959.54	$0
			TOTAL COST for pay item	**$960**

Additional Pay Item Notes :

Assumed removal of hoist, hoist trolley, gantry. 2 Laborers to load the overhead crane motors in the truck using the crane.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.052	Project	: COPCO 1		
Description	: Remove & Dispose of 15-Ton Overhead Crane control equipment				
Quantity	: 1.00 EA				
Daily Production	: 3.00 EA per 8 hour shift	Project #	: 2		
Work Days	: 0.3 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $434.20 per EA	Probable Low Cost Parameter		3.3	$391	$390.78
Total Cost	: $434	Probable High Cost Parameter		2.55	$499	$499.33

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	2.00	0.3	8	4.80	L	$45.80	incl. in rate	incl. in rate	$219.84
Electrician	Active	1.00	0.3	8	2.40	L	$45.23	incl. in rate	incl. in rate	$108.55

Labor Hours	7.2	TOTAL LABOR	$328.39
Equipment Hours	0	TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$16.42	$16.42

TOTAL MATERIAL $16.42

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS $0.00

SUMMARY OF COSTS

Labor Cost	$328.39	Labor Burden @	49.7%	$0.00	$328.39
Material Cost	$16.42	Material Tax @	7.8%	$1.27	$17.69
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00	$0.00
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$345			$1	DIRECT COST SUBTOTALS $346

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$346.08	$51.91
Installing Contractors Profit@	8.0%				$346.08	$27.69
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$79.60

General Contractors Insurance @	1.0%	on	$425.68	$4
Bond @	1.0%	on	$425.68	$4
Contingency @	0.0%	on	$434.20	$0

TOTAL COST for pay item $434

Additional Pay Item Notes :

Assumed 1 cubicle: 1 Laborers and 1 Electrician. Using the same truck, loader, crane as the ones used to load at the end of the day the overhead crane cable and motors.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.053	Project	: COPCO 1				
Description	: Remove & Dispose of 15-Ton Overhead Crane Festoon Cable						
Quantity	: 1.00 EA						
Daily Production	: 2.00 EA per 8 hour shift	Project #	: 2				
Work Days	: 0.5 Days	Estimator	: Mihaela Tomulescu		EA per	Total Cost	Unit Price Per EA
Unit Price	: $637.49 per EA	Probable Low Cost Parameter			2.2	$574	$573.74
Total Cost	: $637	Probable High Cost Parameter			1.7	$733	$733.12

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.1	8	0.40	E	$111.64	incl. in rate	incl. in rate	$44.66
Truck Driver (heavy)	Active	1.00	0.1	8	0.40	L	$57.59	incl. in rate	incl. in rate	$23.04
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.1	8	0.40	E	$64.23	incl. in rate	incl. in rate	$25.69
Equipment Operator (light)	Active	1.00	0.1	8	0.40	L	$64.90	incl. in rate	incl. in rate	$25.96
				Labor Hours	8.8				TOTAL LABOR	$415.40
				Equipment Hours	0.8				TOTAL EQUIPMENT	$70.35

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$20.77	$20.77
					TOTAL MATERIAL	$20.77

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$415.40	Labor Burden @	49.7%	$0.00		$415.40
Material Cost	$20.77	Material Tax @	7.8%	$1.61		$22.38
Equipment Cost	$70.35	Equipment Tax @	0.0%	$0.00		$70.35
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$507			$2	DIRECT COST SUBTOTALS	$508

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$508.12		$76.22
Installing Contractors Profit@	8.0%				$508.12		$40.65
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$116.87
General Contractors Insurance @	1.0%		on		$624.99		$6
Bond @	1.0%		on		$624.99		$6
Contingency @	0.0%		on		$637.49		$0
						TOTAL COST for pay item	$637

Additional Pay Item Notes :

Assumed 100 LF of cable will be removed; 2 Laborers will load in the truck with the loader the overhead crane cable.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.053.a		Project	: COPCO1		
Description	:	Remove petroleum products from mechanical equipment					
Quantity	:	10,500.00 GAL					
Daily Production	:	550.00 GAL per	8 hour shift	Project #	: 2		
Work Days	:	19.1 Days		Estimator	: Mihaela Tomulescu		
					GAL per	Total Cost	Unit Price Per GAL
Unit Price	:	$10.39 per GAL		Probable Low Cost Parameter	605	$98,204	$9.35
Total Cost	:	$109,116		Probable High Cost Parameter	467.5	$125,483	$11.95

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	19.1	8	152.80	L	$46.27	incl. in rate	incl. in rate	$7,070.06
Electrician	Active	1.00	19.1	8	152.80	L	$45.23	incl. in rate	incl. in rate	$6,911.14
Laborer	Active	5.00	19.1	8	764.00	L	$45.80	incl. in rate	incl. in rate	$34,991.20
Truck Driver (heavy)	Active	1.00	19.1	8	152.80	L	$57.59	incl. in rate	incl. in rate	$8,799.75
				Labor Hours	1222.4				TOTAL LABOR	$57,772.15
				Equipment Hours	0				TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (filters, pads, etc)	1.00	LS	1.000	1.00	$2,888.61	$2,888.61
					TOTAL MATERIAL	$2,888.61

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, liquid pickup, vacuum truck, stainless steel tank, 5000 gallons, minimum charge, 4 hours, 2 compartment	152.80	hour	1.000	$200.00	$30,560.00
				TOTAL SUBCONTRACTS	$30,560.00

SUMMARY OF COSTS

Labor Cost	$57,772.15	Labor Burden @		49.7%	$0.00		$57,772.15
Material Cost	$2,888.61	Material Tax @		7.8%	$223.87		$3,112.47
Equipment Cost	$0.00	Equipment Tax @		0.0%	$0.00		$0.00
Subcontractors	$30,560.00						$30,560.00
DIRECT COST SUBTOTALS	$91,221				$224	DIRECT COST SUBTOTALS	$91,445
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$60,884.63		$9,132.69
Installing Contractors Profit@	8.0%				$60,884.63		$4,870.77
GC Markup on Subs @	5.0%				$30,560.00		$1,528.00
						TOTAL MARKUP COSTS	$15,531.46
General Contractors Insurance @	1.0%			on	$106,976.09		$1,070
Bond @	1.0%			on	$106,976.09		$1,070
Contingency @	0.0%			on	$109,115.61		$0
						TOTAL COST for pay item	$109,116

Additional Pay Item Notes :

Petroleum-based products, ranging from fuel oil and hydraulic fluid to lubricating greases and oils, are found throughout every type of power generating plant or system. Lubrication supports bearings and moving parts in all sorts of equipment: pumps, conveyors, feeders, scrubbers, cranes, turbines, and more.A good oil/water separation system will result in a flow of concentrated waste oil to a collection area and a flow of oil-free water ready for secondary processing or discharge. Once an oil layer has been separated from free water, it must be removed for recycling or disposal. Many plants use one or more of these oil removal methods, but each has costly limitations:

1. Absorbent materials. Absorbent mats or materials are frequently used to dam up and absorb excess oils and greases resulting from accidents or the routine operation of machinery. These materials are very effective for preventing the spread of a source leak and very efficient in terms of oil pickup. Yet, their use on large volumes of waste oil results in multiple, recurring costs that can make them impractical as an everyday solution:
- the costs of the materials themselves
- the labor costs for ordering, stocking, application, and removal
- the costs of used-media collection, disposal, or re-processing/recycling.

2. Manually operated "slotted pipes." Many separators feature a "slotted pipe," a pipe located near the top of the vessel that has a horizontal opening. Oil is removed by turning the horizontal opening downward until it meets the floating oil layer, which drains through the pipe to a collection receptacle. These pipes work well on thick layers of oil, but cannot drain off a sheen of oil without draining off a large amount of water as well.

AECOM assumed the best is Vacuum truck removal method .Used a crew formed of 1 Forman, 5 Laborers to takeout the petroleum waste, 1 Electrician to unplug the power and to assure the temporaty power at the contruction site. Vacuum-equipped tank trucks are used to remove waste oil from collection points at plants so that it can be transported to recycling or disposal locations. If the waste oil has been thoroughly separated, highly concentrated, and stored in an appropriate receptacle, this service can be used very efficiently. However, vacuum disposal units are often used to pump oil layers directly off of water. This results in the intake of a significant amount free water along with the waste oil – and a significantly higher cost.

PAY ITEM COST DETAIL WORKSHEET

2.054 Remove & Dispose of 69kV circuit breakers, oil filled, PCB

PAY ITEM INFORMATION

PAY ITEM NUMBER :	2.054		**Project** :	COPCO 1		
Description :	Remove & Dispose of 69kV circuit breakers, oil filled, PCB					
Quantity :	2.00 EA					
Daily Production :	2.00 EA per	8 hour shift	**Project #** :	2		
Work Days :	1.0 Days		**Estimator** :	Mihaela Tomulescu		
				EA per	**Total Cost**	**Unit Price Per EA**
Unit Price :	$861.46 per EA		**Probable Low Cost Parameter**	**2.2**	**$1,551**	**$775.31**
Total Cost :	$1,723		**Probable High Cost Parameter**	**1.8**	**$1,895**	**$947.61**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Hydraulic Crane (35tn)	Active	1.00	0.2	8	1.60	E	$116.30	incl. in rate	incl. in rate	$186.08
Equipment Operator (crane)	Active	1.00	0.2	8	1.60	L	$68.41	incl. in rate	incl. in rate	$109.46
Laborer	Active	2.00	0.2	8	3.20	L	$45.80	incl. in rate	incl. in rate	$146.56
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.2	8	1.60	E	$31.90	incl. in rate	incl. in rate	$51.04
Truck Driver (light)	Active	1.00	0.2	8	1.60	L	$56.29	incl. in rate	incl. in rate	$90.06
				Labor Hours	**22.4**				**TOTAL LABOR**	**$1,078.08**
				Equipment Hours	**3.2**				**TOTAL EQUIPMENT**	**$237.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$53.90	$53.90
					TOTAL MATERIAL	**$53.90**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,078.08	Labor Burden @		49.7%	$0.00		$1,078.08
Material Cost	$53.90	Material Tax @		7.8%	$4.18		$58.08
Equipment Cost	$237.12	Equipment Tax @		0.0%	$0.00		$237.12
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	**$1,369**				**$4**	**DIRECT COST SUBTOTALS**	**$1,373**
		Crew	**Material**	**Subs**	**Cost Basis**		
Installing Contractors Overhead@	15.0%				$1,373.28		$205.99
Installing Contractors Profit@	8.0%				$1,373.28		$109.86
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$315.85**
General Contractors Insurance @	1.0%		on		$1,689.14		$17
Bond @	1.0%		on		$1,689.14		$17
Contingency @	0.0%		on		$1,722.92		$0
						TOTAL COST for pay item	**$1,723**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1Crane. Considered 1 laborer to help loading circuit breakers from the swichyard in the truck for saving it in the designated place.

PAY ITEM COST DETAIL WORKSHEET — **2.055 Remove & Dispose of 69kV disconnect switches, group-operated**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.055	Project	: COPCO 1
Description	: Remove & Dispose of 69kV disconnect switches, group-operated		
Quantity	: 2.00 EA		
Daily Production	: 2.00 EA per 8 hour shift	Project #	: 2
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $861.46 per EA		
Total Cost	: $1,723		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	2.2	$1,551	$775.31
Probable High Cost Parameter	1.8	$1,895	$947.61

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Hydraulic Crane (35tn)	Active	1.00	0.2	8	1.60	E	$116.30	incl. in rate	incl. in rate	$186.08
Equipment Operator (crane)	Active	1.00	0.2	8	1.60	L	$68.41	incl. in rate	incl. in rate	$109.46
Laborer	Active	2.00	0.2	8	3.20	L	$45.80	incl. in rate	incl. in rate	$146.56
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.2	8	1.60	E	$31.90	incl. in rate	incl. in rate	$51.04
Truck Driver (light)	Active	1.00	0.2	8	1.60	L	$56.29	incl. in rate	incl. in rate	$90.06
				Labor Hours	22.4				TOTAL LABOR	$1,078.08
				Equipment Hours	3.2				TOTAL EQUIPMENT	$237.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$53.90	$53.90
					TOTAL MATERIAL	$53.90

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,078.08	Labor Burden @		49.7%	$0.00		$1,078.08
Material Cost	$53.90	Material Tax @		7.8%	$4.18		$58.08
Equipment Cost	$237.12	Equipment Tax @		0.0%	$0.00		$237.12
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$1,369				$4	DIRECT COST SUBTOTALS	$1,373

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,373.28		$205.99
Installing Contractors Profit@	8.0%				$1,373.28		$109.86
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$315.85
General Contractors Insurance @	1.0%		on		$1,689.14		$17
Bond @	1.0%		on		$1,689.14		$17
Contingency @	0.0%		on		$1,722.92		$0
						TOTAL COST for pay item	$1,723

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1Crane. Considered 1 laborer to help loading circuit breakers from the swichyard in the truck for saving it in the designated place.

PAY ITEM COST DETAIL WORKSHEET **2.056 Remove & Dispose of 60-foot wood poles**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.056		Project	: COPCO 1		
Description	:	Remove & Dispose of 60-foot wood poles					
Quantity	:	12.00 EA					
Daily Production	:	5.00 EA per	8 hour shift	Project #	: 2		
Work Days	:	2.4	Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$1,296.96 per EA		Probable Low Cost Parameter		5.75	$13,229	$1,102.41
Total Cost	:	$15,563		Probable High Cost Parameter		4	$18,676	$1,556.35

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.4	8	19.20	L	$46.27	incl. in rate	incl. in rate	$888.38
Electrician	Active	1.00	2.4	8	19.20	L	$45.23	incl. in rate	incl. in rate	$868.42
Hydraulic Crane (17tn)	Active	1.00	2.4	8	19.20	E	$81.52	incl. in rate	incl. in rate	$1,565.18
Equipment Operator (medium)	Active	1.00	2.4	8	19.20	L	$66.28	incl. in rate	incl. in rate	$1,272.58
Truck Driver (heavy)	Active	1.00	2.4	8	19.20	L	$57.59	incl. in rate	incl. in rate	$1,105.73
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.4	8	19.20	E	$111.64	incl. in rate	incl. in rate	$2,143.49
Laborer	Active	2.00	2.4	8	38.40	L	$45.80	incl. in rate	incl. in rate	$1,758.72
Vibratory Hammer & Extractor	Active	1.00	2.4	8	19.20	E	$94.34	incl. in rate	incl. in rate	$1,811.33
Truck, Utility, with Man-Basket	Active	1.00	2.4	8	19.20	E	$31.90	incl. in rate	incl. in rate	$612.48
				Labor Hours	115.2				TOTAL LABOR	$5,893.82
				Equipment Hours	76.8				TOTAL EQUIPMENT	$6,132.48

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$294.69	$294.69
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	12.00	CY	1.000	12.00	$4.74	$56.88
					TOTAL MATERIAL	$351.57

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$5,893.82	Labor Burden @	49.7%	$0.00		$5,893.82
Material Cost	$351.57	Material Tax @	7.8%	$27.25		$378.82
Equipment Cost	$6,132.48	Equipment Tax @	0.0%	$0.00		$6,132.48
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$12,378			$27	DIRECT COST SUBTOTALS	$12,405

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$12,405.12		$1,860.77
Installing Contractors Profit@	8.0%				$12,405.12		$992.41
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$2,853.18
General Contractors Insurance @	1.0%			on	$15,258.30		$153
Bond @	1.0%			on	$15,258.30		$153
Contingency @	0.0%			on	$15,563.47		$0
						TOTAL COST for pay item	$15,563

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane and 1 man-basket truck to help untie the line. Considered 2 laborer and 1 Vibratory Hammer for demolish the pole foundation, helping placing poles in a designated place and loading them in the truck for disposal. This process includes filling in pole locations with gravel, clean fill and topsoil.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.057	Project	: COPCO 1
Description	:	Remove & Dispose of 30-foot wood cross arms		
Quantity	:	24.00 EA		
Daily Production	:	24.00 EA per 8 hour shift	Project #	: 2
Work Days	:	1.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	:	$484.41 per EA		
Total Cost	:	$11,626		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	27.6	$9,882	$411.75
Probable High Cost Parameter	19.2	$13,951	$581.30

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Hydraulic Crane (17tn)	Active	1.00	1.0	8	8.00	E	$81.52	incl. in rate	incl. in rate	$652.16
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Truck Driver (heavy)	Active	1.00	5.0	8	40.00	L	$57.59	incl. in rate	incl. in rate	$2,303.60
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	5.0	8	40.00	E	$111.64	incl. in rate	incl. in rate	$4,465.60

Labor Hours	72	TOTAL LABOR	$3,936.80
Equipment Hours	48	TOTAL EQUIPMENT	$5,117.76

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$196.84	$196.84
					TOTAL MATERIAL	$196.84

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$3,936.80	Labor Burden @	49.7%	$0.00		$3,936.80
Material Cost	$196.84	Material Tax @	7.8%	$15.26		$212.10
Equipment Cost	$5,117.76	Equipment Tax @	0.0%	$0.00		$5,117.76
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$9,251			$15	DIRECT COST SUBTOTALS	$9,267

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$9,266.66		$1,390.00
Installing Contractors Profit@	8.0%				$9,266.66		$741.33
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$2,131.33
General Contractors Insurance @	1.0%			on	$11,397.99		$114
Bond @	1.0%			on	$11,397.99		$114
Contingency @	0.0%			on	$11,625.95		$0
						TOTAL COST for pay item	$11,626

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane and 1 truck to dispose the cross arms.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.058		Project	: COPCO 1		
Description	:	Remove & Dispose of 69-kV insulator strings					
Quantity	:	12.00 EA					
Daily Production	:	6.00 EA per 8 hour shift		Project #	: 2		
Work Days	:	2.0 Days		Estimator	: Mihaela Tomulescu		
					EA per	Total Cost	Unit Price Per EA
Unit Price	:	$372.92 per EA		Probable Low Cost Parameter	6.9	$3,804	$316.98
Total Cost	:	$4,475		Probable High Cost Parameter	4.8	$5,370	$447.50

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Pickup (4x4, 3/4tn)	Active	1.00	2.0	8	16.00	E	$16.94	incl. in rate	incl. in rate	$271.04

Labor Hours	64	TOTAL LABOR	$3,127.36
Equipment Hours	16	TOTAL EQUIPMENT	$271.04

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$156.37	$156.37
					TOTAL MATERIAL	$156.37

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$3,127.36	Labor Burden @	49.7%	$0.00		$3,127.36
Material Cost	$156.37	Material Tax @	7.8%	$12.12		$168.49
Equipment Cost	$271.04	Equipment Tax @	0.0%	$0.00		$271.04
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$3,555			$12	DIRECT COST SUBTOTALS	$3,567

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,566.89	$535.03
Installing Contractors Profit@	8.0%				$3,566.89	$285.35
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$820.38
General Contractors Insurance @	1.0%		on		$4,387.27	$44
Bond @	1.0%		on		$4,387.27	$44
Contingency @	0.0%		on		$4,475.02	$0
					TOTAL COST for pay item	$4,475

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane and 1 truck to dispose the insulator strings.

PAY ITEM COST DETAIL WORKSHEET — **2.059 Remove & Dispose of Transmission Line No. 3**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.059	**Project**	: COPCO 1			
Description	: Remove & Dispose of Transmission Line No. 3					
Quantity	: 1.66 MILE					
Daily Production	: 0.50 MILE per 8 hour shift	**Project #**	: 2			
Work Days	: 3.3 Days	**Estimator**	: Mihaela Tomulescu	**MILE per**	**Total Cost**	**Unit Price Per MILE**
Unit Price	: $31,411.84 per MILE	**Probable Low Cost Parameter**		**0.575**	**$44,322**	**$26,700.06**
Total Cost	: $52,144	**Probable High Cost Parameter**		**0.375**	**$65,180**	**$39,264.80**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	3.3	8	26.56	L	$47.23	incl. in rate	incl. in rate	$1,254.43
Electrician	Active	2.00	3.3	8	53.12	L	$45.23	incl. in rate	incl. in rate	$2,402.62
Truck, Utility, with Man-Basket	Active	2.00	3.3	8	53.12	E	$31.90	incl. in rate	incl. in rate	$1,694.53
Truck Driver (heavy)	Active	4.00	3.3	8	106.24	L	$57.59	incl. in rate	incl. in rate	$6,118.36
Laborer	Active	2.00	3.3	8	53.12	L	$45.80	incl. in rate	incl. in rate	$2,432.90
Hydraulic Excavator (2.5cy)	Active	1.00	3.3	8	26.56	E	$203.63	incl. in rate	incl. in rate	$5,408.41
Hydraulic Crane (80tn)	Active	1.00	3.3	8	26.56	E	$190.46	incl. in rate	incl. in rate	$5,058.62
Equipment Operator (crane)	Active	1.00	3.3	8	26.56	L	$68.41	incl. in rate	incl. in rate	$1,816.97
Equipment Operator (light)	Active	1.00	3.3	8	26.56	L	$64.90	incl. in rate	incl. in rate	$1,723.74
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	3.3	8	26.56	E	$62.72	incl. in rate	incl. in rate	$1,665.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	3.3	8	79.68	E	$31.90	incl. in rate	incl. in rate	$2,541.79
				Labor Hours	**292.16**				**TOTAL LABOR**	**$15,749.02**
				Equipment Hours	**212.48**				**TOTAL EQUIPMENT**	**$16,369.19**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$787.45	$787.45
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	31.00	CY	1.000	31.00	$4.74	$146.94
					TOTAL MATERIAL	**$934.39**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	3.32	days		$3,000.00	$9,960.00
				TOTAL SUBCONTRACTS	**$9,960.00**

SUMMARY OF COSTS

Labor Cost	$15,749.02	Labor Burden @	49.7%	$0.00	$15,749.02
Material Cost	$934.39	Material Tax @	7.8%	$72.42	$1,006.81
Equipment Cost	$16,369.19	Equipment Tax @	0.0%	$0.00	$16,369.19
Subcontractors	$9,960.00				$9,960.00
DIRECT COST SUBTOTALS	**$43,013**			**$72**	**DIRECT COST SUBTOTALS** **$43,085**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$33,125.02	$4,968.75
Installing Contractors Profit@	8.0%				$32,118.21	$2,569.46
GC Markup on Subs @	5.0%				$9,960.00	$498.00
					TOTAL MARKUP COSTS	**$8,036.21**
General Contractors Insurance @	1.0%		on		$51,121.23	$511
Bond @	1.0%		on		$51,121.23	$511
Contingency @	0.0%		on		$52,143.65	$0
					TOTAL COST for pay item	**$52,144**

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :2 Electrician,, 1 utility truck to access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. Transmission line poles or structures are 60 feet tall. There are several different kinds of transmission structures. Transmission structures are constructed of wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. Pole height and load capacity limitations determine the distance between poles (span length) either on the basis of ground clearance or ability to support heavy wind and ice loads. Assumed average span between structures to be 275 feet so for 1.66 miles of overhead transmission we will have aproximately 31 structures. In areas where single-pole structures are preferred, weak or wet soils may require concrete foundations for support. Where a transmission line must cross a street or slightly change direction, larger angle structures or guy wires may be required. Poles with guy wires impact a much larger area. Angle structures are usually more than double the diameter of other steel poles. They are made of steel, usually five to six feet in diameter, and have a large concrete base. The base may be buried ten or more feet below the ground surface. The diameter of the pole and the depth the base is buried depends on the condition of the soils and the voltage of the line. Assumed the structures are disposed to Yreka recycling, 36 miles away.This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.060		Project	: COPCO 1		
Description	: Remove & Dispose of Transmission Line No. 15					
Quantity	: 1.33 MILE					
Daily Production	: 0.50 MILE per 8 hour shift		Project #	: 2		
Work Days	: 2.7 Days		Estimator	: Mihaela Tomulescu		
				MILE per	Total Cost	Unit Price Per MILE
Unit Price	: $31,417.08 per MILE		Probable Low Cost Parameter	0.575	$35,517	$26,704.51
Total Cost	: $41,785		Probable High Cost Parameter	0.375	$52,231	$39,271.34

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.7	8	21.28	L	$47.23	incl. in rate	incl. in rate	$1,005.05
Electrician	Active	2.00	2.7	8	42.56	L	$45.23	incl. in rate	incl. in rate	$1,924.99
Truck, Utility, with Man-Basket	Active	2.00	2.7	8	42.56	E	$31.90	incl. in rate	incl. in rate	$1,357.66
Truck Driver (heavy)	Active	4.00	2.7	8	85.12	L	$57.59	incl. in rate	incl. in rate	$4,902.06
Laborer	Active	2.00	2.7	8	42.56	L	$45.80	incl. in rate	incl. in rate	$1,949.25
Hydraulic Excavator (2.5cy)	Active	1.00	2.7	8	21.28	E	$203.63	incl. in rate	incl. in rate	$4,333.25
Hydraulic Crane (80tn)	Active	1.00	2.7	8	21.28	E	$190.46	incl. in rate	incl. in rate	$4,052.99
Equipment Operator (crane)	Active	1.00	2.7	8	21.28	L	$68.41	incl. in rate	incl. in rate	$1,455.76
Equipment Operator (light)	Active	1.00	2.7	8	21.28	L	$64.90	incl. in rate	incl. in rate	$1,381.07
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	2.7	8	21.28	E	$62.72	incl. in rate	incl. in rate	$1,334.68
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	2.7	8	63.84	E	$31.90	incl. in rate	incl. in rate	$2,036.50
				Labor Hours	234.08				TOTAL LABOR	$12,618.19
				Equipment Hours	170.24				TOTAL EQUIPMENT	$13,115.08

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$630.91	$630.91
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	26.00	CY	1.000	26.00	$4.74	$123.24
					TOTAL MATERIAL	$754.15

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	2.66	days		$3,000.00	$7,980.00
				TOTAL SUBCONTRACTS	$7,980.00

SUMMARY OF COSTS

Labor Cost	$12,618.19	Labor Burden @	49.7%	$0.00		$12,618.19
Material Cost	$754.15	Material Tax @	7.8%	$58.45		$812.60
Equipment Cost	$13,115.08	Equipment Tax @	0.0%	$0.00		$13,115.08
Subcontractors	$7,980.00					$7,980.00
DIRECT COST SUBTOTALS	$34,467			$58	DIRECT COST SUBTOTALS	$34,526

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$26,545.86	$3,981.88
Installing Contractors Profit@	8.0%				$25,733.27	$2,058.66
GC Markup on Subs @	5.0%				$7,980.00	$399.00
					TOTAL MARKUP COSTS	$6,439.54
General Contractors Insurance @	1.0%		on		$40,965.40	$410
Bond @	1.0%		on		$40,965.40	$410
Contingency @	0.0%		on		$41,784.71	$0
					TOTAL COST for pay item	$41,785

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :2 Electrician,, 1 utility truck to access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. Transmission line poles or structures are 60 feet tall. There are several different kinds of transmission structures. Transmission structures are constructed of wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. Pole height and load capacity limitations determine the distance between poles (span length) either on the basis of ground clearance or ability to support heavy wind and ice loads. Assumed average span between structures to be 275 feet so for 1.33 miles of overhead transmission we will have aproximately 26 structures. In areas where single-pole structures are preferred, weak or wet soils may require concrete foundations for support. Where a transmission line must cross a street or slightly change direction, larger angle structures or guy wires may be required. Poles with guy wires impact a much larger area. Angle structures are usually more than double the diameter of other steel poles. They are made of steel, usually five to six feet in diameter, and have a large concrete base. The base may be buried ten or more feet below the ground surface. The diameter of the pole and the depth the base is buried depends on the condition of the soils and the voltage of the line. Assumed the structures are disposed to Yreka recycling, 36 miles away.This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.061		Project	: COPCO 1		
Description	: Remove & Dispose of Transmission Line No. 26-1					
Quantity	: 0.07 MILE					
Daily Production	: 0.50 MILE per 8 hour shift		Project #	: 2		
Work Days	: 0.1 Days		Estimator	: Mihaela Tomulescu		
				MILE per	Total Cost	Unit Price Per MILE
Unit Price	: $33,525.16 per MILE		Probable Low Cost Parameter	0.575	$1,995	$28,496.39
Total Cost	: $2,347		Probable High Cost Parameter	0.375	$2,933	$41,906.45

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.1	8	1.12	L	$47.23	incl. in rate	incl. in rate	$52.90
Electrician	Active	2.00	0.1	8	2.24	L	$45.23	incl. in rate	incl. in rate	$101.32
Truck, Utility, with Man-Basket	Active	2.00	0.1	8	2.24	E	$31.90	incl. in rate	incl. in rate	$71.46
Truck Driver (heavy)	Active	4.00	0.1	8	4.48	L	$57.59	incl. in rate	incl. in rate	$258.00
Laborer	Active	2.00	0.1	8	2.24	L	$45.80	incl. in rate	incl. in rate	$102.59
Hydraulic Excavator (2.5cy)	Active	1.00	0.1	8	1.12	E	$203.63	incl. in rate	incl. in rate	$228.07
Hydraulic Crane (80tn)	Active	1.00	0.1	8	1.12	E	$190.46	incl. in rate	incl. in rate	$213.32
Equipment Operator (crane)	Active	1.00	0.1	8	1.12	L	$68.41	incl. in rate	incl. in rate	$76.62
Equipment Operator (light)	Active	1.00	0.1	8	1.12	L	$64.90	incl. in rate	incl. in rate	$72.69
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	0.1	8	1.12	E	$62.72	incl. in rate	incl. in rate	$70.25
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	0.1	8	3.36	E	$31.90	incl. in rate	incl. in rate	$107.18
				Labor Hours	12.32				TOTAL LABOR	$664.12
				Equipment Hours	8.96				TOTAL EQUIPMENT	$690.27

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$33.21	$33.21
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	26.00	CY	1.000	26.00	$4.74	$123.24
					TOTAL MATERIAL	$156.45

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	0.14	days		$3,000.00	$420.00
				TOTAL SUBCONTRACTS	$420.00

SUMMARY OF COSTS

Labor Cost	$664.12	Labor Burden @	49.7%	$0.00	$664.12
Material Cost	$156.45	Material Tax @	7.8%	$12.12	$168.57
Equipment Cost	$690.27	Equipment Tax @	0.0%	$0.00	$690.27
Subcontractors	$420.00				$420.00
DIRECT COST SUBTOTALS	$1,931			$12	DIRECT COST SUBTOTALS $1,943

	%	Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,522.95	$228.44
Installing Contractors Profit@	8.0%				$1,354.38	$108.35
GC Markup on Subs @	5.0%				$420.00	$21.00
					TOTAL MARKUP COSTS	$357.79
General Contractors Insurance @	1.0%			on	$2,300.75	$23
Bond @	1.0%			on	$2,300.75	$23
Contingency @	0.0%			on	$2,346.76	$0
					TOTAL COST for pay item	$2,347

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :2 Electrician,, 1 utility truck to access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. Transmission line poles or structures are 60 feet tall. There are several different kinds of transmission structures. Transmission structures are constructed of wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. Pole height and load capacity limitations determine the distance between poles (span length) either on the basis of ground clearance or ability to support heavy wind and ice loads. Assumed average span between structures to be 275 feet so for 0.07 miles of overhead transmission we will have aproximately 2 structures. In areas where single-pole structures are preferred, weak or wet soils may require concrete foundations for support. Where a transmission line must cross a street or slightly change direction, larger angle structures or guy wires may be required. Poles with guy wires impact a much larger area. Angle structures are usually more than double the diameter of other steel poles. They are made of steel, usually five to six feet in diameter, and have a large concrete base. The base may be buried ten or more feet below the ground surface. The diameter of the pole and the depth the base is buried depends on the condition of the soils and the voltage of the line. Assumed the structures are disposed to Yreka recycling, 36 miles away.This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.062	Project	: COPCO 1		
Description	:	Remove & Dispose of Transmission Line No. 26-2				
Quantity	:	0.07 MILE				
Daily Production	:	0.50 MILE per 8 hour shift	Project #	: 2		
Work Days	:	0.1 Days	Estimator	: Mihaela Tomulescu	MILE per	Total Cost	Unit Price Per MILE
Unit Price	:	$33,525.16 per MILE	Probable Low Cost Parameter		0.575	$1,995	$28,496.39
Total Cost	:	$2,347	Probable High Cost Parameter		0.375	$2,933	$41,906.45

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.1	8	1.12	L	$47.23	incl. in rate	incl. in rate	$52.90
Electrician	Active	2.00	0.1	8	2.24	L	$45.23	incl. in rate	incl. in rate	$101.32
Truck, Utility, with Man-Basket	Active	2.00	0.1	8	2.24	E	$31.90	incl. in rate	incl. in rate	$71.46
Truck Driver (heavy)	Active	4.00	0.1	8	4.48	L	$57.59	incl. in rate	incl. in rate	$258.00
Laborer	Active	2.00	0.1	8	2.24	L	$45.80	incl. in rate	incl. in rate	$102.59
Hydraulic Excavator (2.5cy)	Active	1.00	0.1	8	1.12	E	$203.63	incl. in rate	incl. in rate	$228.07
Hydraulic Crane (80tn)	Active	1.00	0.1	8	1.12	E	$190.46	incl. in rate	incl. in rate	$213.32
Equipment Operator (crane)	Active	1.00	0.1	8	1.12	L	$68.41	incl. in rate	incl. in rate	$76.62
Equipment Operator (light)	Active	1.00	0.1	8	1.12	L	$64.90	incl. in rate	incl. in rate	$72.69
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	0.1	8	1.12	E	$62.72	incl. in rate	incl. in rate	$70.25
Truck, Flatbed (4x4, 10,000 gvw)	Active	3.00	0.1	8	3.36	E	$31.90	incl. in rate	incl. in rate	$107.18
				Labor Hours	12.32				TOTAL LABOR	$664.12
				Equipment Hours	8.96				TOTAL EQUIPMENT	$690.27

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$33.21	$33.21
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	26.00	CY	1.000	26.00	$4.74	$123.24
					TOTAL MATERIAL	$156.45

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	0.14	days		$3,000.00	$420.00
				TOTAL SUBCONTRACTS	$420.00

SUMMARY OF COSTS

Labor Cost	$664.12	Labor Burden @	49.7%	$0.00		$664.12
Material Cost	$156.45	Material Tax @	7.8%	$12.12		$168.57
Equipment Cost	$690.27	Equipment Tax @	0.0%	$0.00		$690.27
Subcontractors	$420.00					$420.00
DIRECT COST SUBTOTALS	$1,931			$12	DIRECT COST SUBTOTALS	$1,943

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,522.95		$228.44
Installing Contractors Profit@	8.0%				$1,354.38		$108.35
GC Markup on Subs @	5.0%				$420.00		$21.00
						TOTAL MARKUP COSTS	$357.79
General Contractors Insurance @	1.0%			on	$2,300.75		$23
Bond @	1.0%			on	$2,300.75		$23
Contingency @	0.0%			on	$2,346.76		$0
						TOTAL COST for pay item	$2,347

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :2 Electrician,, 1 utility truck to access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. Transmission line poles or structures are 60 feet tall. There are several different kinds of transmission structures. Transmission structures are constructed of wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. Pole height and load capacity limitations determine the distance between poles (span length) either on the basis of ground clearance or ability to support heavy wind and ice loads. Assumed average span between structures to be 275 feet so for 0.07 miles of overhead transmission we will have aproximately 2 structures. In areas where single-pole structures are preferred, weak or wet soils may require concrete foundations for support. Where a transmission line must cross a street or slightly change direction, larger angle structures or guy wires may be required. Poles with guy wires impact a much larger area. Angle structures are usually more than double the diameter of other steel poles. They are made of steel, usually five to six feet in diameter, and have a large concrete base. The base may be buried ten or more feet below the ground surface. The diameter of the pole and the depth the base is buried depends on the condition of the soils and the voltage of the line. Assumed the structures are disposed to Yreka recycling, 36 miles away.This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM COST DETAIL WORKSHEET **2.063 Remove gate house #1 from top of dam**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.063		Project	: Copco 1		
Description	: Remove gate house #1 from top of dam					
Quantity	: 720.00 SF					
Daily Production	: 250.00 SF per 8 hour shift		Project #	: 2		
Work Days	: 2.9 Days		Estimator	: Eric Jones	SF per	Total Cost	Unit Price Per SF
Unit Price	: $72.06 per SF		Probable Low Cost Parameter		287.5	$44,098	$61.25
Total Cost	: $51,880		Probable High Cost Parameter		187.5	$64,850	$90.07

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Carpenter Foreman (out)	Active	1.00	2.9	8	23.20	L	$46.40	incl. in rate	incl. in rate	$1,076.48
Carpenters	Active	2.00	2.9	8	46.40	L	$72.60	incl. in rate	incl. in rate	$3,368.64
Laborer	Active	4.00	2.9	8	92.80	L	$45.80	incl. in rate	incl. in rate	$4,250.24
Truck Driver (heavy)	Active	2.00	2.9	8	46.40	L	$57.59	incl. in rate	incl. in rate	$2,672.18
Equipment Operator (medium)	Active	3.00	2.9	8	69.60	L	$66.28	incl. in rate	incl. in rate	$4,613.09
Equipment Operator (crane)	Active	2.00	***1.5***	8	24.00	L	$68.41	incl. in rate	incl. in rate	$1,641.84
Truck Driver (heavy)	Active	1.00	2.9	8	23.20	L	$57.59	incl. in rate	incl. in rate	$1,336.09
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	2.9	8	46.40	E	$70.35	incl. in rate	incl. in rate	$3,264.24
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	2.9	8	23.20	E	$31.90	incl. in rate	incl. in rate	$740.08
Hydraulic Crane (80tn)	Active	1.00	***1.5***	8	12.00	E	$190.46	incl. in rate	incl. in rate	$2,285.52
Hydraulic Excavator (5.0cy)	Active	2.00	2.9	8	46.40	E	$274.63	incl. in rate	incl. in rate	$12,742.83
Loader, FE Rubber Tire (5.25cy)	Active	1.00	2.9	8	23.20	E	$75.42	incl. in rate	incl. in rate	$1,749.74
			2.9	8	0.00		$2.50			$0.00
			2.9	8	0.00					$0.00
			2.9	8	0.00					$0.00
			2.9	8	0.00					$0.00
			2.9	8	0.00					$0.00
				Labor Hours	**325.6**				**TOTAL LABOR**	**$18,958.55**
				Equipment Hours	**151.2**				**TOTAL EQUIPMENT**	**$20,782.42**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$150.00	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$18,958.55	Labor Burden @	0.0%			$18,958.55
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$20,782.42	Equipment Tax @	7.75%	$1,610.64		$22,393.05
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$39,741**			**$1,611**	**DIRECT COST SUBTOTALS**	**$41,352**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$41,351.61	$6,202.74
Installing Contractors Profit@	8.0%				$41,351.61	$3,308.13
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$9,510.87**
General Contractors Insurance @	1.0%			on	$50,862.47	$509
Bond @	1.0%			on	$50,862.47	$509
Contingency @	0.0%			on	$51,879.72	$0
					TOTAL COST for pay item	**$51,880**

Additional Pay Item Notes :

Remove Head Gate Building. Assumption the crew can remove 1/3 of the building per day. Crane is used to load items on flat bed figured using it half of the duration.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.064	Project	: Copco 1			
Description	: Remove gate house #2 from top of dam					
Quantity	: 690.00 SF					
Daily Production	: 250.00 SF per 8 hour shift	Project #	: 2			
Work Days	: 2.8 Days	Estimator	: Eric Jones	SF per	Total Cost	Unit Price Per SF
Unit Price	: $74.35 per SF	Probable Low Cost Parameter		287.5	$43,607	$63.20
Total Cost	: $51,302	Probable High Cost Parameter		187.5	$64,128	$92.94

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Carpenter Foreman (out)	Active	1.00	2.8	8	22.40	L	$46.40	incl. in rate	incl. in rate	$1,039.36
Carpenters	Active	2.00	2.8	8	44.80	L	$72.60	incl. in rate	incl. in rate	$3,252.48
Laborer	Active	4.00	2.8	8	89.60	L	$45.80	incl. in rate	incl. in rate	$4,103.68
Truck Driver (heavy)	Active	2.00	2.8	8	44.80	L	$57.59	incl. in rate	incl. in rate	$2,580.03
Equipment Operator (medium)	Active	3.00	2.8	8	67.20	L	$66.28	incl. in rate	incl. in rate	$4,454.02
Equipment Operator (crane)	Active	2.00	2.8	8	44.80	L	$68.41	incl. in rate	incl. in rate	$3,064.77
Truck Driver (heavy)	Active	1.00	***1.5***	8	12.00	L	$57.59	incl. in rate	incl. in rate	$691.08
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	2.8	8	44.80	E	$70.35	incl. in rate	incl. in rate	$3,151.68
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	2.8	8	22.40	E	$31.90	incl. in rate	incl. in rate	$714.56
Hydraulic Crane (80tn)	Active	1.00	***1.5***	8	12.00	E	$190.46	incl. in rate	incl. in rate	$2,285.52
Hydraulic Excavator (5.0cy)	Active	2.00	2.8	8	44.80	E	$274.63	incl. in rate	incl. in rate	$12,303.42
Loader, FE Rubber Tire (5.25cy)	Active	1.00	2.8	8	22.40	E	$75.42	incl. in rate	incl. in rate	$1,689.41
			2.8	8	0.00		$2.50			$0.00
			2.8	8	0.00					$0.00
			2.8	8	0.00					$0.00
			2.8	8	0.00					$0.00
			2.8	8	0.00					$0.00
				Labor Hours	325.6				TOTAL LABOR	$19,185.42
				Equipment Hours	146.4				TOTAL EQUIPMENT	$20,144.59

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$150.00	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$19,185.42	Labor Burden @	0.0%			$19,185.42
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$20,144.59	Equipment Tax @	7.75%	$1,561.21		$21,705.80
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$39,330			$1,561	DIRECT COST SUBTOTALS	$40,891

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$40,891.21		$6,133.68
Installing Contractors Profit@	8.0%				$40,891.21		$3,271.30
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$9,404.98
General Contractors Insurance @	1.0%			on	$50,296.19		$503
Bond @	1.0%			on	$50,296.19		$503
Contingency @	0.0%			on	$51,302.12		$0
						TOTAL COST for pay item	$51,302

Additional Pay Item Notes :

Remove Head Gate Building. Assumption the crew can remove 1/3 of the building per day. Crane is used to load items on flat bed figured using it half of the duration.

PAY ITEM COST DETAIL WORKSHEET — **2.065 Remove Concrete Items associated with 10 ft. diam. Penstocks, reinf. Concrete**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.065		**Project**	: COPCO 1		
Description	:	Remove Concrete Items associated with 10 ft. diam. Penstocks, reinf. Concrete					
Quantity	:	1,050.00	cy				
Daily Production	:	50.00	cy per 8 hour shift	**Project #**	: 2		
Work Days	:	21.0	Days	**Estimator**	: Felipe Poletto	**cy per**	**Total Cost** / **Unit Price Per cy**
Unit Price	:	$300.38	per cy	**Probable Low Cost Parameter**		**57.5**	**$268,089** / **$255.32**
Total Cost	:	$315,398		**Probable High Cost Parameter**		**37.5**	**$394,248** / **$375.47**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	21.0	8	336.00	L	$48.27	incl. in rate	incl. in rate	$16,218.72
Laborer	Active	8.00	21.0	8	1,344.00	L	$45.80	incl. in rate	incl. in rate	$61,555.20
Equipment Operator (medium)	Active	2.00	21.0	8	336.00	L	$66.28	incl. in rate	incl. in rate	$22,270.08
Truck Driver (heavy)	Active	1.00	21.0	8	168.00	L	$57.59	incl. in rate	incl. in rate	$9,675.12
Air Compressor 900 cfm	Active	1.00	21.0	8	168.00	E	$38.87	incl. in rate	incl. in rate	$6,529.98
Air Compressor 600 cfm	Active	1.00	21.0	8	168.00	E	$21.74	incl. in rate	incl. in rate	$3,652.14
Air Tool, Chipping Hammer	Active	4.00	21.0	8	672.00	E	$1.64	incl. in rate	incl. in rate	$1,101.43
Generator, Small Generator, 10 - 15 kW	Active	2.00	21.0	8	336.00	E	$7.04	incl. in rate	incl. in rate	$2,365.44
Hydraulic Excavator (2.5cy)	Active	2.00	21.0	8	336.00	E	$203.63	incl. in rate	incl. in rate	$68,419.68
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	21.0	8	168.00	E	$62.72	incl. in rate	incl. in rate	$10,536.96
Hydraulic Thumbs/Shear Attachment	Active	1.00	21.0	8	168.00	E	$16.39	incl. in rate	incl. in rate	$2,753.52
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	21.0	8	168.00	E	$111.64	incl. in rate	incl. in rate	$18,755.52
			21.0	8	0.00					$0.00
			21.0	8	0.00					$0.00
			21.0	8	0.00					$0.00
			21.0	8	0.00					$0.00
			21.0	8	0.00					$0.00
				Labor Hours	**2,184**				**TOTAL LABOR**	**$109,719.12**
				Equipment Hours	**2,184**				**TOTAL EQUIPMENT**	**$114,114.67**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$5,485.96	$5,485.96
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$5,485.96**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	6	EA	**Cost per Mob**	$2,500.00	$15,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$15,000.00**

SUMMARY OF COSTS

Labor Cost	$109,719.12	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$109,719.12
Material Cost	$5,485.96	Material Tax @	7.75%	$425.16		$5,911.12
Equipment Cost	$114,114.67	Equipment Tax @	7.75%	$8,843.89		$122,958.55
Subcontractors	$15,000.00					$15,000.00
DIRECT COST SUBTOTALS	**$244,320**			**$9,269**	**DIRECT COST SUBTOTALS**	**$253,589**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$238,588.79	$35,788.32
Installing Contractors Profit@	8.0%				$238,588.79	$19,087.10
GC Markup on Subs @	5.0%				$15,000.00	$750.00
					TOTAL MARKUP COSTS	**$55,625.42**
General Contractors Insurance @	1.0%		on		$309,214.21	$3,092
Bond @	1.0%		on		$309,214.21	$3,092
Contingency @	0.0%		on		$315,398.50	$0
					TOTAL COST for pay item	**$315,398**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposable site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.066	Project	: Copco 1		
Description	: Plug 14-foot diameter penstock with concrete				
Quantity	: 23.00 CY				
Daily Production	: 2.30 CY per 8 hour shift	Project #	: 2		
Work Days	: 10.0 Days	Estimator	: Eric Jones	CY per / Total Cost	Unit Price Per CY
Unit Price	: $3,373.31 per CY	Probable Low Cost Parameter	2.53	$69,828	$3,035.98
Total Cost	: $77,586	Probable High Cost Parameter	1.955	$89,224	$3,879.31

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Carpenter Foreman (out)	Active	1.00	10.0	8	80.00	L	$46.40	incl. in rate	incl. in rate	$3,712.00
Carpenters	Active	2.00	10.0	8	160.00	L	$72.60	incl. in rate	incl. in rate	$11,616.00
Laborer	Active	2.00	10.0	8	160.00	L	$45.80	incl. in rate	incl. in rate	$7,328.00
Cement finisher	Active	2.00	10.0	8	160.00	L	$72.60	incl. in rate	incl. in rate	$11,616.00
Equipment Operator (light)	Active	2.00	10.0	8	160.00	L	$64.90	incl. in rate	incl. in rate	$10,384.00
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	10.0	8	80.00	E	$54.70	incl. in rate	incl. in rate	$4,376.00
Conc Pump (small)	Active	1.00	10.0	8	80.00	E	$61.43	incl. in rate	incl. in rate	$4,914.40
Pump, Trash Pump, 6"+	Active	2.00	10.0	8	160.00	E	$16.11	incl. in rate	incl. in rate	$2,577.60
0		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	10.0	8	80.00	0	$0.00	$0.00		$0.00
			10.0	8	0.00		$2.50			$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
				Labor Hours	720				TOTAL LABOR	$44,656.00
				Equipment Hours	320				TOTAL EQUIPMENT	$11,868.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Concrete	23.00	ea	1.050	24.15	$144.13	$3,480.74
Concrete blocks for backing	400.00	ea	1.050	420.00	$1.43	$600.60
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$4,081.34

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$44,656.00	Labor Burden @	0.0%			$44,656.00
Material Cost	$4,081.34	Material Tax @	7.75%	$316.30		$4,397.64
Equipment Cost	$11,868.00	Equipment Tax @	7.75%	$919.77		$12,787.77
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$60,605			$1,236	DIRECT COST SUBTOTALS	$61,841

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$61,841.41	$9,276.21
Installing Contractors Profit@	8.0%				$61,841.41	$4,947.31
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$14,223.53
General Contractors Insurance @	1.0%		on		$76,064.94	$761
Bond @	1.0%		on		$76,064.94	$761
Contingency @	0.0%		on		$77,586.24	$0
					TOTAL COST for pay item	$77,586

Additional Pay Item Notes :

8 man crew will construct plug in the dry rough 5 days of construction to plug each side for a total of 10 days. Expect 6" pump will be needed day and night entire duration to control water during construction of plugs.

PAY ITEM COST DETAIL WORKSHEET

2.067 Remove & Dispose of 8 screens

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.067		**Project**	: COPCO 1		
Description	:	Remove & Dispose of 8 screens					
Quantity	:	18,000.00 lbs					
Daily Production	:	18,000.00 lbs per 8 hour shift		**Project #**	: 2		
Work Days	:	1.0 Days		**Estimator**	: Mihaela Tomulescu	**lbs per**	**Total Cost** / **Unit Price Per lbs**
Unit Price	:	$1.17 per lbs		**Probable Low Cost Parameter**		**19800**	**$18,913** / **$1.05**
Total Cost	:	$21,014		**Probable High Cost Parameter**		**14400**	**$25,217** / **$1.40**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	incl. in rate	incl. in rate	$386.16
Laborer	Active	4.00	1.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Crawler Crane (270tn)	Active	2.00	1.0	8	16.00	E	$399.50	incl. in rate	incl. in rate	$6,392.00
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Welder	Active	2.00	1.0	8	16.00	L	$7.84	incl. in rate	incl. in rate	$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	incl. in rate	incl. in rate	$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Steelworker	Active	6.00	1.0	8	48.00	L	$65.52	incl. in rate	incl. in rate	$3,144.96
Truck, Flatbed (4x4, 10,000 gvw)	Active	4.00	1.0	8	32.00	E	$31.90	incl. in rate	incl. in rate	$1,020.80
Truck Driver (heavy)	Active	4.00	1.0	8	32.00	L	$57.59	incl. in rate	incl. in rate	$1,842.88
				Labor Hours	**160**				**TOTAL LABOR**	**$8,387.32**
				Equipment Hours	**64**				**TOTAL EQUIPMENT**	**$7,458.83**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$838.73	$838.73
					TOTAL MATERIAL	**$838.73**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$8,387.32	Labor Burden @	49.7%	$0.00		$8,387.32
Material Cost	$838.73	Material Tax @	7.8%	$65.00		$903.73
Equipment Cost	$7,458.83	Equipment Tax @	0.0%	$0.00		$7,458.83
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$16,685**			**$65**	**DIRECT COST SUBTOTALS**	**$16,750**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$16,749.89		$2,512.48
Installing Contractors Profit@	8.0%				$16,749.89		$1,339.99
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$3,852.47**
General Contractors Insurance @	1.0%		on		$20,602.36		$206
Bond @	1.0%		on		$20,602.36		$206
Contingency @	0.0%		on		$21,014.41		$0
						TOTAL COST for pay item	**$21,014**

Additional Pay Item Notes :

Production based on crew 1 Forman, 2 Steelworkers and 1 Welder to cut and attach hooks to the gate for disposal, 4 Laborers to rigging wire rope slings, 1 Electrician to provide power for tools, 1 Truck for 2 screens. Assuming 1 day of work.

PAY ITEM COST DETAIL WORKSHEET **2.068 Remove & Dispose of 8 Water Gates**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.068		Project	: COPCO 1		
Description	:	Remove & Dispose of 8 Water Gates					
Quantity	:	18,000.00 lbs					
Daily Production	:	18,000.00 lbs per 8 hour shift		Project #	: 2		
Work Days	:	1.0 Days		Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$1.10 per lbs		Probable Low Cost Parameter		19800	$17,822	$0.99
Total Cost	:	$19,802		Probable High Cost Parameter		14400	$23,762	$1.32

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Laborer	Active	4.00	1.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Crawler Crane (270tn)	Active	2.00	1.0	8	16.00	E	$399.50	incl. in rate	incl. in rate	$6,392.00
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Welder	Active	2.00	1.0	8	16.00	L	$7.84	incl. in rate	incl. in rate	$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	incl. in rate	incl. in rate	$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	incl. in rate	incl. in rate	$1,048.32
Truck, Flatbed (4x4, 10,000 gvw)	Active	4.00	1.0	8	32.00	E	$31.90	incl. in rate	incl. in rate	$1,020.80
Truck Driver (heavy)	Active	4.00	1.0	8	32.00	L	$57.59	incl. in rate	incl. in rate	$1,842.88
				Labor Hours	128				TOTAL LABOR	$6,274.68
				Equipment Hours	64				TOTAL EQUIPMENT	$7,458.83

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$627.47	$627.47
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	1,500.00	LF	1.000	1,500.00	$0.85	$1,275.00
					TOTAL MATERIAL	$1,902.47

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$6,274.68	Labor Burden @		49.7%	$0.00		$6,274.68
Material Cost	$1,902.47	Material Tax @		7.8%	$147.44		$2,049.91
Equipment Cost	$7,458.83	Equipment Tax @		0.0%	$0.00		$7,458.83
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$15,636				$147	DIRECT COST SUBTOTALS	$15,783

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$15,783.42		$2,367.51
Installing Contractors Profit@	8.0%				$15,783.42		$1,262.67
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$3,630.19
General Contractors Insurance @	1.0%		on		$19,413.61		$194
Bond @	1.0%		on		$19,413.61		$194
Contingency @	0.0%		on		$19,801.88		$0
						TOTAL COST for pay item	$19,802

Additional Pay Item Notes :

Production based on crew 1 Forman, 2 Steelworkers and 1 Welder to cut and attach hooks to the gate for disposal, 4 Laborers to rigging wire rope slings, 1 Electrician to provide power for tools, 1 Truck for 2 gates. Assuming 1 day of work.

PAY ITEM COST DETAIL WORKSHEET — 2.069 Remove & Dispose of 3 - 30" Dia. x 25' stand pipes

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.069		Project	: COPCO 1		
Description	: Remove & Dispose of 3 - 30" Dia. x 25' stand pipes					
Quantity	: 6,000.00 LBS					
Daily Production	: 6,000.00 LBS per	8 hour shift	Project #	: 2		
Work Days	: 1.0 Days		Estimator	: Mihaela Tomulescu		
				LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $0.91 per LBS		Probable Low Cost Parameter	6600	$4,912	$0.82
Total Cost	: $5,458		Probable High Cost Parameter	4800	$6,550	$1.09

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (35tn)	Active	1.00	1.0	8	8.00	E	$116.30	incl. in rate	incl. in rate	$930.40
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Truck Driver (light)	Active	1.00	1.0	8	8.00	L	$56.29	incl. in rate	incl. in rate	$450.32
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	incl. in rate	incl. in rate	$386.16
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	incl. in rate	incl. in rate	$1,048.32

Labor Hours	56	TOTAL LABOR	$3,164.88
Equipment Hours	16	TOTAL EQUIPMENT	$1,185.60

MATERIAL COSTS

Description	Item	Order	Conversion	Order	Order	Material

TOTAL MATERIAL $0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS $0.00

SUMMARY OF COSTS

Labor Cost	$3,164.88	Labor Burden @	49.7%	$0.00		$3,164.88
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$1,185.60	Equipment Tax @	0.0%	$0.00		$1,185.60
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$4,350			$0	DIRECT COST SUBTOTALS	$4,350

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$4,350.48		$652.57
Installing Contractors Profit@	8.0%				$4,350.48		$348.04
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$1,000.61
General Contractors Insurance @	1.0%			on	$5,351.09		$54
Bond @	1.0%			on	$5,351.09		$54
Contingency @	0.0%			on	$5,458.11		$0
						TOTAL COST for pay item	$5,458

Additional Pay Item Notes :

Crew formed of 2 Steelworker to cut the pipes and 2 Laborers that will use the crane to load the pipe in the truck.

PAY ITEM COST DETAIL WORKSHEET

2.070 Remove & Dispose of 14' Dia. penstock pipe

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.070		**Project**	: COPCO 1		
Description	: Remove & Dispose of 14' Dia. penstock pipe					
Quantity	: 256,000.00 LBS					
Daily Production	: 20,000.00 LBS per 8 hour shift		**Project #**	: 2		
Work Days	: 12.8 Days		**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**
Unit Price	: $1.31 per LBS		**Probable Low Cost Parameter**		**23000**	**$284,926**
Total Cost	: $335,207		**Probable High Cost Parameter**		**15000**	**$419,009**

	Unit Price Per LBS
Probable Low Cost Parameter	**$1.11**
Probable High Cost Parameter	**$1.64**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	12.8	8	204.80	L	$46.27	incl. in rate	incl. in rate	$9,476.10
Steelworker	Active	8.00	12.8	8	819.20	L	$65.52	incl. in rate	incl. in rate	$53,673.98
Equipment Operator (crane)	Active	2.00	12.8	8	204.80	L	$68.41	incl. in rate	incl. in rate	$14,010.37
Crawler Crane (130tn)	Active	2.00	12.8	8	204.80	E	$258.66	incl. in rate	incl. in rate	$52,973.57
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	12.8	8	204.80	E	$111.64	incl. in rate	incl. in rate	$22,863.87
Hydraulic Excavator (2.5cy)	Active	2.00	12.8	8	204.80	E	$203.63	incl. in rate	incl. in rate	$41,703.42
Welder	Active	2.00	12.8	8	204.80	L	$7.84	incl. in rate	incl. in rate	$1,605.12
Gas Welding Machine	Active	2.00	12.8	8	204.80	E	$2.88	incl. in rate	incl. in rate	$589.21
Carpenters, Journeyman	Active	2.00	12.8	8	204.80	L	$65.37	incl. in rate	incl. in rate	$13,387.78
Truck Driver (heavy)	Active	2.00	12.8	8	204.80	L	$57.59	incl. in rate	incl. in rate	$11,794.43
Equipment Operator (oiler)	Active	2.00	12.8	8	204.80	L	$62.94	incl. in rate	incl. in rate	$12,890.11
Loader, FE Rubber Tire (8.6cy)	Active	1.00	12.8	8	102.40	E	$221.50	incl. in rate	incl. in rate	$22,681.60
				Labor Hours	**2048**				**TOTAL LABOR**	**$116,837.89**
				Equipment Hours	**921.6**				**TOTAL EQUIPMENT**	**$140,811.67**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$5,841.89	$5,841.89
Fuel charges and consumable for field repair, lubrication, tire, etc 1% labor	1.00	LS	1.000	1.00	$1,408.12	$1,408.12
					TOTAL MATERIAL	**$7,250.01**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (2% of total)	2.56	ton	1.000	$595.00	$1,523.20
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	68.00	mile	1.000	$7.25	$493.00
				TOTAL SUBCONTRACTS	**$2,016.20**

SUMMARY OF COSTS

Labor Cost	$116,837.89	Labor Burden @	49.7%	$0.00	$116,837.89
Material Cost	$7,250.01	Material Tax @	7.8%	$561.88	$7,811.89
Equipment Cost	$140,811.67	Equipment Tax @	0.0%	$0.00	$140,811.67
Subcontractors	$2,016.20				$2,016.20
DIRECT COST SUBTOTALS	**$266,916**			**$562**	**DIRECT COST SUBTOTALS** **$267,478**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$265,461.45	$39,819.22
Installing Contractors Profit@	8.0%				$265,461.45	$21,236.92
GC Markup on Subs @	5.0%				$2,016.20	$100.81
					TOTAL MARKUP COSTS	**$61,156.94**
General Contractors Insurance @	1.0%			on	$328,634.59	$3,286
Bond @	1.0%			on	$328,634.59	$3,286
Contingency @	0.0%			on	$335,207.28	$0
					TOTAL COST for pay item	**$335,207**

Additional Pay Item Notes :

Removal for pipe, expansion joints and support rings using E-19 crews for demolition. 2 Crews formed from 1 forman, 2 steelworker, 1 welder, 2 carpenters. 3 equipment operators 1 for the crane, 1 excavator and 1 loader. 2 truck driver to drive off road the rubbish. Assumed that the steel includes exterior coatings containing heavy metals so the scrap metal painted with heavy metals will be sent to Yreka salvage yard for recycling 2% of total lbs, average miles 34. Fuel charges and consumable for field repair, lubrication, tire, etc are applied.

PAY ITEM COST DETAIL WORKSHEET

2.071 Remove & Dispose of 10' Dia. penstock pipe

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.071		**Project**	: COPCO1
Description	: Remove & Dispose of 10' Dia. penstock pipe			
Quantity	: 270,000.00 LBS			
Daily Production	: 20,000.00 LBS per 8 hour shift		**Project #**	: 2
Work Days	: 13.5 Days		**Estimator**	: Mihaela Tomulescu
Unit Price	: $1.37 per LBS			
Total Cost	: $370,853			

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	23000	$315,225	$1.17
Probable High Cost Parameter	15000	$463,566	$1.72

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	13.5	8	216.00	L	$46.27	incl. in rate	incl. in rate	$9,994.32
Steelworker	Active	8.00	13.5	8	864.00	L	$65.52	incl. in rate	incl. in rate	$56,609.28
Equipment Operator (crane)	Active	2.00	13.5	8	216.00	L	$68.41	incl. in rate	incl. in rate	$14,776.56
Crawler Crane (130tn)	Active	2.00	13.5	8	216.00	E	$258.66	incl. in rate	incl. in rate	$55,870.56
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	13.5	8	216.00	E	$111.64	incl. in rate	incl. in rate	$24,114.24
Hydraulic Excavator (5.0cy)	Active	2.00	13.5	8	216.00	E	$274.63	incl. in rate	incl. in rate	$59,320.08
Welder	Active	2.00	13.5	8	216.00	L	$7.84	incl. in rate	incl. in rate	$1,692.90
Gas Welding Machine	Active	2.00	13.5	8	216.00	E	$2.88	incl. in rate	incl. in rate	$621.43
Carpenters, Journeyman	Active	2.00	13.5	8	216.00	L	$65.37	incl. in rate	incl. in rate	$14,119.92
Carpenter Foreman (out)	Active	2.00	13.5	8	216.00	L	$46.40	incl. in rate	incl. in rate	$10,022.40
Equipment Operator (oiler)	Active	2.00	13.5	8	216.00	L	$62.94	incl. in rate	incl. in rate	$13,595.04
Loader, FE Rubber Tire (8.6cy)	Active	1.00	13.5	8	108.00	E	$221.50	incl. in rate	incl. in rate	$23,922.00
				Labor Hours	**2160**				**TOTAL LABOR**	**$120,810.42**
				Equipment Hours	**972**				**TOTAL EQUIPMENT**	**$163,848.31**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$6,040.52	$6,040.52
Fuel charges and consumable for field repair, lubrication, tire, etc 2% labor	1.00	LS	1.000	1.00	$3,276.97	$3,276.97
					TOTAL MATERIAL	**$9,317.49**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (1% of total)	1.35	ton	1.000	$595.00	$803.25
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	$7.25	$246.50
				TOTAL SUBCONTRACTS	**$1,049.75**

SUMMARY OF COSTS

Labor Cost	$120,810.42	Labor Burden @	49.7%	$0.00	$120,810.42
Material Cost	$9,317.49	Material Tax @	7.8%	$722.11	$10,039.59
Equipment Cost	$163,848.31	Equipment Tax @	0.0%	$0.00	$163,848.31
Subcontractors	$1,049.75				$1,049.75
DIRECT COST SUBTOTALS	**$295,026**			**$722**	**DIRECT COST SUBTOTALS** **$295,748**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$294,698.32	$44,204.75
Installing Contractors Profit@	8.0%				$294,698.32	$23,575.87
GC Markup on Subs @	5.0%				$1,049.75	$52.49
					TOTAL MARKUP COSTS	**$67,833.10**
General Contractors Insurance @	1.0%			on	$363,581.17	$3,636
Bond @	1.0%			on	$363,581.17	$3,636
Contingency @	0.0%			on	$370,852.80	$0
					TOTAL COST for pay item	**$370,853**

Additional Pay Item Notes :

Removal for pipe, expansion joints and support rings using E-19 crews for demolition. 2 Crews formed from 1 forman, 4 steelworker, 1 welder, 2 carpenters. 3 equipment operators 1 for the crane, 1 excavator and 1 loader. 2 truck drivers to drive off road the rubbish. Assumed that the steel includes exterior coatings containing heavy metals so the scrap metal painted with heavy metals will be sent to Yreka salvage yard for recycling 1% of total lbs, average miles 34. Fuel charges and consumable for field repair, lubrication, tire, etc are applied.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.081	Project	: Copco 1
Description	: Site work - Clear and Grub Disposal Area		
Quantity	: 4.00 AC		
Daily Production	: 1.00 AC per 8 hour shift	Project #	: 2
Work Days	: 4.0 Days	Estimator	: Eric Jones
Unit Price	: $13,732.22 per AC		
Total Cost	: $54,929		

	AC per	Total Cost	Unit Price Per AC
Probable Low Cost Parameter	1.15	$46,690	$11,672.39
Probable High Cost Parameter	0.8	$65,915	$16,478.66

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Laborer	Active	4.00	4.0	8	128.00	L	$45.80	incl. in rate	incl. in rate	$5,862.40
Equipment Operator (medium)	Active	3.00	4.0	8	96.00	L	$66.28	incl. in rate	incl. in rate	$6,362.88
Truck Driver (heavy)	Active	2.00	4.0	8	64.00	L	$57.59	incl. in rate	incl. in rate	$3,685.76
Loader, FE Rubber Tire (5.25cy)	Active	1.00	4.0	8	32.00	E	$75.42	incl. in rate	incl. in rate	$2,413.44
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	4.0	8	64.00	E	$70.35	incl. in rate	incl. in rate	$4,502.40
Hydraulic Excavator (5.0cy)	Active	2.00	4.0	8	64.00	E	$274.63	incl. in rate	incl. in rate	$17,576.32
0		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
0		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
Chipper 600HP up to 22" diameter	Active	3.00	4.0	8	96.00		$57.91			$5,559.36
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
				Labor Hours	320				TOTAL LABOR	$17,391.68
				Equipment Hours	160				TOTAL EQUIPMENT	$24,492.16

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$17,391.68	Labor Burden @	0.0%		$17,391.68
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$24,492.16	Equipment Tax @	7.75%	$1,898.14	$26,390.30
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$41,884			$1,898	DIRECT COST SUBTOTALS $43,782

	%	Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$43,781.98	$6,567.30
Installing Contractors Profit@	8.0%				$43,781.98	$3,502.56
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$10,069.86
General Contractors Insurance @	1.0%		on		$53,851.84	$539
Bond @	1.0%		on		$53,851.84	$539
Contingency @	0.0%		on		$54,928.88	$0

TOTAL COST for pay item $54,929

Additional Pay Item Notes :

Production is based on a 7 man crew and 2 truck drivers processing 1 acre a day. Chipper will be used to process material on site and will be supplied by loader. 2 excavators will be clearing land , laborers will be assisting the excavators and chippers with chain saws.

PAY ITEM COST DETAIL WORKSHEET **2.082 Sitework - Soil Cover for Disposal Area**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.082		**Project**	: Copco 1			
Description	:	Sitework - Soil Cover for Disposal Area						
Quantity	:	12,000.00	cy					
Daily Production	:	1,000.00	cy per 8 hour shift	**Project #**	: 2			
Work Days	:	12.0	Days	**Estimator**	: Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$6.84	per cy	**Probable Low Cost Parameter**		**1150**	**$69,791**	**$5.82**
Total Cost	:	$82,107		**Probable High Cost Parameter**		**800**	**$98,529**	**$8.21**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (235hp)(CATD7)	Active	2.00	12.0	8	192.00	E	$165.11	incl. in rate	incl. in rate	$31,701.12
Loader, FE Rubber Tire (5.25cy)	Active	1.00	12.0	8	96.00	E	$75.42	incl. in rate	incl. in rate	$7,240.32
Equipment Operator (medium)	Active	3.00	12.0	8	288.00	L	$66.28	incl. in rate	incl. in rate	$19,088.64
Laborer	Active	1.00	12.0	8	96.00	L	$45.80	incl. in rate	incl. in rate	$4,396.80
		1.00	12.0	8	96.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	12.0	8	96.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	12.0	8	96.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	12.0	8	96.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	12.0	8	96.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	12.0	8	96.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	12.0	8	96.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	12.0	8	96.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			12.0	8	0.00					$0.00
			12.0	8	0.00					$0.00
			12.0	8	0.00					$0.00
			12.0	8	0.00					$0.00
			12.0	8	0.00					$0.00
				Labor Hours	**384**				**TOTAL LABOR**	**$23,485.44**
				Equipment Hours	**288**				**TOTAL EQUIPMENT**	**$38,941.44**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.300	0.00	$30.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$23,485.44	Labor Burden @	49.7%	$0.00		$23,485.44
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$38,941.44	Equipment Tax @	7.75%	$3,017.96		$41,959.40
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$62,427**			**$3,018**	**DIRECT COST SUBTOTALS**	**$65,445**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$65,444.84		$9,816.73
Installing Contractors Profit@	8.0%				$65,444.84		$5,235.59
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$15,052.31**
General Contractors Insurance @	1.0%		on		$80,497.16		$805
Bond @	1.0%		on		$80,497.16		$805
Contingency @	0.0%		on		$82,107.10		$0
						TOTAL COST for pay item	**$82,107**

Additional Pay Item Notes :

Top soil will be provided from initially stripping disposal area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.085	**Project**	: Copco 1			
Description	:	Access/Haul Road Improvements - Soil Excavation					
Quantity	:	1,600.00 cy					
Daily Production	:	1,000.00 cy per 8 hour shift	**Project #**	: 2			
Work Days	:	1.6 Days	**Estimator**	: Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$17.50 per cy	**Probable Low Cost Parameter**		**1150**	**$23,805**	**$14.88**
Total Cost	:	$28,006	**Probable High Cost Parameter**		**800**	**$33,607**	**$21.00**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (310hp)(CATD8)	Active	2.00	1.6	8	25.60	E	$197.60	incl. in rate	incl. in rate	$5,058.56
Hydraulic Excavator (5.0cy)	Active	1.00	1.6	8	12.80	E	$274.63	incl. in rate	incl. in rate	$3,515.26
Loader, FE Rubber Tire (5.25cy)	Active	2.00	1.6	8	25.60	E	$75.42	incl. in rate	incl. in rate	$1,930.75
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.6	8	25.60	E	$111.64	incl. in rate	incl. in rate	$2,857.98
Equipment Operator (medium)	Active	4.00	1.6	8	51.20	L	$66.28	incl. in rate	incl. in rate	$3,393.54
Equipment Operator (light)	Active	1.00	1.6	8	12.80	L	$64.90	incl. in rate	incl. in rate	$830.72
Truck Driver (heavy)	Active	1.00	1.6	8	12.80	L	$57.59	incl. in rate	incl. in rate	$737.15
Laborer	Active	4.00	1.6	8	51.20	L	$45.80	incl. in rate	incl. in rate	$2,344.96
Labor Foreman	Active	1.00	1.6	8	12.80	L	$48.27	incl. in rate	incl. in rate	$617.86
		1.00	1.6	8	12.80	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	1.6	8	12.80	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	1.6	8	12.80	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	1.6	8	0.00					$0.00
			1.6	8	0.00					$0.00
			1.6	8	0.00					$0.00
			1.6	8	0.00					$0.00
			1.6	8	0.00					$0.00
				Labor Hours	**140.8**				**TOTAL LABOR**	**$7,924.22**
				Equipment Hours	**89.6**				**TOTAL EQUIPMENT**	**$13,362.56**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$7,924.22	Labor Burden @		49.7%	$0.00		$7,924.22
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$13,362.56	Equipment Tax @		7.75%	$1,035.60		$14,398.16
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	**$21,287**				**$1,036**	**DIRECT COST SUBTOTALS**	**$22,322**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$22,322.38		$3,348.36
Installing Contractors Profit@	8.0%				$22,322.38		$1,785.79
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$5,134.15**
General Contractors Insurance @	1.0%		on		$27,456.53		$275
Bond @	1.0%		on		$27,456.53		$275
Contingency @	0.0%		on		$28,005.66		$0
						TOTAL COST for pay item	**$28,006**

Additional Pay Item Notes :

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.087	Project	:	Copco 1		
Description	:	County Road Improvements - Asphalt Overlay Repair - Juniper Road					
Quantity	:	3.00 mile					
Daily Production	:	0.25 mile per 8 hour shift	Project #	:	2		
Work Days	:	12.0 Days	Estimator	:	Michael Barba		
					mile per	Total Cost	Unit Price Per mile
Unit Price	:	$383,087.98 per mile	Probable Low Cost Parameter		0.2875	$976,874	$325,624.78
Total Cost	:	$1,149,264	Probable High Cost Parameter		0.2	$1,379,117	$459,705.57

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Asphalt Paver (80hp)	Active	1.00	12.0	8	96.00	E	$180.11	incl. in rate	incl. in rate	$17,290.56
Roller, Dbl Drum (steel wheel, 5.0 - 7.9 MTn)	Active	1.00	12.0	8	96.00	E	$64.77	incl. in rate	incl. in rate	$6,217.92
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	12.0	8	192.00	E	$70.35	incl. in rate	incl. in rate	$13,507.20
Equipment Operator (light)	Active	1.00	12.0	8	96.00	L	$64.90	incl. in rate	incl. in rate	$6,230.40
Equipment Operator (medium)	Active	2.00	12.0	8	192.00	L	$66.28	incl. in rate	incl. in rate	$12,725.76
Truck Driver (light)	Active	1.00	12.0	8	96.00	L	$56.29	incl. in rate	incl. in rate	$5,403.84
Laborer	Active	2.00	12.0	8	192.00	L	$45.80	incl. in rate	incl. in rate	$8,793.60
		1.00	12.0	8	96.00	0	$0.00	$0.00		$0.00
		1.00	12.0	8	96.00	0	$0.00	$0.00		$0.00
		1.00	12.0	8	96.00	0	$0.00	$0.00		$0.00
		1.00	12.0	8	96.00	0	$0.00	$0.00		$0.00
		1.00	12.0	8	96.00	0	$0.00	$0.00		$0.00
750 HP Pavement Profiler	Active	1.00	12.0	8	96.00	E	$729.37	incl. in rate	incl. in rate	$70,019.52
			12.0	8	0.00					$0.00
			12.0	8	0.00					$0.00
			12.0	8	0.00					$0.00
			12.0	8	0.00					$0.00
				Labor Hours	576				TOTAL LABOR	$33,153.60
				Equipment Hours	480				TOTAL EQUIPMENT	$107,035.20

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Asphalt for 3" Overlay	6,969.00		1.000	6,969.00	$100.00	$696,900.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	$696,900.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
Pavement Markings	3	miles		$6,500.00	$19,500.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$19,500.00

SUMMARY OF COSTS

Labor Cost	$33,153.60	Labor Burden @		49.7%	$0.00		$33,153.60
Material Cost	$696,900.00	Material Tax @		7.75%	$54,009.75		$750,909.75
Equipment Cost	$107,035.20	Equipment Tax @		7.75%	$8,295.23		$115,330.43
Subcontractors	$19,500.00						$19,500.00
DIRECT COST SUBTOTALS	$856,589				$62,305	DIRECT COST SUBTOTALS	$918,894
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$899,393.78		$134,909.07
Installing Contractors Profit@	8.0%				$899,393.78		$71,951.50
GC Markup on Subs @	5.0%				$19,500.00		$975.00
						TOTAL MARKUP COSTS	$207,835.57
General Contractors Insurance @	1.0%			on	$1,126,729.35		$11,267
Bond @	1.0%			on	$1,126,729.35		$11,267
Contingency @	0.0%			on	$1,149,263.93		$0
						TOTAL COST for pay item	$1,149,264

Additional Pay Item Notes :

As per Page 142 of the Klamath Detailed Plan 3" is thickness of asphalt overlay.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.088		Project	: Copco 1
Description	: County Road Improvements - Asphalt Overlay Repair - (			
Quantity	: 19.00 mile			
Daily Production	: 0.50 mile per	8 hour shift	Project #	: 2
Work Days	: 38.0 Days		Estimator	: Michael Barba
Unit Price	: $352,027.38 per mile			
Total Cost	: $6,688,520			

	mile per	Total Cost	Unit Price Per mile
Probable Low Cost Parameter	0.575	$5,685,242	$299,223.27
Probable High Cost Parameter	0.4	$8,026,224	$422,432.85

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Asphalt Paver (80hp)	Active	2.00	38.0	8	608.00	E	$180.11	incl. in rate	incl. in rate	$109,506.88
Roller, Dbl Drum (steel wheel, 5.0 - 7.9 MTn)	Active	3.00	38.0	8	912.00	E	$64.77	incl. in rate	incl. in rate	$59,070.24
Truck, On-Highway Dump (6x4, 12cy)	Active	4.00	38.0	8	1,216.00	E	$70.35	incl. in rate	incl. in rate	$85,545.60
Equipment Operator (light)	Active	3.00	38.0	8	912.00	L	$64.90	incl. in rate	incl. in rate	$59,188.80
Equipment Operator (medium)	Active	2.00	38.0	8	608.00	L	$66.28	incl. in rate	incl. in rate	$40,298.24
Truck Driver (light)	Active	4.00	38.0	8	1,216.00	L	$56.29	incl. in rate	incl. in rate	$68,448.64
Laborer	Active	2.00	38.0	8	608.00	L	$45.80	incl. in rate	incl. in rate	$27,846.40
		1.00	38.0	8	304.00	0	$0.00	$0.00		$0.00
		1.00	38.0	8	304.00	0	$0.00	$0.00		$0.00
		1.00	38.0	8	304.00	0	$0.00	$0.00		$0.00
		1.00	38.0	8	304.00	0	$0.00	$0.00		$0.00
		1.00	38.0	8	304.00	0	$0.00	$0.00		$0.00
750 HP Pavement Profiler		2.00	38.0	8	608.00		$729.37	incl. in rate	incl. in rate	$443,456.96
			38.0	8	0.00					$0.00
			38.0	8	0.00					$0.00
			38.0	8	0.00					$0.00
			38.0	8	0.00					$0.00
				Labor Hours	3344				TOTAL LABOR	$195,782.08
				Equipment Hours	2736				TOTAL EQUIPMENT	$254,122.72

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Asphalt for 3" Overlay	44,140.80		1.000	44,140.80	$100.00	$4,414,080.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	$4,414,080.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
Pavement Markings	19	miles		$6,500.00	$123,500.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$123,500.00

SUMMARY OF COSTS

Labor Cost	$195,782.08	Labor Burden @	49.7%	$0.00		$195,782.08
Material Cost	$4,414,080.00	Material Tax @	7.75%	$342,091.20		$4,756,171.20
Equipment Cost	$254,122.72	Equipment Tax @	7.75%	$19,694.51		$273,817.23
Subcontractors	$123,500.00					$123,500.00
DIRECT COST SUBTOTALS	$4,987,485			$361,786	DIRECT COST SUBTOTALS	$5,349,271

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,225,770.51		$783,865.58
Installing Contractors Profit@	8.0%				$5,225,770.51		$418,061.64
GC Markup on Subs @	5.0%				$123,500.00		$6,175.00
						TOTAL MARKUP COSTS	$1,208,102.22
General Contractors Insurance @	1.0%			on	$6,557,372.73		$65,574
Bond @	1.0%			on	$6,557,372.73		$65,574
Contingency @	0.0%			on	$6,688,520.18		$0
						TOTAL COST for pay item	$6,688,520

Additional Pay Item Notes :

As per Page 142 of the Klamath Detailed Plan 3" is thickness of asphalt overlay.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.089		Project	: Copco 1		
Description	: Mallard Cove - Concrete total					
Quantity	: 106.00 CY					
Daily Production	: 40.00 CY per 8 hour shift		Project #	: 2		
Work Days	: 2.7 Days		Estimator	: Eric Jones		
				CY per	Total Cost	Unit Price Per CY
Unit Price	: $338.09 per CY		Probable Low Cost Parameter	46	$30,462	$287.38
Total Cost	: $35,838		Probable High Cost Parameter	34	$41,214	$388.81

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	2.00	2.7	8	43.20	E	$274.63	incl. in rate	incl. in rate	$11,864.02
Loader, FE Rubber Tire (5.25cy)	Active	1.00	2.7	8	21.60	E	$75.42	incl. in rate	incl. in rate	$1,629.07
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	2.7	8	43.20	E	$70.35	incl. in rate	incl. in rate	$3,039.12
Truck, Pickup (4x4, 3/4tn)	Active	1.00	2.7	8	21.60	E	$16.94	incl. in rate	incl. in rate	$365.90
Hydraulic Impact Breaker Attachment (3k-4k ft-lb)	Active	1.00	2.7	8	21.60	E	$36.58	incl. in rate	incl. in rate	$790.13
Truck Driver (heavy)	Active	1.00	2.7	8	21.60	L	$57.59	incl. in rate	incl. in rate	$1,243.94
Labor Foreman (out)	Active	1.00	2.7	8	21.60	L	$46.27	incl. in rate	incl. in rate	$999.43
Laborer	Active	3.00	2.7	8	64.80	L	$45.80	incl. in rate	incl. in rate	$2,967.84
Equipment Operator (medium)	Active	3.00	2.7	8	64.80	L	$66.28	incl. in rate	incl. in rate	$4,294.94
0		0.00	2.7	8	0.00	0	$0.00	$0.00		$0.00
0		1.00	2.7	8	21.60	0	$0.00	$0.00		$0.00
		1.00	2.7	8	21.60	0	$0.00	$0.00		$0.00
			2.7	8	0.00					$0.00
			2.7	8	0.00					$0.00
			2.7	8	0.00					$0.00
			2.7	8	0.00					$0.00
			2.7	8	0.00					$0.00
				Labor Hours	172.8				TOTAL LABOR	$9,506.16
				Equipment Hours	151.2				TOTAL EQUIPMENT	$17,688.24

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$9,506.16	Labor Burden @		0.0%			$9,506.16
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$17,688.24	Equipment Tax @		7.75%	$1,370.84		$19,059.08
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$27,194				$1,371	DIRECT COST SUBTOTALS	$28,565
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$28,565.24		$4,284.79
Installing Contractors Profit@	8.0%				$28,565.24		$2,285.22
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$6,570.00
General Contractors Insurance @	1.0%			on	$35,135.24		$351
Bond @	1.0%			on	$35,135.24		$351
Contingency @	0.0%			on	$35,837.95		$0
						TOTAL COST for pay item	$35,838

Additional Pay Item Notes :

1 excavator with breaker to perform demolition, 1 excavator to pile material, 1 loader to support loading operation, 1 foreman with truck to oversee operation, 3 laborers to direct trucks and support equipment demolition operations. Production currently shows 2 loads of concrete material per truck and duration of 3 days, the crew output is low due to the items being demolished are small and spaced out.

PAY ITEM COST DETAIL WORKSHEET — **2.090 Mallard Cove - 25'x5' Dock made of composite decking and poly floats**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.090	Project	: Copco 1			
Description	: Mallard Cove - 25'x5' Dock made of composite decking and poly floats					
Quantity	: 1.00 EA					
Daily Production	: 2.00 EA per 8 hour shift	Project #	: 2			
Work Days	: 0.5 Days	Estimator	: Eric Jones	EA per	Total Cost	Unit Price Per EA
Unit Price	: $3,009.15 per EA	Probable Low Cost Parameter		2.3	$2,558	$2,557.77
Total Cost	: $3,009	Probable High Cost Parameter		1.7	$3,461	$3,460.52

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (50tn)	Active	1.00	0.5	8	4.00	E	$134.32	incl. in rate	incl. in rate	$537.28
Truck, Pickup (4x4, 3/4tn)	Active	1.00	0.5	8	4.00	E	$16.94	incl. in rate	incl. in rate	$67.76
Truck Driver (heavy)	Active	1.00	***1.0***	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Equipment Operator (crane)	Active	1.00	0.5	8	4.00	L	$68.41	incl. in rate	incl. in rate	$273.64
Labor Foreman (out)	Active	1.00	0.5	8	4.00	L	$46.27	incl. in rate	incl. in rate	$185.08
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Truck Driver (heavy)	Active	1.00	***1.0***	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
		3.00	0.5	8	12.00	0	$0.00	$0.00		$0.00
		2.00	0.5	8	8.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
				Labor Hours	32				TOTAL LABOR	$1,746.56
				Equipment Hours	8				TOTAL EQUIPMENT	$605.04

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,746.56	Labor Burden @		0.0%			$1,746.56
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$605.04	Equipment Tax @		7.75%	$46.89		$651.93
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$2,352				$47	DIRECT COST SUBTOTALS	$2,398
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$2,398.49		$359.77
Installing Contractors Profit@	8.0%				$2,398.49		$191.88
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$551.65
General Contractors Insurance @	1.0%			on	$2,950.14		$30
Bond @	1.0%			on	$2,950.14		$30
Contingency @	0.0%			on	$3,009.15		$0
						TOTAL COST for pay item	$3,009

Additional Pay Item Notes :

This based on crane already being near location of the dock, 1 50ton crane to lift dock and place on truck, 1 flat bed truck hauling all day to dispose of material, 2 laborers will be used to disassemble the dock and rig dock to crane, Foreman with truck will oversee operation.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.091	Project	: Copco 1			
Description	: Mallard Cove - 20'x5' Gangway w/ aluminum grate and railings					
Quantity	: 1.00 EA					
Daily Production	: 2.00 EA per 8 hour shift	Project #	: 2			
Work Days	: 0.5 Days	Estimator	: Eric Jones	EA per	Total Cost	Unit Price Per EA
Unit Price	: $2,758.50 per EA	Probable Low Cost Parameter		2.3	$2,345	$2,344.72
Total Cost	: $2,758	Probable High Cost Parameter		1.7	$3,172	$3,172.27

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (50tn)	Active	1.00	0.5	8	4.00	E	$134.32	incl. in rate	incl. in rate	$537.28
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	*1.0*	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
Truck, Pickup (4x4, 3/4tn)	Active	1.00	0.5	8	4.00	E	$16.94	incl. in rate	incl. in rate	$67.76
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	incl. in rate	incl. in rate	$259.60
Labor Foreman (out)	Active	1.00	0.5	8	4.00	L	$46.27	incl. in rate	incl. in rate	$185.08
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Truck Driver (heavy)	Active	1.00	*1.0*	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
		3.00	0.5	8	12.00	0	$0.00	$0.00		$0.00
		2.00	0.5	8	8.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
				Labor Hours	24				TOTAL LABOR	$1,271.80
				Equipment Hours	16				TOTAL EQUIPMENT	$860.24

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,271.80	Labor Burden @			0.0%			$1,271.80
Material Cost	$0.00	Material Tax @			7.75%	$0.00		$0.00
Equipment Cost	$860.24	Equipment Tax @			7.75%	$66.67		$926.91
Subcontractors	$0.00							$0.00
DIRECT COST SUBTOTALS	$2,132					$67	DIRECT COST SUBTOTALS	$2,199
		Crew	Material	Subs		Cost Basis		
Installing Contractors Overhead@	15.0%					$2,198.71		$329.81
Installing Contractors Profit@	8.0%					$2,198.71		$175.90
GC Markup on Subs @	5.0%					$0.00		$0.00
							TOTAL MARKUP COSTS	$505.70
General Contractors Insurance @	1.0%			on		$2,704.41		$27
Bond @	1.0%			on		$2,704.41		$27
Contingency @	0.0%			on		$2,758.50		$0
							TOTAL COST for pay item	$2,758

Additional Pay Item Notes :

This based on crane already being near location of the dock, 1 50ton crane to lift gangway and place on truck, 1 flat bed truck hauling all day to dispose of material, 2 laborers will be used to disassemble the gangway and rig gangway to crane, Foreman with truck will oversee operation.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.092	Project	: Copco 1
Description	: Mallard Cove - Signs to be removed and hauled away		
Quantity	: 6.00 EA		
Daily Production	: 24.00 EA per 8 hour shift	Project #	: 2
Work Days	: 0.3 Days	Estimator	: Eric Jones
Unit Price	: $152.39 per EA		
Total Cost	: $914		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	26.4	$823	$137.15
Probable High Cost Parameter	21.6	$1,006	$167.63

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (5.25cy)	Active	1.00	0.3	8	2.40	E	$75.42	incl. in rate	incl. in rate	$181.01
Truck, Pickup (4x4, 3/4tn)	Active	1.00	0.3	8	2.40	E	$16.94	incl. in rate	incl. in rate	$40.66
Equipment Operator (medium)	Active	1.00	0.3	8	2.40	L	$66.28	incl. in rate	incl. in rate	$159.07
Labor Foreman (out)	Active	1.00	0.3	8	2.40	L	$46.27	incl. in rate	incl. in rate	$111.05
Laborer	Active	2.00	0.3	8	4.80	L	$45.80	incl. in rate	incl. in rate	$219.84
0	Active	1.00	0.3	8	2.40	0	$0.00	incl. in rate	incl. in rate	$0.00
0		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		3.00	0.3	8	7.20	0	$0.00	$0.00		$0.00
		2.00	0.3	8	4.80	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
				Labor Hours	9.6				TOTAL LABOR	$489.96
				Equipment Hours	4.8				TOTAL EQUIPMENT	$221.66

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$489.96	Labor Burden @	0.0%			$489.96
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$221.66	Equipment Tax @	7.75%	$17.18		$238.84
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$712			$17	DIRECT COST SUBTOTALS	$729

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$728.80	$109.32
Installing Contractors Profit@	8.0%				$728.80	$58.30
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$167.62
General Contractors Insurance @	1.0%			on	$896.43	$9
Bond @	1.0%			on	$896.43	$9
Contingency @	0.0%			on	$914.36	$0
					TOTAL COST for pay item	$914

Additional Pay Item Notes :

Based on a 4 man crew removing signs with loader, material is expected to be loaded on either the gangway truck or the dock truck for disposal. This operation is expected to happen with the pay item 93.

PAY ITEM COST DETAIL WORKSHEET — **2.093 Mallard Cove - Wood plank tables to be removed and hauled away**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.093	**Project**	: Copco 1		
Description	:	Mallard Cove - Wood plank tables to be removed and hauled away				
Quantity	:	8.00 EA				
Daily Production	:	32.00 EA per 8 hour shift	**Project #**	: 2		
Work Days	:	0.3 Days	**Estimator**	: Eric Jones	**EA per** / **Total Cost**	**Unit Price Per EA**
Unit Price	:	$114.29 per EA	**Probable Low Cost Parameter**	**35.2**	**$823**	**$102.87**
Total Cost	:	$914	**Probable High Cost Parameter**	**28.8**	**$1,006**	**$125.72**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (5.25cy)	Active	1.00	0.3	8	2.40	E	$75.42	incl. in rate	incl. in rate	$181.01
Truck, Pickup (4x4, 3/4tn)	Active	1.00	0.3	8	2.40	E	$16.94	incl. in rate	incl. in rate	$40.66
Equipment Operator (medium)	Active	1.00	0.3	8	2.40	L	$66.28	incl. in rate	incl. in rate	$159.07
Labor Foreman (out)	Active	1.00	0.3	8	2.40	L	$46.27	incl. in rate	incl. in rate	$111.05
Laborer	Active	2.00	0.3	8	4.80	L	$45.80	incl. in rate	incl. in rate	$219.84
	Active	1.00	0.3	8	2.40	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		3.00	0.3	8	7.20	0	$0.00	$0.00		$0.00
		2.00	0.3	8	4.80	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
				Labor Hours	**9.6**				**TOTAL LABOR**	**$489.96**
				Equipment Hours	**4.8**				**TOTAL EQUIPMENT**	**$221.66**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$489.96	Labor Burden @	0.0%			$489.96
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$221.66	Equipment Tax @	7.75%	$17.18		$238.84
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$712**			**$17**	**DIRECT COST SUBTOTALS**	**$729**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$728.80	$109.32
Installing Contractors Profit@	8.0%				$728.80	$58.30
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$167.62**
General Contractors Insurance @	1.0%		on		$896.43	$9
Bond @	1.0%		on		$896.43	$9
Contingency @	0.0%		on		$914.36	$0
					TOTAL COST for pay item	**$914**

Additional Pay Item Notes :

4 man crew will remove tables and load them on to either truck hauling dock or gangway. This activity will occur with pay item 92.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.094	Project	: Copco 1			
Description	: Mallard Cove - Parking area to be regraded					
Quantity	: 2.50 AC					
Daily Production	: 1.00 AC per 8 hour shift	Project #	: 2			
Work Days	: 2.5 Days	Estimator	: Eric Jones	AC per	Total Cost	Unit Price Per AC
Unit Price	: $7,451.08 per AC	Probable Low Cost Parameter		1.1	$16,765	$6,705.97
Total Cost	: $18,628	Probable High Cost Parameter		0.85	$21,422	$8,568.74

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (125hp)(CATD6)	Active	1.00	2.5	8	20.00	E	$82.17	incl. in rate	incl. in rate	$1,643.40
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	2.5	8	20.00	E	$70.35	incl. in rate	incl. in rate	$1,407.00
Grader, 180hp, 13' blade	Active	1.00	2.5	8	20.00	E	$80.79	incl. in rate	incl. in rate	$1,615.80
Roller, Single Drum (steel wheel, 12.0 - 14.9 MTn)	Active	1.00	2.5	8	20.00	E	$72.79	incl. in rate	incl. in rate	$1,455.80
Truck, Pickup (4x4, 3/4tn)	Active	1.00	2.5	8	20.00	E	$16.94	incl. in rate	incl. in rate	$338.80
Truck Driver (heavy)	Active	1.00	2.5	8	20.00	L	$57.59	incl. in rate	incl. in rate	$1,151.80
Labor Foreman (out)	Active	1.00	2.5	8	20.00	L	$46.27	incl. in rate	incl. in rate	$925.40
Laborer	Active	2.00	2.5	8	40.00	L	$45.80	incl. in rate	incl. in rate	$1,832.00
Equipment Operator (medium)	Active	3.00	2.5	8	60.00	L	$66.28	incl. in rate	incl. in rate	$3,976.80
0	Active	2.00	2.5	8	40.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	3.00	2.5	8	60.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	2.5	8	20.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			2.5	8	0.00					$0.00
			2.5	8	0.00					$0.00
			2.5	8	0.00					$0.00
			2.5	8	0.00					$0.00
			2.5	8	0.00					$0.00
				Labor Hours	140				TOTAL LABOR	$7,886.00
				Equipment Hours	100				TOTAL EQUIPMENT	$6,460.80

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.050	0.00	$10.69	$0.00
		lbs PLS	1.050	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$7,886.00	Labor Burden @		0.0%			$7,886.00
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$6,460.80	Equipment Tax @		7.75%	$500.71		$6,961.51
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$14,347				$501	DIRECT COST SUBTOTALS	$14,848
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$14,847.51		$2,227.13
Installing Contractors Profit@	8.0%				$14,847.51		$1,187.80
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$3,414.93
General Contractors Insurance @	1.0%			on	$18,262.44		$183
Bond @	1.0%			on	$18,262.44		$183
Contingency @	0.0%			on	$18,627.69		$0
						TOTAL COST for pay item	$18,628

Additional Pay Item Notes :

Production is based off of 12 man crew finishing .5 acres a shift, dozers will be regrading area, grader will be used to fine grade, tractors will be used to rip material for seeding, seed sprayers will use Idaho Fescue seed, water truck will continuously water area for 2 weeks.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.095		Project	: Copco 1		
Description	: Copco Cove - Concrete Total					
Quantity	: 84.00 CY					
Daily Production	: 40.00 CY per 8 hour shift		Project #	: 2		
Work Days	: 2.1 Days		Estimator	: Eric Jones	CY per	Total Cost	Unit Price Per CY
Unit Price	: $331.83 per CY		Probable Low Cost Parameter		46	$23,693	$282.06
Total Cost	: $27,874		Probable High Cost Parameter		34	$32,055	$381.61

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	2.00	2.1	8	33.60	E	$274.63	incl. in rate	incl. in rate	$9,227.57
Loader, FE Rubber Tire (5.25cy)	Active	1.00	2.1	8	16.80	E	$75.42	incl. in rate	incl. in rate	$1,267.06
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	2.1	8	33.60	E	$70.35	incl. in rate	incl. in rate	$2,363.76
Truck, Pickup (4x4, 3/4tn)	Active	1.00	2.1	8	16.80	E	$16.94	incl. in rate	incl. in rate	$284.59
Hydraulic Impact Breaker Attachment (3k-4k ft-lb)	Active	1.00	2.1	8	16.80	E	$36.58	incl. in rate	incl. in rate	$614.54
Truck Driver (heavy)	Active	1.00	2.1	8	16.80	L	$57.59	incl. in rate	incl. in rate	$967.51
Labor Foreman (out)	Active	1.00	2.1	8	16.80	L	$46.27	incl. in rate	incl. in rate	$777.34
Laborer	Active	3.00	2.1	8	50.40	L	$45.80	incl. in rate	incl. in rate	$2,308.32
Equipment Operator (medium)	Active	3.00	2.1	8	50.40	L	$66.28	incl. in rate	incl. in rate	$3,340.51
		1.00	2.1	8	16.80	0	$0.00	$0.00		$0.00
		1.00	2.1	8	16.80	0	$0.00	$0.00		$0.00
		1.00	2.1	8	16.80	0	$0.00	$0.00		$0.00
			2.1	8	0.00					$0.00
			2.1	8	0.00					$0.00
			2.1	8	0.00					$0.00
			2.1	8	0.00					$0.00
			2.1	8	0.00					$0.00
				Labor Hours	134.4				TOTAL LABOR	$7,393.68
				Equipment Hours	117.6				TOTAL EQUIPMENT	$13,757.52

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$7,393.68	Labor Burden @		0.0%			$7,393.68
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$13,757.52	Equipment Tax @		7.75%	$1,066.21		$14,823.73
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$21,151				$1,066	DIRECT COST SUBTOTALS	$22,217
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$22,217.41		$3,332.61
Installing Contractors Profit@	8.0%				$22,217.41		$1,777.39
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$5,110.00
General Contractors Insurance @	1.0%		on		$27,327.41		$273
Bond @	1.0%		on		$27,327.41		$273
Contingency @	0.0%		on		$27,873.96		$0
						TOTAL COST for pay item	$27,874

Additional Pay Item Notes :

1 excavator with breaker to perform demolition, 1 excavator to pile material, 1 loader to support loading operation, 1 foreman with truck to oversee operation, 3 laborers to direct trucks and support equipment demolition operations. Production currently shows 2 loads of concrete material per truck and duration of 3 days, the crew output is low due to the items being demolished are small and spaced out.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.096		Project	: COPCO 1		
Description	:	Copco Cove - Dock abutment railing made of 2.5" dia. steel pipe					
Quantity	:	1.00 EA					
Daily Production	:	2.00 EA per 8 hour shift		Project #	: 2		
Work Days	:	0.5 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$1,446.70 per EA		Probable Low Cost Parameter		2.2	$1,302	$1,302.03
Total Cost	:	$1,447		Probable High Cost Parameter		1.8	$1,591	$1,591.37

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	1.00	0.5	8	4.00	L	$45.80	incl. in rate	incl. in rate	$183.20
Steelworker	Active	1.00	0.5	8	4.00	L	$65.52	incl. in rate	incl. in rate	$262.08
Truck Driver (light)	Active	1.00	0.5	8	4.00	L	$56.29	incl. in rate	incl. in rate	$225.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56

Labor Hours	12	TOTAL LABOR	$670.44
Equipment Hours	4	TOTAL EQUIPMENT	$446.56

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$33.52	$33.52
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$33.52

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$670.44	Labor Burden @	49.7%	$0.00		$670.44
Material Cost	$33.52	Material Tax @	7.8%	$2.60		$36.12
Equipment Cost	$446.56	Equipment Tax @	0.0%	$0.00		$446.56
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$1,151			$3	DIRECT COST SUBTOTALS	$1,153

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,153.12	$172.97
Installing Contractors Profit@	8.0%				$1,153.12	$92.25
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$265.22
General Contractors Insurance @	1.0%			on	$1,418.34	$14
Bond @	1.0%			on	$1,418.34	$14
Contingency @	0.0%			on	$1,446.70	$0
					TOTAL COST for pay item	$1,447

Additional Pay Item Notes :

Assumed 1/2 day of work done by 1 Steelman to cut and 1 Laborer to load in the truck.

PAY ITEM COST DETAIL WORKSHEET

2.097 Copco Cove - Signs to be removed and hauled away

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.097	**Project**	: Copco 1		
Description	:	Copco Cove - Signs to be removed and hauled away				
Quantity	:	6.00 EA				
Daily Production	:	12.00 EA per 8 hour shift	**Project #**	: 2		
Work Days	:	0.5 Days	**Estimator**	: Eric Jones	**EA per**	**Total Cost**
Unit Price	:	$407.82 per EA	**Probable Low Cost Parameter**	13.2	$2,202	$367.04
Total Cost	:	$2,447	**Probable High Cost Parameter**	10.8	$2,692	$448.60

(Column heads for the parameter rows: EA per, Total Cost, Unit Price Per EA.)

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (5.25cy)	Active	1.00	0.5	8	4.00	E	$75.42	incl. in rate	incl. in rate	$301.68
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	*1.0*	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
Truck Driver (heavy)	Active	1.00	*1.0*	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Pickup (4x4, 3/4tn)	Active	1.00	0.5	8	4.00	E	$16.94	incl. in rate	incl. in rate	$67.76
Labor Foreman (out)	Active	1.00	0.5	8	4.00	L	$46.27	incl. in rate	incl. in rate	$185.08
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Equipment Operator (medium)	Active	1.00	0.5	8	4.00	L	$66.28	incl. in rate	incl. in rate	$265.12
		3.00	0.5	8	12.00	0	$0.00	$0.00		$0.00
		2.00	0.5	8	8.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
		1.00	0.5	8	4.00	0	$0.00	$0.00		$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
			0.5	8	0.00					$0.00
				Labor Hours	**24**				**TOTAL LABOR**	**$1,277.32**
				Equipment Hours	**16**				**TOTAL EQUIPMENT**	**$624.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$1,277.32	Labor Burden @	0.0%			$1,277.32
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$624.64	Equipment Tax @	7.75%	$48.41		$673.05
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,902**			**$48**	**DIRECT COST SUBTOTALS**	**$1,950**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,950.37	$292.56
Installing Contractors Profit@	8.0%				$1,950.37	$156.03
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$448.59**
General Contractors Insurance @	1.0%			on	$2,398.95	$24
Bond @	1.0%			on	$2,398.95	$24
Contingency @	0.0%			on	$2,446.93	$0
					TOTAL COST for pay item	**$2,447**

Additional Pay Item Notes :

Based on a 4 man crew removing signs with loader, extra time accounts for getting equipment to area, flatbed truck is expected to be used whole day to dispose material.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.098	Project	: Copco 1			
Description	: Copco Cove - Wood plank tables to be removed and hauled away					
Quantity	: 2.00 EA					
Daily Production	: 24.00 EA per 8 hour shift	Project #	: 2			
Work Days	: 0.1 Days	Estimator	: Eric Jones	EA per	Total Cost	Unit Price Per EA
Unit Price	: $152.39 per EA	Probable Low Cost Parameter		26.4	$274	$137.15
Total Cost	: $305	Probable High Cost Parameter		21.6	$335	$167.63

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (5.25cy)	Active	1.00	0.1	8	0.80	E	$75.42	incl. in rate	incl. in rate	$60.34
Truck, Pickup (4x4, 3/4tn)	Active	1.00	0.1	8	0.80	E	$16.94	incl. in rate	incl. in rate	$13.55
Equipment Operator (medium)	Active	1.00	0.1	8	0.80	L	$66.28	incl. in rate	incl. in rate	$53.02
Labor Foreman (out)	Active	1.00	0.1	8	0.80	L	$46.27	incl. in rate	incl. in rate	$37.02
Laborer	Active	2.00	0.1	8	1.60	L	$45.80	incl. in rate	incl. in rate	$73.28
		0.00	0.1	8	0.00	0	$0.00	$0.00		$0.00
		0.00	0.1	8	0.00	0	$0.00	$0.00		$0.00
		0.00	0.1	8	0.00	0	$0.00	$0.00		$0.00
		0.00	0.1	8	0.00	0	$0.00	$0.00		$0.00
		0.00	0.1	8	0.00	0	$0.00	$0.00		$0.00
		0.00	0.1	8	0.00	0	$0.00	$0.00		$0.00
		0.00	0.1	8	0.00	0	$0.00	$0.00		$0.00
			0.1	8	0.00					$0.00
			0.1	8	0.00					$0.00
			0.1	8	0.00					$0.00
			0.1	8	0.00					$0.00
			0.1	8	0.00					$0.00
				Labor Hours	3.2				TOTAL LABOR	$163.32
				Equipment Hours	1.6				TOTAL EQUIPMENT	$73.89

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.050	0.00	$144.13	$0.00
		ea	1.050	0.00	$1.43	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$163.32	Labor Burden @	0.0%			$163.32
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$73.89	Equipment Tax @	7.75%	$5.73		$79.61
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$237			$6	DIRECT COST SUBTOTALS	$243

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$242.93		$36.44
Installing Contractors Profit@	8.0%				$242.93		$19.43
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$55.87
General Contractors Insurance @	1.0%			on	$298.81		$3
Bond @	1.0%			on	$298.81		$3
Contingency @	0.0%			on	$304.79		$0
						TOTAL COST for pay item	$305

Additional Pay Item Notes :

Base don four man crew taking 2 hours to remove and load tables. Tables to be loaded on same flatbed truck from pay item 97.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 2.099		Project	: Copco 1		
Description	: Copco Cove - Regrade					
Quantity	: 2.30 AC					
Daily Production	: 1.00 AC per 8 hour shift		Project #	: 2		
Work Days	: 2.3 Days		Estimator	: Eric Jones	AC per	Total Cost	Unit Price Per AC
Unit Price	: $6,531.70 per AC		Probable Low Cost Parameter		1.1	$13,521	$5,878.53
Total Cost	: $15,023		Probable High Cost Parameter		0.85	$17,276	$7,511.46

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (125hp)(CATD6)	Active	1.00	2.3	8	18.40	E	$82.17	incl. in rate	incl. in rate	$1,511.93
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	2.3	8	18.40	E	$70.35	incl. in rate	incl. in rate	$1,294.44
Grader, 180hp, 13' blade	Active	1.00	2.3	8	18.40	E	$80.79	incl. in rate	incl. in rate	$1,486.54
Roller, Single Drum (steel wheel, 12.0 - 14.9 MTn)	Active	1.00	2.3	8	18.40	E	$72.79	incl. in rate	incl. in rate	$1,339.34
Truck, Pickup (4x4, 3/4tn)	Active	1.00	2.3	8	18.40	E	$16.94	incl. in rate	incl. in rate	$311.70
Truck Driver (heavy)	Active	1.00	2.3	8	18.40	L	$57.59	incl. in rate	incl. in rate	$1,059.66
Labor Foreman (out)	Active	1.00	2.3	8	18.40	L	$46.27	incl. in rate	incl. in rate	$851.37
Equipment Operator (medium)	Active	3.00	2.3	8	55.20	L	$66.28	incl. in rate	incl. in rate	$3,658.66
0	Active	1.00	2.3	8	18.40	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	2.00	2.3	8	36.80	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	0.00	2.3	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	0.00	2.3	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			2.3	8	0.00					$0.00
			2.3	8	0.00					$0.00
			2.3	8	0.00					$0.00
			2.3	8	0.00					$0.00
			2.3	8	0.00					$0.00
				Labor Hours	92				TOTAL LABOR	$5,569.68
				Equipment Hours	92				TOTAL EQUIPMENT	$5,943.94

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.050	0.00	$10.69	$0.00
		lbs PLS	1.050	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA			$0.00
		EA			$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$5,569.68	Labor Burden @	0.0%			$5,569.68
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$5,943.94	Equipment Tax @	7.75%	$460.66		$6,404.59
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$11,514			$461	DIRECT COST SUBTOTALS	$11,974

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$11,974.27		$1,796.14
Installing Contractors Profit@	8.0%				$11,974.27		$957.94
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$2,754.08
General Contractors Insurance @	1.0%			on	$14,728.35		$147
Bond @	1.0%			on	$14,728.35		$147
Contingency @	0.0%			on	$15,022.92		$0
						TOTAL COST for pay item	$15,023

Additional Pay Item Notes :

Production is based off of 12 man crew finishing .5 acres a shift, dozers will be regrading area, grader will be used to fine grade, tractors will be used to rip material for seeding, seed sprayers will use Idaho Fescue seed, water truck will continuously water area for 2 weeks.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	2.100		**Project**	: Copco 1		
Description	:	Diversion Tunnel Lining					
Quantity	:	1.00 LS					
Daily Production	:	0.33 LS per 8 hour shift		**Project #**	: 2		
Work Days	:	3.0 Days		**Estimator**	: Eric Jones	**LS per**	**Total Cost** / **Unit Price Per LS**
Unit Price	:	$244,844.33 per LS		**Probable Low Cost Parameter**		**0.363**	**$220,360** / **$220,359.90**
Total Cost	:	$244,844		**Probable High Cost Parameter**		**0.2805**	**$281,571** / **$281,570.98**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
0	Active	1.00	3.0	8	24.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	3.0	8	24.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	3.0	8	24.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	3.0	8	24.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	3.0	8	24.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	3.0	8	24.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	3.0	8	24.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	3.00	3.0	8	72.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	3.0	8	24.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	2.00	3.0	8	48.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	0.00	3.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	0.00	3.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
			3.0	8	0.00					$0.00
				Labor Hours	**0**				**TOTAL LABOR**	**$0.00**
				Equipment Hours	**0**				**TOTAL EQUIPMENT**	**$0.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.050	0.00	$10.69	$0.00
		lbs PLS	1.050	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Tunnel Lining (Shotcrete with Reinforcement)	1	LS	**RSMs (569 CY @ $401.78/CY)**	$228,612.82	$228,612.82
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$228,612.82**

SUMMARY OF COSTS

Labor Cost	$0.00	Labor Burden @	0.0%			$0.00
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$0.00	Equipment Tax @	7.75%	$0.00		$0.00
Subcontractors	$228,612.82					$228,612.82
DIRECT COST SUBTOTALS	**$228,613**			**$0**	**DIRECT COST SUBTOTALS**	**$228,613**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$0.00	$0.00
Installing Contractors Profit@	8.0%				$0.00	$0.00
GC Markup on Subs @	5.0%				$228,612.82	$11,430.64
					TOTAL MARKUP COSTS	**$11,430.64**
General Contractors Insurance @	1.0%		on		$240,043.46	$2,400
Bond @	1.0%		on		$240,043.46	$2,400
Contingency @	0.0%		on		$244,844.33	$0
					TOTAL COST for pay item	**$244,844**

Additional Pay Item Notes :

Subcontract will reinforce and shotcrete divervsion tunnels

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.001	**Project**	: Copco 2				
Description	: Construct and Remove Embankment Cofferdam-Right Side of Dam						
Quantity	: 3,100.00 cy						
Daily Production	: 425.00 cy per 8 hour shift	**Project #**	: 3				
Work Days	: 7.3 Days	**Estimator**	: Michael Barba		**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	: $59.70 per cy	**Probable Low Cost Parameter**			**488.75**	**$157,311**	**$50.75**
Total Cost	: $185,071	**Probable High Cost Parameter**			**361.25**	**$212,832**	**$68.66**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (310hp)(CATD8)	Active	1.00	7.3	8	58.40	E	$197.60	$197.60		$11,539.84
Hydraulic Excavator (5.0cy)	Active	1.00	7.3	8	58.40	E	$274.63	$274.63		$16,038.39
Truck, On-Highway Dump (6x4, 12cy)	Active	4.00	7.3	8	233.60	E	$70.35	$70.35		$16,433.76
Equipment Operator (medium)	Active	2.00	7.3	8	116.80	L	$66.28	$0.00		$7,741.50
Truck Driver (heavy)	Active	1.00	7.3	8	58.40	L	$57.59	$0.00		$3,363.26
Laborer	Active	2.00	7.3	8	116.80	L	$45.80	$0.00		$5,349.44
		1.00	7.3	8	58.40	0	$0.00	$0.00		$0.00
		1.00	7.3	8	58.40	0	$0.00	$0.00		$0.00
		1.00	7.3	8	58.40	0	$0.00	$0.00		$0.00
		1.00	7.3	8	58.40	0	$0.00	$0.00		$0.00
		1.00	7.3	8	58.40	0	$0.00	$0.00		$0.00
		1.00	7.3	8	58.40	0	$0.00	$0.00		$0.00
			7.3	8	0.00					$0.00
			7.3	8	0.00					$0.00
			7.3	8	0.00					$0.00
			7.3	8	0.00					$0.00
			7.3	8	0.00					$0.00
				Labor Hours	**292**				**TOTAL LABOR**	**$16,454.20**
				Equipment Hours	**350.4**				**TOTAL EQUIPMENT**	**$44,011.99**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.300	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Cofferdam Sheet Piling Drive and Extract (131' X 3	3,930	SF	**RSMs Data**	$24.93	$97,974.90
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$97,974.90**

SUMMARY OF COSTS

Labor Cost	$16,454.20	Labor Burden @	49.7%	$0.00		$16,454.20
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$44,011.99	Equipment Tax @	7.75%	$3,410.93		$47,422.92
Subcontractors	$97,974.90					$97,974.90
DIRECT COST SUBTOTALS	**$158,441**			**$3,411**	**DIRECT COST SUBTOTALS**	**$161,852**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$63,877.12		$9,581.57
Installing Contractors Profit@	8.0%				$63,877.12		$5,110.17
GC Markup on Subs @	5.0%				$97,974.90		$4,898.75
						TOTAL MARKUP COSTS	**$19,590.48**
General Contractors Insurance @	1.0%			on	$181,442.50		$1,814
Bond @	1.0%			on	$181,442.50		$1,814
Contingency @	0.0%			on	$185,071.35		$0
						TOTAL COST for pay item	**$185,071**

Additional Pay Item Notes :

Figuring that there will need to be sheet pile drive to allow the cofferdam to with stand the flow from the river. Fill material will be provided from onsite demolition.

PAY ITEM COST DETAIL WORKSHEET

3.002 Furnish, Install, and Remove RipRap

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.002		Project	: Copco 2		
Description	:	Furnish, Install, and Remove RipRap					
Quantity	:	465.00	CY				
Daily Production	:	100.00	CY per 8 hour shift	Project #	: 3		
Work Days	:	4.7	Days	Estimator	: Eric Jones		
					CY per	Total Cost	Unit Price Per CY
Unit Price	:	$129.88	per CY	Probable Low Cost Parameter	115	$51,333	$110.39
Total Cost	:	$60,392		Probable High Cost Parameter	80	$72,471	$155.85

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	2.00	4.7	8	75.20	E	$274.63	incl. in rate	incl. in rate	$20,652.18
Equipment Operator (medium)	Active	2.00	4.7	8	75.20	L	$66.28	incl. in rate	incl. in rate	$4,984.26
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	4.7	8	75.20	E	$70.35	incl. in rate	incl. in rate	$5,290.32
Truck Driver (heavy)	Active	3.00	4.7	8	112.80	L	$57.59	incl. in rate	incl. in rate	$6,496.15
Labor Foreman	Active	1.00	4.7	8	37.60	L	$48.27	incl. in rate	incl. in rate	$1,814.95
Laborer	Active	4.00	4.7	8	150.40	L	$45.80	incl. in rate	incl. in rate	$6,888.32
		1.00	4.7	8	37.60	0	$0.00	$0.00		$0.00
		2.00	4.7	8	75.20	0	$0.00	$0.00		$0.00
		1.00	4.7	8	37.60	0	$0.00	$0.00		$0.00
		1.00	4.7	8	37.60	0	$0.00	$0.00		$0.00
		1.00	4.7	8	37.60	0	$0.00	$0.00		$0.00
		1.00	4.7	8	37.60	0	$0.00	$0.00		$0.00
			4.7	8	0.00					$0.00
			4.7	8	0.00					$0.00
			4.7	8	0.00					$0.00
			4.7	8	0.00					$0.00
			4.7	8	0.00					$0.00
				Labor Hours	376				TOTAL LABOR	$20,183.68
				Equipment Hours	150.4				TOTAL EQUIPMENT	$25,942.50

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.300	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$20,183.68	Labor Burden @	0.0%			$20,183.68
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$25,942.50	Equipment Tax @	7.75%	$2,010.54		$27,953.04
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$46,126			$2,011	DIRECT COST SUBTOTALS	$48,137

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$48,136.72		$7,220.51
Installing Contractors Profit@	8.0%				$48,136.72		$3,850.94
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$11,071.45
General Contractors Insurance @	1.0%		on		$59,208.16		$592
Bond @	1.0%		on		$59,208.16		$592
Contingency @	0.0%		on		$60,392.33		$0
						TOTAL COST for pay item	$60,392

Additional Pay Item Notes :

1 excavator will place the rip rap in its final position, two trucks will run from Iron gate and stock pile material due to tight area more trucks will cause too much congestion. Laborers will be directing truck traffic, foreman will oversee operation.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.003	Project	: Copco 2		
Description	: Provide Dewatering behind Cofferdams				
Quantity	: 1.00 LS				
Daily Production	: 1.00 LS per 8 hour shift	Project #	: 3		
Work Days	: 1.0 Days	Estimator	: Eric Jones	LS per	Total Cost	Unit Price Per LS
Unit Price	: $143,210.99 per LS	Probable Low Cost Parameter	1.1	$128,890	$128,889.89
Total Cost	: $143,211	Probable High Cost Parameter	0.9	$157,532	$157,532.09

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	***120.0***	8	960.00	E	$3.87	incl. in rate	incl. in rate	$3,715.20
Laborer	Active	2.00	***120.0***	8	1,920.00	L	$45.80	incl. in rate	incl. in rate	$87,936.00
Labor Foreman (out)	Active	1.00	***60.0***	8	480.00	L	$46.27	incl. in rate	incl. in rate	$22,209.60
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	2400				TOTAL LABOR	$110,145.60
				Equipment Hours	960				TOTAL EQUIPMENT	$3,715.20

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		cy	1.300	0.00	$65.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$110,145.60	Labor Burden @	0.0%			$110,145.60
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$3,715.20	Equipment Tax @	7.75%	$287.93		$4,003.13
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$113,861			$288	DIRECT COST SUBTOTALS	$114,149

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$114,148.73	$17,122.31
Installing Contractors Profit@	8.0%				$114,148.73	$9,131.90
GC Markup on Subs @	10.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$26,254.21

General Contractors Insurance @	1.0%	on	$140,402.94	$1,404
Bond @	1.0%	on	$140,402.94	$1,404
Contingency @	0.0%	on	$143,210.99	$0
			TOTAL COST for pay item	$143,211

Additional Pay Item Notes :

3" pump will be used for 4 months, 1 laborer will be managing the pump during the day and 1 laborer will be managing the pump at night, foreman will be involved with managing the pump 1/2 of the 4 months.

PAY ITEM COST DETAIL WORKSHEET — **3.004 Remove Water from behind Cofferdams**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.004		**Project**	: Copco 2		
Description	:	Remove Water from behind Cofferdams					
Quantity	:	241,000.00 GAL					
Daily Production	:	120,500.00 GAL per 8 hour shift		**Project #**	: 3		
Work Days	:	2.0 Days		**Estimator**	: Eric Jones	**GAL per**	**Total Cost** / **Unit Price Per GAL**
Unit Price	:	$0.02 per GAL		**Probable Low Cost Parameter**		**132550**	**$5,251** / **$0.02**
Total Cost	:	$5,834		**Probable High Cost Parameter**		**108450**	**$6,418** / **$0.03**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	2.0	8	16.00	E	$3.87	incl. in rate	incl. in rate	$61.92
Loader, FE Rubber Tire (5.25cy)	Active	1.00	***1.0***	8	8.00	E	$75.42	incl. in rate	incl. in rate	$603.36
Truck, Pickup (4x4, 3/4tn)	Active	1.00	2.0	8	16.00	E	$16.94	incl. in rate	incl. in rate	$271.04
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Laborer	Active	3.00	2.0	8	48.00	L	$45.80	incl. in rate	incl. in rate	$2,198.40
Equipment Operator (medium)	Active	1.00	***1.0***	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
		2.00	2.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
Intake and Discharge Hose, 3" 20' lengths		4.00	2.0	8	64.00	E	$2.50			$160.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
				Labor Hours	**72**				**TOTAL LABOR**	**$3,468.96**
				Equipment Hours	**104**				**TOTAL EQUIPMENT**	**$1,096.32**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		cy	1.300	0.00	$65.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,468.96	Labor Burden @	0.0%			$3,468.96
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$1,096.32	Equipment Tax @	7.75%	$84.96		$1,181.28
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$4,565**			**$85**	**DIRECT COST SUBTOTALS**	**$4,650**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$4,650.24		$697.54
Installing Contractors Profit@	8.0%				$4,650.24		$372.02
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$1,069.56**
General Contractors Insurance @	1.0%			on	$5,719.80		$57
Bond @	1.0%			on	$5,719.80		$57
Contingency @	0.0%			on	$5,834.20		$0
						TOTAL COST for pay item	**$5,834**

Additional Pay Item Notes :

It will take a 3" pump 2 days to dewater 241,000gallons of water, 1 laborer will manage pump at night and 1 laborer will manage the pump during the day, loader will be used half of the time to place pump. Foreman with truck will oversee operation.

PAY ITEM COST DETAIL WORKSHEET

3.005 Construct and Remove Embankment Cofferdam-Left Side of Dam

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.005		Project	: Copco 2		
Description	:	Construct and Remove Embankment Cofferdam-Left Side of Dam					
Quantity	:	1,100.00	CY				
Daily Production	:	200.00	CY per 8 hour shift	Project #	: 3		
Work Days	:	5.5	Days	Estimator	: Eric Jones	CY per	Total Cost	Unit Price Per CY
Unit Price	:	$172.54	per CY	Probable Low Cost Parameter	230	$161,324	$146.66
Total Cost	:	$189,793		Probable High Cost Parameter	160	$227,752	$207.05

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (310hp)(CATD8)	Active	1.00	5.5	8	44.00	E	$197.60	incl. in rate	incl. in rate	$8,694.40
Hydraulic Excavator (5.0cy)	Active	1.00	5.5	8	44.00	E	$274.63	incl. in rate	incl. in rate	$12,083.72
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	5.5	8	88.00	E	$70.35	incl. in rate	incl. in rate	$6,190.80
Loader, FE Rubber Tire (5.25cy)	Active	1.00	5.5	8	44.00	E	$75.42	incl. in rate	incl. in rate	$3,318.48
Roller, Single Drum (steel wheel, 12.0 - 14.9 MTn)	Active	1.00	5.5	8	44.00	E	$72.79	incl. in rate	incl. in rate	$3,202.76
Truck, Pickup (4x4, 3/4tn)	Active	1.00	5.5	8	44.00	E	$16.94	incl. in rate	incl. in rate	$745.36
Equipment Operator (medium)	Active	3.00	5.5	8	132.00	L	$66.28	incl. in rate	incl. in rate	$8,748.96
Equipment Operator (light)	Active	1.00	5.5	8	44.00	L	$64.90	incl. in rate	incl. in rate	$2,855.60
Truck Driver (heavy)	Active	2.00	5.5	8	88.00	L	$57.59	incl. in rate	incl. in rate	$5,067.92
Labor Foreman (out)	Active	1.00	5.5	8	44.00	L	$46.27	incl. in rate	incl. in rate	$2,035.88
Laborer	Active	4.00	5.5	8	176.00	L	$45.80	incl. in rate	incl. in rate	$8,060.80
		1.00	5.5	8	44.00	0	$0.00	$0.00		$0.00
		0.00	5.5	8	0.00	E	$0.00			$0.00
			5.5	8	0.00					$0.00
			5.5	8	0.00					$0.00
			5.5	8	0.00					$0.00
			5.5	8	0.00					$0.00
				Labor Hours	484				TOTAL LABOR	$26,769.16
				Equipment Hours	308				TOTAL EQUIPMENT	$34,235.52

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		cy	1.300	0.00	$25.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Cofferdam Sheet Piling Drive and Extract (131' X	3,930	SF	RSMs Data	$24.93	$97,974.90
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$97,974.90

SUMMARY OF COSTS

Labor Cost	$26,769.16	Labor Burden @	0.0%			$26,769.16
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$34,235.52	Equipment Tax @	7.75%	$2,653.25		$36,888.77
Subcontractors	$97,974.90					$97,974.90
DIRECT COST SUBTOTALS	$158,980			$2,653	DIRECT COST SUBTOTALS	$161,633

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$63,657.93	$9,548.69
Installing Contractors Profit@	8.0%				$63,657.93	$5,092.63
GC Markup on Subs @	10.0%				$97,974.90	$9,797.49
					TOTAL MARKUP COSTS	$24,438.81
General Contractors Insurance @	1.0%		on		$186,071.65	$1,861
Bond @	1.0%		on		$186,071.65	$1,861
Contingency @	0.0%		on		$189,793.08	$0
					TOTAL COST for pay item	$189,793

Additional Pay Item Notes :

Figuring that there will need to be sheet pile drive to allow the cofferdam to with stand the flow from the river. Fill material will be provided from onsite demolition.

PAY ITEM COST DETAIL WORKSHEET — **3.006 Furnish, Install, and Remove RipRap**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.006		Project	: Copco 2			
Description	:	Furnish, Install, and Remove RipRap						
Quantity	:	250.00	CY					
Daily Production	:	50.00	CY per 8 hour shift	Project #	: 3			
Work Days	:	5.0	Days	Estimator	: Eric Jones	CY per	Total Cost	Unit Price Per CY
Unit Price	:	$185.94	per CY	Probable Low Cost Parameter		57.5	$39,513	$158.05
Total Cost	:	$46,486		Probable High Cost Parameter		40	$55,783	$223.13

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	2.00	5.0	8	80.00	E	$274.63	incl. in rate	incl. in rate	$21,970.40
Truck, Pickup (4x4, 3/4tn)	Active	1.00	5.0	8	40.00	E	$16.94	incl. in rate	incl. in rate	$677.60
Labor Foreman (out)	Active	1.00	5.0	8	40.00	L	$46.27	incl. in rate	incl. in rate	$1,850.80
Laborer	Active	3.00	5.0	8	120.00	L	$45.80	incl. in rate	incl. in rate	$5,496.00
Equipment Operator (medium)	Active	2.00	5.0	8	80.00	L	$66.28	incl. in rate	incl. in rate	$5,302.40
0		2.00	5.0	8	80.00	0	$0.00	$0.00		$0.00
		2.00	5.0	8	80.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		0.00	5.0	8	0.00	E	$0.00			$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
				Labor Hours	240				TOTAL LABOR	$12,649.20
				Equipment Hours	120				TOTAL EQUIPMENT	$22,648.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		cy	1.300	0.00	$65.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$12,649.20	Labor Burden @	0.0%			$12,649.20
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$22,648.00	Equipment Tax @	7.75%	$1,755.22		$24,403.22
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$35,297			$1,755	DIRECT COST SUBTOTALS	$37,052

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$37,052.42	$5,557.86
Installing Contractors Profit@	8.0%				$37,052.42	$2,964.19
GC Markup on Subs @	10.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$8,522.06
General Contractors Insurance @	1.0%		on		$45,574.48	$456
Bond @	1.0%		on		$45,574.48	$456
Contingency @	0.0%		on		$46,485.97	$0
					TOTAL COST for pay item	$46,486

Additional Pay Item Notes :

Expect that existing riprap will be used from the right side of the coffer dam, material will be moved with 2 excavators, laborers will direct placement of lime stone and support the equipment, Foreman with truck will oversee operation. Production of this activity is low due to not be able to move big quantities using a dump truck.This material will be used as backfill behind sheet wall for coffer dam.

PAY ITEM COST DETAIL WORKSHEET | **3.007 Provide Dewatering behind left Side Cofferdam**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.007		**Project**	: Copco 2			
Description	:	Provide Dewatering behind left Side Cofferdam						
Quantity	:	1.00	LS					
Daily Production	:	1.00	LS per 8 hour shift	**Project #**	: 3			
Work Days	:	1.0	Days	**Estimator**	: Eric Jones	**LS per**	**Total Cost**	**Unit Price Per LS**
Unit Price	:	$79,612.67	per LS	**Probable Low Cost Parameter**		**1.1**	**$71,651**	**$71,651.40**
Total Cost	:	$79,613		**Probable High Cost Parameter**		**0.9**	**$87,574**	**$87,573.93**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	***120.0***	8	960.00	E	$3.87	incl. in rate	incl. in rate	$3,715.20
Truck, Pickup (4x4, 3/4tn)	Active	1.00	***30.0***	8	240.00	E	$16.94	incl. in rate	incl. in rate	$4,065.60
Labor Foreman (out)	Active	1.00	***30.0***	8	240.00	L	$46.27	incl. in rate	incl. in rate	$11,104.80
Laborer	Active	2.00	***60.0***	8	960.00	L	$45.80	incl. in rate	incl. in rate	$43,968.00
0		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**1200**				**TOTAL LABOR**	**$55,072.80**
				Equipment Hours	**1200**				**TOTAL EQUIPMENT**	**$7,780.80**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		cy	1.300	0.00	$65.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$55,072.80	Labor Burden @	0.0%		$55,072.80
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$7,780.80	Equipment Tax @	7.75%	$603.01	$8,383.81
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$62,854**			**$603**	**DIRECT COST SUBTOTALS** **$63,457**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$63,456.61	$9,518.49
Installing Contractors Profit@	8.0%				$63,456.61	$5,076.53
GC Markup on Subs @	10.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$14,595.02**
General Contractors Insurance @	1.0%		on		$78,051.63	$781
Bond @	1.0%		on		$78,051.63	$781
Contingency @	0.0%		on		$79,612.67	$0
					TOTAL COST for pay item	**$79,613**

Additional Pay Item Notes :

3" pump will be used for 4 months, 1 laborer during the day and 1 laborer during the night will maintain the pump half of the 4 month period, 1 foreman with truck will oversee the operation .25 of the duration.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.008	Project	: Copco 2		
Description	:	Remove Water from behind Cofferdams				
Quantity	:	36,000.00 GAL				
Daily Production	:	36,000.00 GAL per 8 hour shift	Project #	: 3		
Work Days	:	1.0 Days	Estimator	: Eric Jones	GAL per	Total Cost	Unit Price Per GAL
Unit Price	:	$0.15 per GAL	Probable Low Cost Parameter		39600	$4,817	$0.13
Total Cost	:	$5,352	Probable High Cost Parameter		32400	$5,887	$0.16

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	1.0	8	8.00	E	$3.87	incl. in rate	incl. in rate	$30.96
Hydraulic Excavator (5.0cy)	Active	1.00	1.0	8	8.00	E	$274.63	incl. in rate	incl. in rate	$2,197.04
Truck, Pickup (4x4, 3/4tn)	Active	1.00	1.0	8	8.00	E	$16.94	incl. in rate	incl. in rate	$135.52
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
Intake and Discharge Hose, 3"		4.00	1.0	8	32.00	E	$2.50			$80.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	32				TOTAL LABOR	$1,633.20
				Equipment Hours	56				TOTAL EQUIPMENT	$2,443.52

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		cy	1.300	0.00	$65.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,633.20	Labor Burden @	0.0%			$1,633.20
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$2,443.52	Equipment Tax @	7.75%	$189.37		$2,632.89
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$4,077			$189	DIRECT COST SUBTOTALS	$4,266

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,266.09	$639.91
Installing Contractors Profit@	8.0%				$4,266.09	$341.29
GC Markup on Subs @	10.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$981.20

General Contractors Insurance @	1.0%	on	$5,247.29	$52
Bond @	1.0%	on	$5,247.29	$52
Contingency @	0.0%	on	$5,352.24	$0
			TOTAL COST for pay item	$5,352

Additional Pay Item Notes :

3" pump will pump down 36,000 gals in .25 of a shift, It will take a full day to set pump up and to pump down area. Excavator will be used to set pump and hoses, laborers will assist equipment with setting up pump and maintaining the pump, 1 foreman with truck will oversee operation.

PAY ITEM COST DETAIL WORKSHEET — **3.009 Remove Water from behind Tailrace Cofferdam**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.009	**Project**	: Copco 2		
Description	:	Remove Water from behind Tailrace Cofferdam				
Quantity	:	400,000.00 GAL				
Daily Production	:	100,000.00 GAL per 8 hour shift	**Project #**	: 3		
Work Days	:	4.0 Days	**Estimator**	: Eric Jones	**GAL per**	**Total Cost**	**Unit Price Per GAL**
Unit Price	:	$0.03 per GAL	**Probable Low Cost Parameter**		**110000**	**$9,258**	**$0.02**
Total Cost	:	$10,287	**Probable High Cost Parameter**		**90000**	**$11,316**	**$0.03**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	4.0	8	32.00	E	$3.87	incl. in rate	incl. in rate	$123.84
Hydraulic Excavator (5.0cy)	Active	1.00	***1.0***	8	8.00	E	$274.63	incl. in rate	incl. in rate	$2,197.04
Truck, Pickup (4x4, 3/4tn)	Active	1.00	4.0	8	32.00	E	$16.94	incl. in rate	incl. in rate	$542.08
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Laborer	Active	2.00	4.0	8	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Equipment Operator (medium)	Active	1.00	***1.0***	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		2.00	4.0	8	64.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
		1.00	4.0	8	32.00	0	$0.00	$0.00		$0.00
Intake and Discharge Hose, 3"		2.00	4.0	8	64.00	E	$2.50			$160.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
				Labor Hours	**104**				**TOTAL LABOR**	**$4,942.08**
				Equipment Hours	**136**				**TOTAL EQUIPMENT**	**$3,022.96**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		cy	1.300	0.00	$65.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$4,942.08	Labor Burden @	0.0%		$4,942.08
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$3,022.96	Equipment Tax @	7.75%	$234.28	$3,257.24
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$7,965**			**$234**	**DIRECT COST SUBTOTALS** **$8,199**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$8,199.32	$1,229.90
Installing Contractors Profit@	8.0%				$8,199.32	$655.95
GC Markup on Subs @	10.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,885.84**
General Contractors Insurance @	1.0%		on		$10,085.16	$101
Bond @	1.0%		on		$10,085.16	$101
Contingency @	0.0%		on		$10,286.87	$0
					TOTAL COST for pay item	**$10,287**

Additional Pay Item Notes :

It will take roughly 3 days to pump 300,000gallons with a 3" pump. 1 day will be need to set up pump and hoses, excavator will be used 1 day to set up pump, laborers will support equipment during set up and maintain the pump through the duration of the dewatering, 1 foreman with truck will oversee operation.

PAY ITEM COST DETAIL WORKSHEET — **3.010 Provide Dewatering behind Tailrace Cofferdam**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.010		**Project**	: Copco 2		
Description	: Provide Dewatering behind Tailrace Cofferdam					
Quantity	: 1.00 LS					
Daily Production	: 1.00 LS per 8 hour shift		**Project #**	: 3		
Work Days	: 1.0 Days		**Estimator**	: Eric Jones	**LS per**	**Total Cost**	**Unit Price Per LS**
Unit Price	: $49,938.86 per LS		**Probable Low Cost Parameter**		**1.1**	**$44,945**	**$44,944.98**
Total Cost	: $49,939		**Probable High Cost Parameter**		**0.9**	**$54,933**	**$54,932.75**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
0			1.0	8	0.00	0	$0.00	$0.00		$0.00
Pump, Submersible Trash Pump, 3" & 4"	Active	2.00	***92.0***	8	1,472.00	E	$3.87	incl. in rate	incl. in rate	$5,696.64
Laborer	Active	1.00	***46.0***	8	368.00	L	$45.80	incl. in rate	incl. in rate	$16,854.40
Labor Foreman	Active	1.00	***23.0***	8	184.00	L	$48.27	incl. in rate	incl. in rate	$8,881.68
0	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
	Active	2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
	Active	2.00	1.0	8	16.00	0	$0.00	$0.00		$0.00
	Active	1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
Intake and Discharge Hose, 3"		4.00	***92.0***	8	2,944.00	E	$2.50			$7,360.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**552**				**TOTAL LABOR**	**$25,736.08**
				Equipment Hours	**4416**				**TOTAL EQUIPMENT**	**$13,056.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.000	0.00	$65.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$25,736.08	Labor Burden @		0.0%			$25,736.08
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$13,056.64	Equipment Tax @		7.75%	$1,011.89		$14,068.53
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	**$38,793**				**$1,012**	**DIRECT COST SUBTOTALS**	**$39,805**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$39,804.61	$5,970.69
Installing Contractors Profit@	8.0%				$39,804.61	$3,184.37
GC Markup on Subs @	10.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$9,155.06**
General Contractors Insurance @	1.0%		on		$48,959.67	$490
Bond @	1.0%		on		$48,959.67	$490
Contingency @	0.0%		on		$49,938.86	$0
					TOTAL COST for pay item	**$49,939**

Additional Pay Item Notes :

1 Foreman Involved 1/4 of the time of the pump operation for adjustments and maintenance. 1 Laborer Involved 1/2 of the time of the pump operation for adjustments and maintenance (fueling). 1 Extra pump Added 1 extra pump to help manage water and when pump is down for maintenance.

PAY ITEM COST DETAIL WORKSHEET

3.011 Construct Embankment Cofferdam across Tailrace

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.011		Project	: Copco 2		
Description	:	Construct Embankment Cofferdam across Tailrace					
Quantity	:	1,700.00	cy				
Daily Production	:	100.00	cy per 8 hour shift	Project #	: 3		
Work Days	:	17.0	Days	Estimator	: Michael Barba	cy per	Total Cost	Unit Price Per cy
Unit Price	:	$115.34	per cy	Probable Low Cost Parameter	115	$166,666	$98.04
Total Cost	:	$196,077		Probable High Cost Parameter	85	$225,489	$132.64

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (310hp)(CATD8)	Active	1.00	17.0	8	136.00	E	$197.60	$197.60		$26,873.60
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	17.0	8	272.00	E	$70.35	$70.35		$19,135.20
Equipment Operator (medium)	Active	1.00	17.0	8	136.00	L	$66.28	$0.00		$9,014.08
Truck Driver (heavy)	Active	1.00	17.0	8	136.00	L	$57.59	$0.00		$7,832.24
Laborer	Active	1.00	17.0	8	136.00	L	$45.80	$0.00		$6,228.80
		1.00	17.0	8	136.00	0	$0.00	$0.00		$0.00
		1.00	17.0	8	136.00	0	$0.00	$0.00		$0.00
		1.00	17.0	8	136.00	0	$0.00	$0.00		$0.00
		1.00	17.0	8	136.00	0	$0.00	$0.00		$0.00
		1.00	17.0	8	136.00	0	$0.00	$0.00		$0.00
		1.00	17.0	8	136.00	0	$0.00	$0.00		$0.00
		1.00	17.0	8	136.00	0	$0.00	$0.00		$0.00
			17.0	8	0.00					$0.00
			17.0	8	0.00					$0.00
			17.0	8	0.00					$0.00
			17.0	8	0.00					$0.00
			17.0	8	0.00					$0.00
				Labor Hours	408				TOTAL LABOR	$23,075.12
				Equipment Hours	408				TOTAL EQUIPMENT	$46,008.80

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.300	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Cofferdam Sheet Piling Drive and Extract (131' X	3,930	SF	RSMs Data	$24.93	$97,974.90
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$97,974.90

SUMMARY OF COSTS

Labor Cost	$23,075.12	Labor Burden @	49.7%	$0.00			$23,075.12
Material Cost	$0.00	Material Tax @	7.75%	$0.00			$0.00
Equipment Cost	$46,008.80	Equipment Tax @	7.75%	$3,565.68			$49,574.48
Subcontractors	$97,974.90						$97,974.90
DIRECT COST SUBTOTALS	$167,059			$3,566		DIRECT COST SUBTOTALS	$170,625

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$72,649.60		$10,897.44
Installing Contractors Profit@	8.0%				$72,649.60		$5,811.97
GC Markup on Subs @	5.0%				$97,974.90		$4,898.75
						TOTAL MARKUP COSTS	$21,608.15
General Contractors Insurance @	1.0%			on	$192,232.66		$1,922
Bond @	1.0%			on	$192,232.66		$1,922
Contingency @	0.0%			on	$196,077.31		$0
						TOTAL COST for pay item	$196,077

Additional Pay Item Notes :

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.014		Project	: COPCO 2			
Description	:	Remove Concrete in Dam						
Quantity	:	4,430.00	cy					
Daily Production	:	240.00	cy per 8 hour shift	Project #	: 3			
Work Days	:	18.5	Days	Estimator	: Felipe Poletto	cy per	Total Cost	Unit Price Per cy
Unit Price	:	$253.02	per cy	Probable Low Cost Parameter		276	$952,738	$215.06
Total Cost	:	$1,120,868		Probable High Cost Parameter		192	$1,345,041	$303.62

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	4.00	18.5	8	592.00	L	$48.27	incl. in rate	incl. in rate	$28,575.84
Laborer	Active	8.00	18.5	8	1,184.00	L	$45.80	incl. in rate	incl. in rate	$54,227.20
Equipment Operator (medium)	Active	8.00	18.5	8	1,184.00	L	$66.28	incl. in rate	incl. in rate	$78,475.52
Truck Driver (heavy)	Active	4.00	18.5	8	592.00	L	$57.59	incl. in rate	incl. in rate	$34,093.28
Barge (400T)	Active	4.00	18.5	8	592.00	E	$99.50	incl. in rate	incl. in rate	$58,904.00
Air Compressor 900 cfm	Active	2.00	18.5	8	296.00	E	$38.87	incl. in rate	incl. in rate	$11,505.20
Air Tool, Chipping Hammer	Active	8.00	18.5	8	1,184.00	E	$1.64	incl. in rate	incl. in rate	$1,940.62
Generator, Small Generator, 10 - 15 kW	Active	4.00	18.5	8	592.00	E	$7.04	incl. in rate	incl. in rate	$4,167.68
Hydraulic Excavator (5.0cy)	Active	8.00	18.5	8	1,184.00	E	$274.63	incl. in rate	incl. in rate	$325,161.92
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	8.00	18.5	8	1,184.00	E	$62.72	incl. in rate	incl. in rate	$74,260.48
Hydraulic Thumbs/Shear Attachment	Active	8.00	18.5	8	1,184.00	E	$16.39	incl. in rate	incl. in rate	$19,405.76
Truck, On-Highway Dump (6x4, 12cy)	Active	8.00	18.5	8	1,184.00	E	$70.35	incl. in rate	incl. in rate	$83,294.40
			18.5	8	0.00					$0.00
			18.5	8	0.00					$0.00
			18.5	8	0.00					$0.00
			18.5	8	0.00					$0.00
			18.5	8	0.0					$0.00
				Labor Hours	3,552				TOTAL LABOR	$195,371.84
				Equipment Hours	7,400				TOTAL EQUIPMENT	$578,640.06

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$9,768.59	$9,768.59
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	$9,768.59

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting and Drilling	30	EA	Cost per Mob	$2,500.00	$75,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$75,000.00

SUMMARY OF COSTS

Labor Cost	$195,371.84	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$195,371.84
Material Cost	$9,768.59	Material Tax @	7.75%	$757.07		$10,525.66
Equipment Cost	$578,640.06	Equipment Tax @	7.75%	$44,844.60		$623,484.66
Subcontractors	$75,000.00					$75,000.00
DIRECT COST SUBTOTALS	$858,780			$45,602	DIRECT COST SUBTOTALS	$904,382

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$829,382.16	$124,407.32
Installing Contractors Profit@	8.0%				$829,382.16	$66,350.57
GC Markup on Subs @	5.0%				$75,000.00	$3,750.00
					TOTAL MARKUP COSTS	$194,507.90
General Contractors Insurance @	1.0%			on	$1,098,890.06	$10,989
Bond @	1.0%			on	$1,098,890.06	$10,989
Contingency @	0.0%			on	$1,120,867.86	$0
					TOTAL COST for pay item	$1,120,868

Additional Pay Item Notes :

The work is done by one 6-men crew (foreman, 4 laborers, and 2 equipment operators). Concrete hauling to disposal site is also included - based on the current production rate only 3 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.015	Project	: Copco 2			
Description	:	Remove concrete equipment slab from top of embankment wing dam on right abutment					
Quantity	:	5.00 CY					
Daily Production	:	15.00 CY per 8 hour shift	Project #	: 3			
Work Days	:	0.3 Days	Estimator	: Eric Jones	CY per	Total Cost	Unit Price Per CY
Unit Price	:	$353.89 per CY	Probable Low Cost Parameter		16.5	$1,593	$318.50
Total Cost	:	$1,769	Probable High Cost Parameter		13.5	$1,946	$389.28

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	0.3	8	2.40	L	$46.27	incl. in rate	incl. in rate	$111.05
Laborer	Active	1.00	0.3	8	2.40	L	$45.80	incl. in rate	incl. in rate	$109.92
Equipment Operator (medium)	Active	1.00	0.3	8	2.40	L	$66.28	incl. in rate	incl. in rate	$159.07
Truck Driver (heavy)	Active	1.00	0.3	8	2.40	L	$57.59	incl. in rate	incl. in rate	$138.22
Hydraulic Excavator (5.0cy)	Active	1.00	0.3	8	2.40	E	$274.63	incl. in rate	incl. in rate	$659.11
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	0.3	8	2.40	E	$70.35	incl. in rate	incl. in rate	$168.84
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
		1.00	0.3	8	2.40	0	$0.00	$0.00		$0.00
			0.3	8	0.00	E	$0.00			$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
			0.3	8	0.00					$0.00
				Labor Hours	9.6				TOTAL LABOR	$518.26
				Equipment Hours	4.8				TOTAL EQUIPMENT	$827.95

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		EA	1.000	0.00	$235.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$518.26	Labor Burden @		0.0%			$518.26
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$827.95	Equipment Tax @		7.75%	$64.17		$892.12
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$1,346				$64	DIRECT COST SUBTOTALS	$1,410
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,410.37		$211.56
Installing Contractors Profit@	8.0%				$1,410.37		$112.83
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$324.39
General Contractors Insurance @	1.0%			on	$1,734.76		$17
Bond @	1.0%			on	$1,734.76		$17
Contingency @	0.0%			on	$1,769.46		$0
						TOTAL COST for pay item	$1,769

Additional Pay Item Notes :

4 man crew roughly 3 hours to mobilize to area and haul off material

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.016		**Project**	: Copco 2		
Description	: Remove Concrete Wing wall					
Quantity	: 240.00 CY					
Daily Production	: 50.00 CY per 8 hour shift		**Project #**	: 3		
Work Days	: 4.8 Days		**Estimator**	: Eric Jones	**CY per**	**Total Cost** / **Unit Price Per CY**
Unit Price	: $217.45 per CY		**Probable Low Cost Parameter**		**55**	**$46,968** / **$195.70**
Total Cost	: $52,187		**Probable High Cost Parameter**		**45**	**$57,406** / **$239.19**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.8	8	38.40	L	$46.27	incl. in rate	incl. in rate	$1,776.77
Laborer	Active	1.00	4.8	8	38.40	L	$45.80	incl. in rate	incl. in rate	$1,758.72
Equipment Operator (medium)	Active	2.00	4.8	8	76.80	L	$66.28	incl. in rate	incl. in rate	$5,090.30
Truck Driver (heavy)	Active	2.00	4.8	8	76.80	L	$57.59	incl. in rate	incl. in rate	$4,422.91
Hydraulic Excavator (5.0cy)	Active	2.00	4.8	8	76.80	E	$274.63	incl. in rate	incl. in rate	$21,091.58
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	4.8	8	76.80	E	$70.35	incl. in rate	incl. in rate	$5,402.88
		1.00	4.8	8	38.40	0	$0.00	$0.00		$0.00
		1.00	4.8	8	38.40	0	$0.00	$0.00		$0.00
		1.00	4.8	8	38.40	0	$0.00	$0.00		$0.00
		1.00	4.8	8	38.40	0	$0.00	$0.00		$0.00
		1.00	4.8	8	38.40	0	$0.00	$0.00		$0.00
		1.00	4.8	8	38.40	0	$0.00	$0.00		$0.00
			4.8	8	0.00	E	$0.00			$0.00
			4.8	8	0.00					$0.00
			4.8	8	0.00					$0.00
			4.8	8	0.00					$0.00
			4.8	8	0.00					$0.00
				Labor Hours	**230.4**				**TOTAL LABOR**	**$13,048.70**
				Equipment Hours	**153.6**				**TOTAL EQUIPMENT**	**$26,494.46**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		EA	1.000	0.00	$235.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$13,048.70	Labor Burden @	0.0%		$13,048.70
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$26,494.46	Equipment Tax @	7.75%	$2,053.32	$28,547.78
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$39,543**			**$2,053**	**DIRECT COST SUBTOTALS** **$41,596**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$41,596.49	$6,239.47
Installing Contractors Profit@	8.0%				$41,596.49	$3,327.72
GC Markup on Subs @	10.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$9,567.19**

General Contractors Insurance @	1.0%	on	$51,163.68	$512
Bond @	1.0%	on	$51,163.68	$512
Contingency @	0.0%	on	$52,186.96	$0
			TOTAL COST for pay item	**$52,187**

Additional Pay Item Notes :

6 man crew 1 week to demolish wing wall. 1 excavator with breaker performing demolition, 1 excavator loading trucks, only two trucks due to the haul road being such a tight area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.017		Project	: Copco 2		
Description	: Right Abutment Removal - Random Fill					
Quantity	: 1,510.00 CY					
Daily Production	: 300.00 CY per 8 hour shift		Project #	: 3		
Work Days	: 5.0 Days		Estimator	: Eric Jones		
				CY per	Total Cost	Unit Price Per CY
Unit Price	: $52.34 per CY		Probable Low Cost Parameter	330	$71,137	$47.11
Total Cost	: $79,041		Probable High Cost Parameter	270	$86,945	$57.58

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	5.0	8	40.00	L	$46.27	incl. in rate	incl. in rate	$1,850.80
Laborer	Active	3.00	5.0	8	120.00	L	$45.80	incl. in rate	incl. in rate	$5,496.00
Equipment Operator (medium)	Active	2.00	5.0	8	80.00	L	$66.28	incl. in rate	incl. in rate	$5,302.40
Truck Driver (heavy)	Active	5.00	5.0	8	200.00	L	$57.59	incl. in rate	incl. in rate	$11,518.00
Hydraulic Excavator (5.0cy)	Active	2.00	5.0	8	80.00	E	$274.63	incl. in rate	incl. in rate	$21,970.40
Truck, On-Highway Dump (6x4, 12cy)	Active	5.00	5.0	8	200.00	E	$70.35	incl. in rate	incl. in rate	$14,070.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
		1.00	5.0	8	40.00	0	$0.00	$0.00		$0.00
			5.0	8	0.00	E	$0.00			$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
				Labor Hours	440				TOTAL LABOR	$24,167.20
				Equipment Hours	280				TOTAL EQUIPMENT	$36,040.40

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		EA	1.000	0.00	$235.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$24,167.20	Labor Burden @		0.0%			$24,167.20
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$36,040.40	Equipment Tax @		7.75%	$2,793.13		$38,833.53
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$60,208				$2,793	DIRECT COST SUBTOTALS	$63,001
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$63,000.73		$9,450.11
Installing Contractors Profit@	8.0%				$63,000.73		$5,040.06
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$14,490.17
General Contractors Insurance @	1.0%			on	$77,490.90		$775
Bond @	1.0%			on	$77,490.90		$775
Contingency @	0.0%			on	$79,040.72		$0
						TOTAL COST for pay item	$79,041

Additional Pay Item Notes :

Crew and production is based on moving 1510CY which is a total of 151 each 10 CY loads. 5 trucks will be used hauling 6 loads per day for 5 days. There will be 2 excavators loading trucks, 3 laborers directing truck traffic, 1 foreman will oversee operation. All material will be hauled to Copco disposal site.

PAY ITEM COST DETAIL WORKSHEET — **3.018 Right Abutment Removal - Remove Hand Placed Riprap**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.018	**Project**	: Copco 2			
Description	:	Right Abutment Removal - Remove Hand Placed Riprap					
Quantity	:	5,400.00 SF					
Daily Production	:	5,400.00 SF per 8 hour shift	**Project #**	: 3			
Work Days	:	1.0 Days	**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$2.26 per SF	**Probable Low Cost Parameter**		**5940**	**$10,990**	**$2.04**
Total Cost	:	$12,211	**Probable High Cost Parameter**		**4860**	**$13,432**	**$2.49**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Laborer	Active	1.00	1.0	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Truck Driver (heavy)	Active	3.00	1.0	8	24.00	L	$57.59	incl. in rate	incl. in rate	$1,382.16
Hydraulic Excavator (5.0cy)	Active	2.00	1.0	8	16.00	E	$274.63	incl. in rate	incl. in rate	$4,394.08
Truck, On-Highway Dump (6x4, 12cy)	Active	3.00	1.0	8	24.00	E	$70.35	incl. in rate	incl. in rate	$1,688.40
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00	E	$0.00			$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**56**				**TOTAL LABOR**	**$3,179.20**
				Equipment Hours	**40**				**TOTAL EQUIPMENT**	**$6,082.48**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		EA	1.000	0.00	$235.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$3,179.20	Labor Burden @		0.0%			$3,179.20
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$6,082.48	Equipment Tax @		7.75%	$471.39		$6,553.87
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	**$9,262**				**$471**	**DIRECT COST SUBTOTALS**	**$9,733**
		Crew	**Material**	**Subs**	**Cost Basis**		
Installing Contractors Overhead@	15.0%				$9,733.07		$1,459.96
Installing Contractors Profit@	8.0%				$9,733.07		$778.65
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$2,238.61**
General Contractors Insurance @	1.0%			on	$11,971.68		$120
Bond @	1.0%			on	$11,971.68		$120
Contingency @	0.0%			on	$12,211.11		$0
						TOTAL COST for pay item	**$12,211**

Additional Pay Item Notes :

Assuming Rip Rap is 12" thick which will equal 200 CY of material to move. 3 trucks total to be used each truck will haul 6 loads at 10 cy a load. Total of 200 Cys roughly 67 cy per truck, which is 7 loads a truck.

PAY ITEM COST DETAIL WORKSHEET — **3.019 Right Abutment Removal - Gunite Curtain Wall**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.019		Project	: Copco 2		
Description	: Right Abutment Removal - Gunite Curtain Wall					
Quantity	: 180.00 CY					
Daily Production	: 40.00 CY per 8 hour shift		Project #	: 3		
Work Days	: 4.5 Days		Estimator	: Eric Jones		
				CY per	Total Cost	Unit Price Per CY
Unit Price	: $333.73 per CY		Probable Low Cost Parameter	44	$54,064	$300.35
Total Cost	: $60,071		Probable High Cost Parameter	36	$66,078	$367.10

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.5	8	36.00	L	$46.27	incl. in rate	incl. in rate	$1,665.72
Laborer	Active	2.00	4.5	8	72.00	L	$45.80	incl. in rate	incl. in rate	$3,297.60
Equipment Operator (medium)	Active	2.00	4.5	8	72.00	L	$66.28	incl. in rate	incl. in rate	$4,772.16
Truck Driver (heavy)	Active	3.00	4.5	8	108.00	L	$57.59	incl. in rate	incl. in rate	$6,219.72
Hydraulic Excavator (5.0cy)	Active	2.00	4.5	8	72.00	E	$274.63	incl. in rate	incl. in rate	$19,773.36
Truck, On-Highway Dump (6x4, 12cy)	Active	3.00	4.5	8	108.00	E	$70.35	incl. in rate	incl. in rate	$7,597.80
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	4.5	8	36.00	E	$62.72	incl. in rate	incl. in rate	$2,257.92
0		1.00	4.5	8	36.00	0	$0.00	$0.00		$0.00
		1.00	4.5	8	36.00	0	$0.00	$0.00		$0.00
		1.00	4.5	8	36.00	0	$0.00	$0.00		$0.00
		1.00	4.5	8	36.00	0	$0.00	$0.00		$0.00
		1.00	4.5	8	36.00	0	$0.00	$0.00		$0.00
			4.5	8	0.00	E	$0.00			$0.00
			4.5	8	0.00					$0.00
			4.5	8	0.00					$0.00
			4.5	8	0.00					$0.00
			4.5	8	0.00					$0.00
				Labor Hours	288				TOTAL LABOR	$15,955.20
				Equipment Hours	216				TOTAL EQUIPMENT	$29,629.08

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		EA	1.000	0.00	$235.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$15,955.20	Labor Burden @		0.0%			$15,955.20
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$29,629.08	Equipment Tax @		7.75%	$2,296.25		$31,925.33
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$45,584				$2,296	DIRECT COST SUBTOTALS	$47,881
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$47,880.53		$7,182.08
Installing Contractors Profit@	8.0%				$47,880.53		$3,830.44
GC Markup on Subs @	10.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$11,012.52
General Contractors Insurance @	1.0%		on		$58,893.06		$589
Bond @	1.0%		on		$58,893.06		$589
Contingency @	0.0%		on		$60,070.92		$0
						TOTAL COST for pay item	**$60,071**

Additional Pay Item Notes :

3 trucks total to be used each truck will haul 6 loads at 10 cy a load, 2 laborers directing trucks,1 excavator loading trucks and 1 excavator breaking up curtain wall. Foreman will oversee operation.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.020	Project	: COPCO 2			
Description	:	Remove & Dispose - Hand rails and Light Poles					
Quantity	:	5,000.00 LBS					
Daily Production	:	18,500.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	0.3 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.84 per LBS	Probable Low Cost Parameter		20350	$3,765	$0.75
Total Cost	:	$4,183	Probable High Cost Parameter		16650	$4,602	$0.92

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (80tn)	Active	1.00	0.3	8	2.40	E	$190.46	$190.46		$457.10
Equipment Operator (crane)	Active	1.00	0.3	8	2.40	L	$68.41	$0.00		$164.18
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.3	8	2.40	E	$111.64	$111.64		$267.94
Truck Driver (light)	Active	1.00	0.3	8	2.40	L	$56.29	$0.00		$135.10
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.3	8	2.40	E	$221.50	$221.50		$531.60
Electrician	Active	1.00	0.3	8	2.40	L	$45.23	$0.00		$108.55
Millwright	Active	6.00	0.3	8	14.40	L	$69.46	$0.00		$1,000.22
Labor Foreman	Active	2.00	0.3	8	4.80	L	$48.27	$0.00		$231.70

Labor Hours	26.4	TOTAL LABOR	$1,639.75
Equipment Hours	7.2	TOTAL EQUIPMENT	$1,256.64

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$81.99	$81.99
					TOTAL MATERIAL	$81.99

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	0.25	ton	1.000	0.25	$595.00	$148.75
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	36.00	mile	1.000	36.00	$7.25	$261.00
					TOTAL SUBCONTRACTS	$409.75

SUMMARY OF COSTS

Labor Cost	$1,639.75	Labor Burden @	49.7%	$0.00		$1,639.75
Material Cost	$81.99	Material Tax @	7.8%	$6.35		$88.34
Equipment Cost	$1,256.64	Equipment Tax @	0.0%	$0.00		$1,256.64
Subcontractors	$409.75					$409.75
DIRECT COST SUBTOTALS	$3,388			$6	DIRECT COST SUBTOTALS	$3,394

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,984.73	$447.71
Installing Contractors Profit@	8.0%				$2,984.73	$238.78
GC Markup on Subs @	5.0%				$409.75	$20.49
					TOTAL MARKUP COSTS	$706.98
General Contractors Insurance @	1.0%		on		$4,101.46	$41
Bond @	1.0%		on		$4,101.46	$41
Contingency @	0.0%		on		$4,183.49	$0
					TOTAL COST for pay item	$4,183

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed hazardous waste 100% of the total lbs, calculated 36 miles from Copco2 to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.021		Project	: COPCO2
Description	: Remove & Dispose - Radial Gates and Hoists			
Quantity	: 66,000.00 LBS			
Daily Production	: 30,000.00 LBS per 8 hour shift		Project #	: Klamath Dams Removal
Work Days	: 2.2 Days		Estimator	: Mihaela Tomulescu
Unit Price	: $0.81 per LBS			
Total Cost	: $53,452			

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	34500	$45,434	$0.69
Probable High Cost Parameter	24000	$64,142	$0.97

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.2	8	17.60	L	$47.23	$0.00		$831.25
Electrician	Active	1.00	2.2	8	17.60	L	$45.23	$0.00		$796.05
Steelworker	Active	5.00	2.2	8	88.00	L	$65.52	$0.00		$5,765.76
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.2	8	17.60	E	$221.50	$221.50		$3,898.40
Truck Driver (heavy)	Active	1.00	2.2	8	17.60	L	$57.59	$0.00		$1,013.58
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.2	8	17.60	E	$111.64	$111.64		$1,964.86
Hydraulic Crane (120tn)	Active	1.00	2.2	8	17.60	E	$239.06	$239.06		$4,207.46
Welder	Active	1.00	2.2	8	17.60	L	$7.84	$0.00		$137.94
Gas Welding Machine	Active	1.00	2.2	8	17.60	E	$2.88	$2.88		$50.64
Equipment Operator (medium)	Active	1.00	2.2	8	17.60	L	$66.28	$0.00		$1,166.53
Equipment Operator (crane)	Active	1.00	2.2	8	17.60	L	$68.41	$0.00		$1,204.02

Labor Hours	193.6	TOTAL LABOR	$10,915.12
Equipment Hours	70.4	TOTAL EQUIPMENT	$10,121.36

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$545.76	$545.76
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	2,500.00	LF	1.000	2,500.00	$0.85	$2,125.00
TOTAL MATERIAL						$2,670.76

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	33.00	ton	1.000	33.00	$595.00	$19,635.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	311.67	mile	1.000	311.67	$7.25	$2,259.58
TOTAL SUBCONTRACTS						$21,894.58

SUMMARY OF COSTS

Labor Cost	$10,915.12	Labor Burden @	49.7%	$0.00	$10,915.12
Material Cost	$2,670.76	Material Tax @	7.8%	$206.98	$2,877.74
Equipment Cost	$10,121.36	Equipment Tax @	0.0%	$0.00	$10,121.36
Subcontractors	$21,894.58				$21,894.58
DIRECT COST SUBTOTALS	$45,602			$207	DIRECT COST SUBTOTALS $45,809

	Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%			$23,914.22	$3,587.13
Installing Contractors Profit@	8.0%			$23,914.22	$1,913.14
GC Markup on Subs @	5.0%			$21,894.58	$1,094.73
				TOTAL MARKUP COSTS	$6,595.00
General Contractors Insurance @	1.0%		on	$52,403.80	$524
Bond @	1.0%		on	$52,403.80	$524
Contingency @	0.0%		on	$53,451.88	$0
				TOTAL COST for pay item	$53,452

Additional Pay Item Notes :

Production based on crew 1 Forman, 5 Steelworkers and 1 Welder to cut and attach hooks to the gate for disposal, 4 Laborers to rigging wire rope slings, 1 Electrician to provide power for tools, 1 Truck for disposal to Yreka facility. Assuming 2.2 day of work.

PAY ITEM COST DETAIL WORKSHEET **3.022 Remove & Dispose - 5-Radial Gate Stoplogs & Slots (steel)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.022	Project	: COPCO2
Description	:	Remove & Dispose - 5-Radial Gate Stoplogs & Slots (steel)		
Quantity	:	95,800.00 LBS		
Daily Production	:	30,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	:	3.2 Days	Estimator	: Mihaela Tomulescu
Unit Price	:	$0.93 per LBS		
Total Cost	:	$89,381		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	34500	$75,974	$0.79
Probable High Cost Parameter	24000	$107,258	$1.12

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	3.2	8	25.60	L	$47.23	$0.00		$1,209.09
Electrician	Active	1.00	3.2	8	25.60	L	$45.23	$0.00		$1,157.89
Ironworkers	Active	10.00	3.2	8	256.00	L	$63.95	$0.00		$16,371.20
Vibratory Hammer & Extractor	Active	1.00	3.2	8	25.60	E	$94.34	$94.34		$2,415.10
Truck Driver (heavy)	Active	2.00	3.2	8	51.20	L	$57.59	$0.00		$2,948.61
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	3.2	8	51.20	E	$111.64	$111.64		$5,715.97
Hydraulic Crane (120tn)	Active	2.00	3.2	8	51.20	E	$239.06	$239.06		$12,239.87
Welder	Active	2.00	3.2	8	51.20	L	$7.84	$0.00		$401.28
Gas Welding Machine	Active	2.00	3.2	8	51.20	E	$2.88	$2.88		$147.30
Equipment Operator (medium)	Active	2.00	3.2	8	51.20	L	$66.28	$0.00		$3,393.54
Equipment Operator (crane)	Active	1.00	3.2	8	25.60	L	$68.41	$0.00		$1,751.30
Laborer	Active	10.00	3.2	8	256.00	L	$45.80	$0.00		$11,724.80
				Labor Hours	742.4				TOTAL LABOR	$38,957.70
				Equipment Hours	179.2				TOTAL EQUIPMENT	$20,518.25

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,947.88	$1,947.88
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	5,000.00	LF	1.000	5,000.00	$0.85	$4,250.00
					TOTAL MATERIAL	$6,197.88

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit	Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (20%)	9.58	ton	1.000	9.58	$595.00	$5,700.10
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	36.00	mile	1.000	36.00	$7.25	$261.00
					TOTAL SUBCONTRACTS	$5,961.10

SUMMARY OF COSTS

Labor Cost	$38,957.70	Labor Burden @	49.7%	$0.00	$38,957.70
Material Cost	$6,197.88	Material Tax @	7.8%	$480.34	$6,678.22
Equipment Cost	$20,518.25	Equipment Tax @	0.0%	$0.00	$20,518.25
Subcontractors	$5,961.10				$5,961.10
DIRECT COST SUBTOTALS	$71,635			$480	DIRECT COST SUBTOTALS $72,115

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$66,154.16	$9,923.12
Installing Contractors Profit@	8.0%				$66,154.16	$5,292.33
GC Markup on Subs @	5.0%				$5,961.10	$298.06
					TOTAL MARKUP COSTS	$15,513.51

General Contractors Insurance @	1.0%	on	$87,628.78	$876
Bond @	1.0%	on	$87,628.78	$876
Contingency @	0.0%	on	$89,381.35	$0
			TOTAL COST for pay item	$89,381

Additional Pay Item Notes :

Production based on crew 1 Forman, 5 Ironworkers and 1 Welder to cut and attach hooks to the gate for disposal, 4 Laborers to rigging wire rope slings. Electrical crew to provide power for tools, 1 Truck for disposal to Yreka facility. Assuming using a Vibratory Hammer & Extractor for attachments in concrete and 2 cranes for balance when the gates are discharged.

PAY ITEM COST DETAIL WORKSHEET **3.023 Remove & Dispose - Spillway intake gate motor & control panel**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.023	Project	: COPCO 2
Description	:	Remove & Dispose - Spillway intake gate motor & control panel		
Quantity	:	1.00 EA		
Daily Production	:	1.00 EA per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	:	1.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	:	$1,297.31 per EA		
Total Cost	:	$1,297		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	1.1	$1,168	$1,167.58
Probable High Cost Parameter	0.9	$1,427	$1,427.04

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician	Active	2.00	1.0	8	16.00	L	$45.23	$0.00		$723.68

Labor Hours	16	TOTAL LABOR	$723.68
Equipment Hours	0	TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 0.5% labor (Side Cutter, Sharp-Nose Pliers, Sharp Tip Tweezers PCB Clamp, etc)	3.98	LS	1.000	3.98	$72.37	$288.04
					TOTAL MATERIAL	$288.04

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$723.68	Labor Burden @	49.7%	$0.00	$723.68
Material Cost	$288.04	Material Tax @	7.8%	$22.32	$310.37
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00	$0.00
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$1,012			$22	DIRECT COST SUBTOTALS $1,034

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,034.05	$155.11
Installing Contractors Profit@	8.0%				$1,034.05	$82.72
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$237.83

General Contractors Insurance @	1.0%	on	$1,271.88	$13
Bond @	1.0%	on	$1,271.88	$13
Contingency @	0.0%	on	$1,297.31	$0
			TOTAL COST for pay item	$1,297

Additional Pay Item Notes :

Assumed that two electrician will work one day to unconnect and remove the control panel and the gate motor.

PAY ITEM COST DETAIL WORKSHEET

3.024 Remove & Dispose - Spillway radial gate motor & control panel

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.024	Project	: COPCO 2		
Description	:	Remove & Dispose - Spillway radial gate motor & control panel				
Quantity	:	1.00 EA				
Daily Production	:	1.00 EA per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	1.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$1,297.31 per EA	Probable Low Cost Parameter	1.1	$1,168	$1,167.58
Total Cost	:	$1,297	Probable High Cost Parameter	0.9	$1,427	$1,427.04

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician	Active	2.00	1.0	8	16.00	L	$45.23	$0.00		$723.68

Labor Hours	16	TOTAL LABOR	$723.68
Equipment Hours	0	TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 0.5% labor (Side Cutter, Sharp-Nose Pliers, Sharp Tip Tweezers PCB Clamp, etc)	3.98	LS	1.000	3.98	$72.37	$288.04
					TOTAL MATERIAL	$288.04

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$723.68	Labor Burden @	49.7%	$0.00		$723.68
Material Cost	$288.04	Material Tax @	7.8%	$22.32		$310.37
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$1,012			$22	DIRECT COST SUBTOTALS	$1,034

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,034.05	$155.11
Installing Contractors Profit@	8.0%				$1,034.05	$82.72
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$237.83
General Contractors Insurance @	1.0%	on			$1,271.88	$13
Bond @	1.0%	on			$1,271.88	$13
Contingency @	0.0%	on			$1,297.31	$0
					TOTAL COST for pay item	$1,297

Additional Pay Item Notes :

Assumed that two electrician will work one day to unconnect and remove the control panel and the gate motor.

PAY ITEM COST DETAIL WORKSHEET

3.025 Remove & Dispose - Spillway trashrake motor, festoon cable & control panel

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.025	**Project**	: COPCO 2
Description	: Remove & Dispose - Spillway trashrake motor, festoon cable & control panel		
Quantity	: 1.00 EA		
Daily Production	: 1.00 EA per 8 hour shift	**Project #**	: Klamath Dams Removal
Work Days	: 1.0 Days	**Estimator**	: Mihaela Tomulescu
Unit Price	: $551.31 per EA		
Total Cost	: $551		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	1.1	$496	$496.18
Probable High Cost Parameter	0.9	$606	$606.44

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84

Labor Hours	8	TOTAL LABOR	$361.84
Equipment Hours	0	TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 0.5% labor (Side Cutter, Sharp-Nose Pliers, Sharp Tip Tweezers PCB Clamp, etc)	1.99	LS	1.000	1.99	$36.18	$72.01
					TOTAL MATERIAL	$72.01

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$361.84	Labor Burden @	49.7%	$0.00	$361.84
Material Cost	$72.01	Material Tax @	7.8%	$5.58	$77.59
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00	$0.00
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$434**			**$6**	**DIRECT COST SUBTOTALS $439**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$439.43	$65.91
Installing Contractors Profit@	8.0%				$439.43	$35.15
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$101.07**

General Contractors Insurance @	1.0%	on	$540.50	$5
Bond @	1.0%	on	$540.50	$5
Contingency @	0.0%	on	$551.31	$0
			TOTAL COST for pay item	**$551**

Additional Pay Item Notes :

Assumed that one electrician will work one day to unconnect and remove the festoon cable, control panel and the motor.

PAY ITEM COST DETAIL WORKSHEET **3.026 Remove & Dispose - Distribution equipment, panelboards**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.026		**Project**	: COPCO 2		
Description	:	Remove & Dispose - Distribution equipment, panelboards					
Quantity	:	1.00 EA					
Daily Production	:	0.50 EA per 8 hour shift		**Project #**	: Klamath Dams Removal		
Work Days	:	2.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per** / **Total Cost**	**Unit Price Per EA**
Unit Price	:	$5,877.55 per EA		**Probable Low Cost Parameter**		**0.55** / **$5,290**	**$5,289.80**
Total Cost	:	$5,878		**Probable High Cost Parameter**		**0.45** / **$6,465**	**$6,465.31**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.0	8	16.00	L	$47.23	$0.00		$755.68
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	$0.00		$723.68
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
Hydraulic Crane (17tn)	Active	1.00	2.0	8	16.00	E	$81.52	$81.52		$1,304.32
				Labor Hours	**48**			**TOTAL LABOR**		**$2,487.36**
				Equipment Hours	**24**			**TOTAL EQUIPMENT**		**$2,197.44**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 0.5% labor (Side Cutter, Sharp-Nose Pliers, Sharp Tip Tweezers PCB Clamp, etc)	0.00	LS	1.000	0.00	$124.37	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,487.36	Labor Burden @	49.7%	$0.00	$2,487.36
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$2,197.44	Equipment Tax @	0.0%	$0.00	$2,197.44
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$4,685**			**$0**	**DIRECT COST SUBTOTALS** **$4,685**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,684.80	$702.72
Installing Contractors Profit@	8.0%				$4,684.80	$374.78
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,077.50**
General Contractors Insurance @	1.0%		on		$5,762.30	$58
Bond @	1.0%		on		$5,762.30	$58
Contingency @	0.0%		on		$5,877.55	$0
					TOTAL COST for pay item	**$5,878**

Additional Pay Item Notes :

Assumed that electrical crew formed of 1 Forman and 1 Electricians will work two days to unconnect and remove the distribution panels. They are going to use same crane and a truck for disposal of spillway intake, trash rake and radial motor & control panel.

PAY ITEM COST DETAIL WORKSHEET — **3.027 Remove Copper Shingles from Roof of Powerhouse**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.027	**Project**	: Copco 2			
Description	:	Remove Copper Shingles from Roof of Powerhouse					
Quantity	:	7,000.00 SF					
Daily Production	:	3,500.00 SF per 8 hour shift	**Project #**	: 3			
Work Days	:	2.0 Days	**Estimator**	: Eric Jones	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$2.07 per SF	**Probable Low Cost Parameter**		**3850**	**$13,026**	**$1.86**
Total Cost	:	$14,473	**Probable High Cost Parameter**		**3150**	**$15,920**	**$2.27**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Carpenter Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.40	incl. in rate	incl. in rate	$742.40
Carpenters	Active	2.00	2.0	8	32.00	L	$72.60	incl. in rate	incl. in rate	$2,323.20
Laborer	Active	3.00	2.0	8	48.00	L	$45.80	incl. in rate	incl. in rate	$2,198.40
Truck Driver (heavy)	Active	2.00	2.0	8	32.00	L	$57.59	incl. in rate	incl. in rate	$1,842.88
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	2.0	8	32.00	E	$70.35	incl. in rate	incl. in rate	$2,251.20
Forklift, Rough Terrain (9,000 lb capacity)	Active	1.00	2.0	8	16.00	E	$54.70	incl. in rate	incl. in rate	$875.20
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
		1.00	2.0	8	16.00	0	$0.00	$0.00		$0.00
			2.0	8	0.00	E	$0.00			$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
				Labor Hours	**144**				**TOTAL LABOR**	**$8,167.36**
				Equipment Hours	**48**				**TOTAL EQUIPMENT**	**$3,126.40**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		EA	1.000	0.00	$235.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$8,167.36	Labor Burden @	0.0%			$8,167.36
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$3,126.40	Equipment Tax @	7.75%	$242.30		$3,368.70
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$11,294**			**$242**	**DIRECT COST SUBTOTALS**	**$11,536**

		Crew	**Material**	**Subs**	**Cost Basis**	
Installing Contractors Overhead@	15.0%				$11,536.06	$1,730.41
Installing Contractors Profit@	8.0%				$11,536.06	$922.88
GC Markup on Subs @	10.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$2,653.29**

General Contractors Insurance @	1.0%	on	$14,189.35	$142
Bond @	1.0%	on	$14,189.35	$142
Contingency @	0.0%	on	$14,473.14	$0
			TOTAL COST for pay item	**$14,473**

Additional Pay Item Notes :

2 working days to strip roof organize and haul off material. The carpenters and laborers will remove roof and stack and organized material, Forklift will be used to load material in two dump trucks.

PAY ITEM COST DETAIL WORKSHEET

3.028 Remove Powerhouse Concrete down to spring-line of turbine

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.028	Project	: COPCO 2			
Description	:	Remove Powerhouse Concrete down to spring-line of turbine					
Quantity	:	1,110.00 cy					
Daily Production	:	50.00 cy per 8 hour shift	Project #	: 3			
Work Days	:	22.2 Days	Estimator	: Felipe Poletto	cy per	Total Cost	Unit Price Per cy
Unit Price	:	$514.15 per cy	Probable Low Cost Parameter		57.5	$485,097	$437.02
Total Cost	:	$570,702	Probable High Cost Parameter		40	$684,843	$616.98

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	4.00	22.2	8	710.40	E	$274.63	incl. in rate	incl. in rate	$195,097.15
Hydraulic Thumbs/Shear Attachment	Active	1.00	22.2	8	177.60	E	$16.39	incl. in rate	incl. in rate	$2,910.86
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	22.2	8	177.60	E	$62.72	incl. in rate	incl. in rate	$11,139.07
Loader, FE Rubber Tire (5.25cy)	Active	2.00	22.2	8	355.20	E	$75.42	incl. in rate	incl. in rate	$26,789.18
Hydraulic Crane (80tn)	Active	1.00	22.2	8	177.60	E	$190.46	incl. in rate	incl. in rate	$33,825.70
Truck, On-Highway Dump (6x4, 12cy)	Active	4.00	22.2	8	710.40	E	$70.35	incl. in rate	incl. in rate	$49,976.64
Labor Foreman (out)	Active	1.00	22.2	8	177.60	L	$46.27	incl. in rate	incl. in rate	$8,217.55
Laborer	Active	1.00	22.2	8	177.60	L	$45.80	incl. in rate	incl. in rate	$8,134.08
Equipment Operator (medium)	Active	3.00	22.2	8	532.80	L	$66.28	incl. in rate	incl. in rate	$35,313.98
Equipment Operator (crane)	Active	1.00	22.2	8	177.60	L	$68.41	incl. in rate	incl. in rate	$12,149.62
Truck Driver (heavy)	Active	4.00	22.2	8	710.40	L	$57.59	incl. in rate	incl. in rate	$40,911.94
0		1.00	22.2	8	177.60	0	$0.00	incl. in rate	incl. in rate	$0.00
			22.2	8	0.00					$0.00
			22.2	8	0.00					$0.00
			22.2	8	0.00					$0.00
			22.2	8	0.00					$0.00
			22.2	8	0.00					$0.00
				Labor Hours	1,776				TOTAL LABOR	$104,727.17
				Equipment Hours	2,309				TOTAL EQUIPMENT	$319,738.61

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$5,236.36	$5,236.36
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	$5,236.36

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$104,727.17	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$104,727.17
Material Cost	$5,236.36	Material Tax @	7.75%	$405.82		$5,642.18
Equipment Cost	$319,738.61	Equipment Tax @	7.75%	$24,779.74		$344,518.35
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$429,702			$25,186	DIRECT COST SUBTOTALS	$454,888

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$454,887.69	$68,233.15
Installing Contractors Profit@	8.0%				$454,887.69	$36,391.02
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$104,624.17
General Contractors Insurance @	1.0%			on	$559,511.86	$5,595
Bond @	1.0%			on	$559,511.86	$5,595
Contingency @	0.0%			on	$570,702.10	$0
					TOTAL COST for pay item	$570,702

Additional Pay Item Notes :

There will be 2 excavators managing material and loading trucks, 1 excavator with shear attachment to cut reinforcement, 1 excavator with breaker attachment breaking concrete, 4 trucks will be used to haul material to scour site, each truck will have to make roughly 2 loads per day for the duration of the operation, due to the distance to the dump site location 4 trucks will be the minimum used. Production of the concrete demolition will be reduced due to the amount of items that will need to be demolished.

PAY ITEM COST DETAIL WORKSHEET — **3.029 Remove Structural Steel items associated with Powerhouse**

PAY ITEM INFORMATION

PAY ITEM NUMBER :	3.029		Project :	COPCO 2		
Description :	Remove Structural Steel items associated with Powerhouse					
Quantity :	220,000.00 LBS					
Daily Production :	30,000.00 LBS per 8 hour shift		Project # :	Klamath Dams Removal		
Work Days :	7.3 Days		Estimator :	Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price :	$0.96 per LBS		Probable Low Cost Parameter		34500	$179,995	$0.82
Total Cost :	$211,759		Probable High Cost Parameter		25500	$243,523	$1.11

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	7.3	8	58.40	L	$47.23	$0.00		$2,758.23
Electrician	Active	1.00	7.3	8	58.40	L	$45.23	$0.00		$2,641.43
Ironworkers	Active	10.00	7.3	8	584.00	L	$63.95	$0.00		$37,346.80
Loader, FE Rubber Tire (8.6cy)	Active	1.00	7.3	8	58.40	E	$221.50	$221.50		$12,935.60
Truck Driver (heavy)	Active	2.00	7.3	8	116.80	L	$57.59	$0.00		$6,726.51
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	7.3	8	116.80	E	$111.64	$111.64		$13,039.55
Hydraulic Crane (120tn)	Active	2.00	7.3	8	116.80	E	$239.06	$239.06		$27,922.21
Welder	Active	4.00	7.3	8	233.60	L	$7.84	$0.00		$1,830.84
Gas Welding Machine	Active	4.00	7.3	8	233.60	E	$2.88	$2.88		$672.06
Equipment Operator (medium)	Active	1.00	7.3	8	58.40	L	$66.28	$0.00		$3,870.75
Equipment Operator (crane)	Active	1.00	7.3	8	58.40	L	$68.41	$0.00		$3,995.14
Laborer	Active	10.00	7.3	8	584.00	L	$45.80	$0.00		$26,747.20
				Labor Hours	1752			TOTAL LABOR		$85,916.91
				Equipment Hours	525.6			TOTAL EQUIPMENT		$54,569.42

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, wrenches, electrodes, welding accessories, etc)	1.00	LS	1.000	1.00	$12,887.54	$12,887.54
					TOTAL MATERIAL	$12,887.54

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (25% from total)	27.50	ton	1.000	27.50	$595.00	$16,362.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	72.00	mile	1.000	72.00	$7.25	$522.00
					TOTAL SUBCONTRACTS	$16,884.50

SUMMARY OF COSTS

Labor Cost	$85,916.91	Labor Burden @	49.7%	$0.00		$85,916.91
Material Cost	$12,887.54	Material Tax @	7.8%	$998.78		$13,886.32
Equipment Cost	$54,569.42	Equipment Tax @	0.0%	$0.00		$54,569.42
Subcontractors	$16,884.50					$16,884.50
DIRECT COST SUBTOTALS	$170,258			$999	DIRECT COST SUBTOTALS	$171,257

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$154,372.66	$23,155.90
Installing Contractors Profit@	8.0%				$154,372.66	$12,349.81
GC Markup on Subs @	5.0%				$16,884.50	$844.23
					TOTAL MARKUP COSTS	$36,349.94
General Contractors Insurance @	1.0%		on		$207,607.09	$2,076
Bond @	1.0%		on		$207,607.09	$2,076
Contingency @	0.0%		on		$211,759.24	$0

TOTAL COST for pay item **$211,759**

Additional Pay Item Notes :

Includes columns, beams, crane girders, bracing, misc. shapes, roof trusses, purlins, etc. Assumed contains paint with heavy metals 25% of the total lbs, 36 miles from Copco lake to Yreka transfer recycling. Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assuming using 2 cranes and 2 trucks for disposal in 7 days.

PAY ITEM COST DETAIL WORKSHEET

3.030 Remove Control House Concrete

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.030	**Project**	: Copco 2		
Description	:	Remove Control House Concrete				
Quantity	:	30.00 CY				
Daily Production	:	30.00 CY per 8 hour shift	**Project #**	: 3		
Work Days	:	1.0 Days	**Estimator**	: Eric Jones	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	:	$317.78 per CY	**Probable Low Cost Parameter**	**34.5**	**$8,103**	**$270.11**
Total Cost	:	$9,533	**Probable High Cost Parameter**	**24**	**$11,440**	**$381.34**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Laborer	Active	1.00	1.0	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Hydraulic Excavator (5.0cy)	Active	2.00	1.0	8	16.00	E	$274.63	incl. in rate	incl. in rate	$4,394.08
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	1.0	8	8.00	E	$70.35	incl. in rate	incl. in rate	$562.80
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
		1.00	1.0	8	8.00	0	$0.00	$0.00		$0.00
			1.0	8	0.00	E	$0.00			$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**40**				**TOTAL LABOR**	**$2,257.76**
				Equipment Hours	**24**				**TOTAL EQUIPMENT**	**$4,956.88**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		EA	1.000	0.00	$235.00	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,257.76	Labor Burden @	0.0%			$2,257.76
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$4,956.88	Equipment Tax @	7.75%	$384.16		$5,341.04
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$7,215**			**$384**	**DIRECT COST SUBTOTALS**	**$7,599**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$7,598.80	$1,139.82
Installing Contractors Profit@	8.0%				$7,598.80	$607.90
GC Markup on Subs @	10.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,747.72**
General Contractors Insurance @	1.0%		on		$9,346.52	$93
Bond @	1.0%		on		$9,346.52	$93
Contingency @	0.0%		on		$9,533.45	$0
					TOTAL COST for pay item	**$9,533**

Additional Pay Item Notes :

1 truck 3 loads and 2 excavators 1 breaking and 1 loading material, foreman managing operation and labor flagging trucks.

PAY ITEM COST DETAIL WORKSHEET

3.031 Remove Control House Structural Steel Items

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.031		**Project**	: COPCO2			
Description	: Remove Control House Structural Steel Items						
Quantity	: 3,500.00 LBS						
Daily Production	: 18,000.00 LBS per	8 hour shift	**Project #**	: 0			
Work Days	: 0.2	Days	**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	: $0.88	per LBS	**Probable Low Cost Parameter**		**20700**	**$2,625**	**$0.75**
Total Cost	: $3,088		**Probable High Cost Parameter**		**15300**	**$3,552**	**$1.01**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.2	8	1.60	L	$48.27	$0.00		$77.23
Electrician	Active	1.00	0.2	8	1.60	L	$45.23	$0.00		$72.37
Steelworker	Active	2.00	0.2	8	3.20	L	$65.52	$0.00		$209.66
Welder	Active	1.00	0.2	8	1.60	L	$7.84	$0.00		$12.54
Truck Driver (heavy)	Active	1.00	0.2	8	1.60	L	$57.59	$0.00		$92.14
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	$111.64		$178.62
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.2	8	1.60	E	$221.50	$221.50		$354.40
Hydraulic Crane (17tn)	Active	1.00	0.2	8	1.60	E	$81.52	$81.52		$130.43
Equipment Operator (medium)	Active	2.00	0.2	8	3.20	L	$66.28	$0.00		$212.10
Gas Welding Machine	Active	1.00	0.2	8	1.60	E	$2.88	$2.88		$4.60
Laborer	Active	4.00	0.2	8	6.40	L	$45.80	$0.00		$293.12
				Labor Hours	**19.2**				**TOTAL LABOR**	**$969.16**
				Equipment Hours	**6.4**				**TOTAL EQUIPMENT**	**$668.06**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, wrenches, electrodes, welding accessories, etc)	1.00	LS	1.000	1.00	$145.37	$145.37
					TOTAL MATERIAL	**$145.37**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (25% from total)	0.44	ton	1.000	0.44	$595.00	$260.31
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	72.00	mile	1.000	72.00	$7.25	$522.00
					TOTAL SUBCONTRACTS	**$782.31**

SUMMARY OF COSTS

Labor Cost	$969.16	Labor Burden @		49.7%	$0.00		$969.16
Material Cost	$145.37	Material Tax @		7.8%	$11.27		$156.64
Equipment Cost	$668.06	Equipment Tax @		0.0%	$0.00		$668.06
Subcontractors	$782.31						$782.31
DIRECT COST SUBTOTALS	**$2,565**				**$11**	**DIRECT COST SUBTOTALS**	**$2,576**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,793.86		$269.08
Installing Contractors Profit@	8.0%				$1,793.86		$143.51
GC Markup on Subs @	5.0%				$782.31		$39.12
						TOTAL MARKUP COSTS	**$451.70**
General Contractors Insurance @	1.0%		on		$3,027.88		$30
Bond @	1.0%		on		$3,027.88		$30
Contingency @	0.0%		on		$3,088.44		$0
						TOTAL COST for pay item	**$3,088**

Additional Pay Item Notes :

Assumed structural frames contains paint with heavy metals 25% of the total lbs, 36 miles from Copco lake to Yreka transfer recycling. Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assuming using 1 cranes, 1 loader and 1 trucks for disposal.

PAY ITEM COST DETAIL WORKSHEET

3.032 Remove Shop Building

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.032		**Project**	: Copco 2		
Description	: Remove Shop Building					
Quantity	: 4,300.00 SF					
Daily Production	: 308.00 SF per 8 hour shift		**Project #**	: 3		
Work Days	: 14.0 Days		**Estimator**	: Eric Jones	**SF per**	**Total Cost** / **Unit Price Per SF**
Unit Price	: $69.45 per SF		**Probable Low Cost Parameter**		**354.2**	**$253,829** / **$59.03**
Total Cost	: $298,623		**Probable High Cost Parameter**		**231**	**$373,279** / **$86.81**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	14.0	8	112.00	L	$46.27	incl. in rate	incl. in rate	$5,182.24
Laborer	Active	6.00	14.0	8	672.00	L	$45.80	incl. in rate	incl. in rate	$30,777.60
Equipment Operator (medium)	Active	4.00	14.0	8	448.00	L	$66.28	incl. in rate	incl. in rate	$29,693.44
Truck Driver (heavy)	Active	1.00	14.0	8	112.00	L	$57.59	incl. in rate	incl. in rate	$6,450.08
Steelworker	Active	2.00	14.0	8	224.00	L	$65.52	incl. in rate	incl. in rate	$14,676.48
Hydraulic Excavator (5.0cy)	Active	3.00	14.0	8	336.00	E	$274.63	incl. in rate	incl. in rate	$92,275.68
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	2.00	14.0	8	224.00	E	$62.72	incl. in rate	incl. in rate	$14,049.28
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	14.0	8	224.00	E	$111.64	incl. in rate	incl. in rate	$25,007.36
Loader, FE Rubber Tire (5.25cy)	Active	1.00	14.0	8	112.00	E	$75.42	incl. in rate	incl. in rate	$8,447.04
		1.00	14.0	8	112.00	0	$0.00	$0.00		$0.00
		1.00	14.0	8	112.00	0	$0.00	$0.00		$0.00
		1.00	14.0	8	112.00	0	$0.00	$0.00		$0.00
			14.0	8	0.00					$0.00
			14.0	8	0.00					$0.00
			14.0	8	0.00					$0.00
			14.0	8	0.00					$0.00
			14.0	8	0.00					$0.00
				Labor Hours	**1568**				**TOTAL LABOR**	**$86,779.84**
				Equipment Hours	**896**				**TOTAL EQUIPMENT**	**$139,779.36**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Glyphosate	31.00	gal	1.000	31.00	$18.87	$584.97
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$584.97**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$86,779.84	Labor Burden @	0.0%		$86,779.84
Material Cost	$584.97	Material Tax @	7.75%	$45.34	$630.31
Equipment Cost	$139,779.36	Equipment Tax @	7.75%	$10,832.90	$150,612.26
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$227,144**			**$10,878**	**DIRECT COST SUBTOTALS** **$238,022**

	Rate	Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$238,022.41	$35,703.36
Installing Contractors Profit@	8.0%				$238,022.41	$19,041.79
GC Markup on Subs @	10.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$54,745.15**
General Contractors Insurance @	1.0%		on		$292,767.56	$2,928
Bond @	1.0%		on		$292,767.56	$2,928
Contingency @	0.0%		on		$298,622.91	$0
					TOTAL COST for pay item	**$298,623**

Additional Pay Item Notes :

Crew should take 2 weeks to remove building. Assuming the building is a combination of structural steel and CMU. 1 labor foreman to run crews 6 laborer for running and cleaning up misc mats, and backing up trucks 3 equipment operators 2 for the excavators (1 with breaker, 1 with bucket,) and 1 for loader excavators will be performing the demolition and the loader/ excavator will load trucks, 1 truck driver to drive off road truck, 2 steel works to cut steel members as necessary, Work duration includes demo of Slab on grade

PAY ITEM COST DETAIL WORKSHEET — **3.033 Remove & Dispose - 2 - Governor oil systems**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.033		Project	: COPCO 2		
Description	: Remove & Dispose - 2 - Governor oil systems					
Quantity	: 38,000.00 LBS					
Daily Production	: 25,000.00 LBS per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 1.5 Days		Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $1.06 per LBS		Probable Low Cost Parameter		27500	$36,365	$0.96
Total Cost	: $40,406		Probable High Cost Parameter		20000	$48,487	$1.28

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	1.5	8	24.00	L	$48.27	$0.00		$1,158.48
Laborer	Active	2.00	1.5	8	24.00	L	$45.80	$0.00		$1,099.20
Crawler Crane (270tn)	Active	2.00	1.5	8	24.00	E	$399.50	$446.84		$9,588.00
Equipment Operator (medium)	Active	2.00	1.5	8	24.00	L	$66.28	$0.00		$1,590.72
Welder	Active	3.00	1.5	8	36.00	L	$7.84	$0.00		$282.15
Gas Welding Machine	Active	3.00	1.5	8	36.00	E	$2.88	$2.88		$103.57
Electrician	Active	2.00	1.5	8	24.00	L	$45.23	$0.00		$1,085.52
Steelworker	Active	2.00	1.5	8	24.00	L	$65.52	$0.00		$1,572.48
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.5	8	12.00	E	$111.64	$111.64		$1,339.68
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.5	8	12.00	E	$221.50	$221.50		$2,658.00
Truck Driver (heavy)	Active	1.00	1.5	8	12.00	L	$57.59	$0.00		$691.08
Hydraulic Impact Breaker Attachment (2k-3k ft-lb)	Active	1.00	1.5	8	12.00	E	$30.85	$30.85		$370.20
				Labor Hours	168				TOTAL LABOR	$7,479.63
				Equipment Hours	96				TOTAL EQUIPMENT	$14,059.45

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, wrenches, electrodes, welding accessories, etc)	1.00	LS	1.000	1.00	$747.96	$747.96
					TOTAL MATERIAL	$747.96

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	19.00	ton	1.000	19.00	$595.00	$11,305.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	34.00	mile	1.000	34.00	$7.25	$246.50
					TOTAL SUBCONTRACTS	$11,551.50

SUMMARY OF COSTS

Labor Cost	$7,479.63	Labor Burden @	49.7%	$0.00		$7,479.63
Material Cost	$747.96	Material Tax @	7.8%	$57.97		$805.93
Equipment Cost	$14,059.45	Equipment Tax @	0.0%	$0.00		$14,059.45
Subcontractors	$11,551.50					$11,551.50
DIRECT COST SUBTOTALS	$33,839			$58	DIRECT COST SUBTOTALS	$33,897

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$22,345.01	$3,351.75
Installing Contractors Profit@	8.0%				$22,345.01	$1,787.60
GC Markup on Subs @	5.0%				$11,551.50	$577.58
					TOTAL MARKUP COSTS	$5,716.93
General Contractors Insurance @	1.0%		on		$39,613.44	$396
Bond @	1.0%		on		$39,613.44	$396
Contingency @	0.0%		on		$40,405.71	$0
					TOTAL COST for pay item	$40,406

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Using hydraulic impact breaker because of the systems that are encased in concrete. Assumed hazardous waste 100% of the total lbs, calculated 34 miles from Copco1 to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.034	**Project**	: COPCO 2
Description	: Remove & Dispose - Cooling water and bearing oil systems		
Quantity	: 13,300.00 LBS		
Daily Production	: 25,000.00 LBS per 8 hour shift	**Project #**	: Klamath Dams Removal
Work Days	: 0.5 Days	**Estimator**	: Mihaela Tomulescu
Unit Price	: $0.93 per LBS		
Total Cost	: $12,414		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	27500	$11,173	$0.84
Probable High Cost Parameter	20000	$14,897	$1.12

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.5	8	4.00	L	$48.27	$0.00		$193.08
Steelworker	Active	2.00	0.5	8	8.00	L	$65.52	$0.00		$524.16
Crawler Crane (270tn)	Active	2.00	0.5	8	8.00	E	$399.50	$446.84		$3,196.00
Equipment Operator (medium)	Active	2.00	0.5	8	8.00	L	$66.28	$0.00		$530.24
Welder	Active	3.00	0.5	8	12.00	L	$7.84	$0.00		$94.05
Gas Welding Machine	Active	3.00	0.5	8	12.00	E	$2.88	$2.88		$34.52
Electrician	Active	2.00	0.5	8	8.00	L	$45.23	$0.00		$361.84
Laborer	Active	3.00	0.5	8	12.00	L	$45.80	$0.00		$549.60
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	0.5	8	8.00	E	$70.35	$70.35		$562.80
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.5	8	4.00	E	$221.50	$221.50		$886.00
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	$0.00		$230.36
Equipment Operator (oiler)	Active	1.00	0.5	8	4.00	L	$62.94	$0.00		$251.76
				Labor Hours	60				TOTAL LABOR	$2,735.09
				Equipment Hours	32				TOTAL EQUIPMENT	$4,679.32

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$273.51	$273.51
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00
					TOTAL MATERIAL	$1,973.51

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.67	ton	1.000	0.67	$595.00	$395.68
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	2.66	mile	1.000	2.66	$7.25	$19.29
					TOTAL SUBCONTRACTS	$414.96

SUMMARY OF COSTS

Labor Cost	$2,735.09	Labor Burden @	49.7%	$0.00	$2,735.09
Material Cost	$1,973.51	Material Tax @	7.8%	$152.95	$2,126.46
Equipment Cost	$4,679.32	Equipment Tax @	0.0%	$0.00	$4,679.32
Subcontractors	$414.96				$414.96
DIRECT COST SUBTOTALS	$9,803			$153	**DIRECT COST SUBTOTALS** $9,956

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$9,540.87	$1,431.13
Installing Contractors Profit@	8.0%				$9,540.87	$763.27
GC Markup on Subs @	5.0%				$414.96	$20.75
					TOTAL MARKUP COSTS	$2,215.15
General Contractors Insurance @	1.0%		on		$12,170.98	$122
Bond @	1.0%		on		$12,170.98	$122
Contingency @	0.0%		on		$12,414.40	$0

TOTAL COST for pay item **$12,414**

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition,4890 LF of 1 1/2" oil pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 3 Laborers to load the pipes in the truck. The cooling and lubrication systems for the Hydroelectric Barge turbine, speed increaser and generator will be a combination of water and oil. These systems will be isolated from the water passages so that no contamination of passing water will occur. The following is a list of hazardous materials, substances, chemicals, and wastes normally found at a hydropower facility that may require disposal actions if not recycled or reused for their intended purpose:

1. Polychlorinated Biphenyls (PCBs)
2. Asbestos
3. Paint/abrasive blast grit (red lead paint)
4. Oil
5. Mercury
6. Antifreeze
7. Halogenated and non-halogenated solvents
8. Greases
9. Pesticides (includes herbicides, insecticides, and wood preservatives)
10. Petroleum contaminated
11. Chlorinated fluorocarbons (CFCs) Freon/Halon
12. Gasoline/diesel (includes product and sludge in tanks)
13. Batteries (includes acid)
14. Water treatment sludge (septic tanks/wastewater treatment).

Based on the hazardous materials above assumed hazardous waste 100% of the total lbs

PAY ITEM COST DETAIL WORKSHEET

3.035 Remove & Dispose - Oil / Water separator tank and piping

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.035		Project	: COPCO 2		
Description	:	Remove & Dispose - Oil / Water separator tank and piping					
Quantity	:	2,700.00 LBS					
Daily Production	:	15,000.00 LBS per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	:	0.2 Days		Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.93 per LBS		Probable Low Cost Parameter		16500	$2,268	$0.84
Total Cost	:	$2,520		Probable High Cost Parameter		12000	$3,024	$1.12

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.2	8	1.60	L	$48.27	$0.00		$77.23
Steelworker	Active	4.00	0.2	8	6.40	L	$65.52	$0.00		$419.33
Laborer	Active	4.00	0.2	8	6.40	L	$45.80	$0.00		$293.12
Equipment Operator (crane)	Active	1.00	0.2	8	1.60	L	$68.41	$0.00		$109.46
Truck Driver (heavy)	Active	1.00	0.2	8	1.60	L	$57.59	$0.00		$92.14
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	$111.64		$178.62
Hydraulic Crane (80tn)	Active	1.00	0.2	8	1.60	E	$190.46	$190.46		$304.74

Labor Hours	17.6	TOTAL LABOR	$991.28
Equipment Hours	3.2	TOTAL EQUIPMENT	$483.36

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$99.13	$99.13
					TOTAL MATERIAL	$99.13

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Disposal fee	1.00	EA	1.000	1.00	$500.00	$500.00
					TOTAL SUBCONTRACTS	$500.00

SUMMARY OF COSTS

Labor Cost	$991.28	Labor Burden @	49.7%	$0.00	$991.28
Material Cost	$99.13	Material Tax @	7.8%	$7.68	$106.81
Equipment Cost	$483.36	Equipment Tax @	0.0%	$0.00	$483.36
Subcontractors	$500.00				$500.00
DIRECT COST SUBTOTALS	$2,074			$8	DIRECT COST SUBTOTALS $2,081

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,581.45	$237.22
Installing Contractors Profit@	8.0%				$1,581.45	$126.52
GC Markup on Subs @	5.0%				$500.00	$25.00
					TOTAL MARKUP COSTS	$388.73
General Contractors Insurance @	1.0%		on		$2,470.18	$25
Bond @	1.0%		on		$2,470.18	$25
Contingency @	0.0%		on		$2,519.59	$0
					TOTAL COST for pay item	$2,520

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-25 for cutting steel and A-3H for equipment disposal. .Assumed a disposal fee will be required.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.036		Project	: COPCO 2			
Description	: Remove & Dispose - 12 - Cast Iron Columns						
Quantity	: 54,000.00 LBS						
Daily Production	: 25,000.00 LBS per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	: 2.2	Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $0.83 per LBS		Probable Low Cost Parameter		28750	$37,988	$0.70
Total Cost	: $44,692		Probable High Cost Parameter		21250	$51,396	$0.95

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.2	8	17.60	L	$48.27	$0.00		$849.55
Welder	Active	2.00	2.2	8	35.20	L	$7.84	$0.00		$275.88
Steelworker	Active	10.00	2.2	8	176.00	L	$65.52	$0.00		$11,531.52
Equipment Operator (crane)	Active	2.00	2.2	8	35.20	L	$68.41	$0.00		$2,408.03
Truck Driver (heavy)	Active	2.00	2.2	8	35.20	L	$57.59	$0.00		$2,027.17
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	2.2	8	35.20	E	$31.90	$31.90		$1,122.88
Crawler Crane (90tn)	Active	2.00	2.2	8	35.20	E	$208.09	$208.09		$7,324.77
Gas Welding Machine	Active	2.00	2.2	8	35.20	E	$2.88	$2.88		$101.27
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.2	8	17.60	E	$221.50	$221.50		$3,898.40
Vibratory Hammer & Extractor	Active	2.00	2.2	8	35.20	E	$94.34	$94.34		$3,320.77
				Labor Hours	299.2				TOTAL LABOR	$17,092.15
				Equipment Hours	158.4				TOTAL EQUIPMENT	$15,768.09

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$2,563.82	$2,563.82
					TOTAL MATERIAL	$2,563.82

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$17,092.15	Labor Burden @	49.7%	$0.00		$17,092.15
Material Cost	$2,563.82	Material Tax @	7.8%	$198.70		$2,762.52
Equipment Cost	$15,768.09	Equipment Tax @	0.0%	$0.00		$15,768.09
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$35,424			$199	DIRECT COST SUBTOTALS	$35,623

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$35,622.76		$5,343.41
Installing Contractors Profit@	8.0%				$35,622.76		$2,849.82
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$8,193.23
General Contractors Insurance @	1.0%			on	$43,815.99		$438
Bond @	1.0%			on	$43,815.99		$438
Contingency @	0.0%			on	$44,692.31		$0
						TOTAL COST for pay item	$44,692

Additional Pay Item Notes :

Assumed Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal., B-34A for hauling. Assuming using 2 cranes, 1 loader and 2 trucks for disposal. Using hydraulic impact breaker because columns that are encased in concrete.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.037	Project	: COPCO 2		
Description	: Remove & Dispose - 2 - Francis Turbines				
Quantity	: 660,000.00 LBS				
Daily Production	: 30,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	: 22.0 Days	Estimator	: Mihaela Tomulescu		
			LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $0.83 per LBS	Probable Low Cost Parameter	34500	$465,377	$0.71
Total Cost	: $547,502	Probable High Cost Parameter	24000	$657,003	$1.00

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	22.0	8	176.00	L	$47.23	$0.00		$8,312.48
Ironworkers	Active	5.00	22.0	8	880.00	L	$63.95	$0.00		$56,276.00
Crawler Crane (270tn)	Active	2.00	22.0	8	352.00	E	$399.50	$446.84		$140,624.00
Equipment Operator (medium)	Active	2.00	22.0	8	352.00	L	$66.28	$0.00		$23,330.56
Welder	Active	4.00	22.0	8	704.00	L	$7.84	$0.00		$5,517.60
Gas Welding Machine	Active	4.00	22.0	8	704.00	E	$2.88	$2.88		$2,025.40
Electrician	Active	2.00	22.0	8	352.00	L	$45.23	$0.00		$15,920.96
Millwright	Active	5.00	22.0	8	880.00	L	$69.46	$0.00		$61,124.80
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	22.0	8	352.00	E	$31.90	$31.90		$11,228.80
Loader, FE Rubber Tire (8.6cy)	Active	1.00	22.0	8	176.00	E	$221.50	$221.50		$38,984.00
Truck Driver (heavy)	Active	2.00	22.0	8	352.00	L	$57.59	$0.00		$20,271.68
Equipment Operator (oiler)	Active	1.00	22.0	8	176.00	L	$62.94	$0.00		$11,077.44
				Labor Hours	3872				TOTAL LABOR	$201,831.52
				Equipment Hours	1584				TOTAL EQUIPMENT	$192,862.20

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$20,183.15	$20,183.15
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	3,000.00	LF	1.000	3,000.00	$0.85	$2,550.00
					TOTAL MATERIAL	$22,733.15

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	33.00	ton	1.000	33.00	$595.00	$19,635.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	72.00	mile	1.000	72.00	$7.25	$522.00
					TOTAL SUBCONTRACTS	$20,157.00

SUMMARY OF COSTS

Labor Cost	$201,831.52	Labor Burden @	49.7%	$0.00	$201,831.52
Material Cost	$22,733.15	Material Tax @	7.8%	$1,761.82	$24,494.97
Equipment Cost	$192,862.20	Equipment Tax @	0.0%	$0.00	$192,862.20
Subcontractors	$20,157.00				$20,157.00
DIRECT COST SUBTOTALS	$437,584			$1,762	DIRECT COST SUBTOTALS $439,346

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$419,188.69	$62,878.30
Installing Contractors Profit@	8.0%				$419,188.69	$33,535.10
GC Markup on Subs @	5.0%				$20,157.00	$1,007.85
					TOTAL MARKUP COSTS	$97,421.25
General Contractors Insurance @	1.0%		on		$536,766.94	$5,368
Bond @	1.0%		on		$536,766.94	$5,368
Contingency @	0.0%		on		$547,502.28	$0
					TOTAL COST for pay item	$547,502

Additional Pay Item Notes :

Working with a crew formed of 1 El. Foreman 2 Electrician starting to disconnect power and take care of the temporary electrical power they need at the site. The crew of 5 Ironworker and 5 Millwright. open the engine side panels, and remove the nacelle access panels. Disconnect the engine thermocouple leads at the terminal board. Before disconnecting any lines all fuel, oil, and hydraulic fluid valves are closed. Plug all lines as they are disconnected to prevent entrance of foreign material. Remove the clamps securing the bleed-air ducts at the firewall. Then, disconnect the electrical connector plugs, engine breather and vent lines, and fuel, oil, and hydraulic lines. Disconnect the engine power lever and propeller control rods or cables. Remove the covers from the lift points, attach the sling, and remove slack from the cables using a suitable hoist. The sling must be adjusted to position. Remove the engine mount bolts. The engine ready to be removed. Move the engine forward, out of the nacelle structure, until it clears the aircraft. Lower the into position on the stand, and secure it prior to removing the engine sling. The crew of 4 Welder are going to cut in pieces the big parts of the turbine to be able to load them in the truck using a loader and dispose. .Assumed contains paint with heavy metals 10% of the total lbs, 36 miles from Copco2 to Yreka transfer recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.038	Project	: COPCO 2
Description	: Remove & Dispose - 2 - 40 Ton indoor cranes		
Quantity	: 140,000.00 LBS		
Daily Production	: 30,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 4.7 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $1.17 per LBS		
Total Cost	: $163,271		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	34500	$138,781	$0.99
Probable High Cost Parameter	24000	$195,925	$1.40

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (80tn)	Active	2.00	4.7	8	75.20	E	$190.46	$190.46		$14,322.59
Equipment Operator (crane)	Active	2.00	4.7	8	75.20	L	$68.41	$0.00		$5,144.43
Hydraulic Excavator (6.0cy)	Active	2.00	4.7	8	75.20	E	$322.48	$322.48		$24,250.50
Equipment Operator (medium)	Active	3.00	4.7	8	112.80	L	$66.28	$0.00		$7,476.38
Loader, FE Rubber Tire (8.6cy)	Active	1.00	4.7	8	37.60	E	$221.50	$221.50		$8,328.40
Electrician	Active	6.00	4.7	8	225.60	L	$45.23	$0.00		$10,203.89
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	4.7	8	37.60	E	$111.64	$111.64		$4,197.66
Labor Foreman	Active	2.00	4.7	8	75.20	L	$48.27	$0.00		$3,629.90
Welder	Active	2.00	4.7	8	75.20	L	$7.84	$0.00		$589.38
Gas Welding Machine	Active	2.00	4.7	8	75.20	E	$2.88	$2.88		$216.35
Millwright	Active	16.00	4.7	8	601.60	L	$69.46	$0.00		$41,787.14
Truck Driver (heavy)	Active	1.00	4.7	8	37.60	L	$57.59	$0.00		$2,165.38
				Labor Hours	1203.2			TOTAL LABOR		$70,996.51
				Equipment Hours	300.8			TOTAL EQUIPMENT		$51,315.50

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$3,549.83	$3,549.83
					TOTAL MATERIAL	$3,549.83

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	7.00	ton	1.000	7.00	$595.00	$4,165.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	72.00	mile	1.000	72.00	$7.25	$522.00
					TOTAL SUBCONTRACTS	$4,687.00

SUMMARY OF COSTS

Labor Cost	$70,996.51	Labor Burden @	49.7%	$0.00	$70,996.51
Material Cost	$3,549.83	Material Tax @	7.8%	$275.11	$3,824.94
Equipment Cost	$51,315.50	Equipment Tax @	0.0%	$0.00	$51,315.50
Subcontractors	$4,687.00				$4,687.00
DIRECT COST SUBTOTALS	$130,549			$275	DIRECT COST SUBTOTALS $130,824

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$126,136.95	$18,920.54
Installing Contractors Profit@	8.0%				$126,136.95	$10,090.96
GC Markup on Subs @	5.0%				$4,687.00	$234.35
					TOTAL MARKUP COSTS	$29,245.85
General Contractors Insurance @	1.0%		on		$160,069.79	$1,601
Bond @	1.0%		on		$160,069.79	$1,601
Contingency @	0.0%		on		$163,271.19	$0
					TOTAL COST for pay item	$163,271

Additional Pay Item Notes :

Assumed the crane and the rail will take 5 days to dismantle and contains paint with heavy metals 10% of the total lbs, 36 miles from Copco lake to Yreka transfer recycling. Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal, B-34A for hauling.

PAY ITEM INFORMATION

PAY ITEM NUMBER :	3.039		**Project** :	COPCO 2		
Description :	Remove & Dispose - Compressed Air Systems					
Quantity :	1,000.00 LBS					
Daily Production :	6,000.00 LBS per	8 hour shift	**Project #** :	0		
Work Days :	0.167 Days		**Estimator** :	Mihaela Tomulescu		
				LBS per	**Total Cost**	**Unit Price Per LBS**
Unit Price :	$1.13 per LBS		**Probable Low Cost Parameter**	6600	$1,016	$1.02
Total Cost :	$1,129		**Probable High Cost Parameter**	4800	$1,355	$1.35

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.167	8	1.33	L	$47.23	$0.00		$62.97
Steelworker	Active	1.00	0.167	8	1.33	L	$65.52	$0.00		$87.36
Laborer	Active	3.00	0.167	8	4.00	L	$45.80	$0.00		$183.20
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.167	8	1.33	E	$221.50	$221.50		$295.33
Truck Driver (heavy)	Active	1.00	0.167	8	1.33	L	$57.59	$0.00		$76.79
Truck Driver (light)	Active	1.00	0.167	8	1.33	L	$56.29	$0.00		$75.05
Equipment Operator (medium)	Active	1.00	0.167	8	1.33	L	$66.28	$0.00		$88.37
				Labor Hours	**10.66666667**			**TOTAL LABOR**		**$573.75**
				Equipment Hours	**1.333333333**			**TOTAL EQUIPMENT**		**$295.33**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$28.69	$28.69
					TOTAL MATERIAL	**$28.69**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$573.75	Labor Burden @	49.7%	$0.00		$573.75
Material Cost	$28.69	Material Tax @	7.8%	$2.22		$30.91
Equipment Cost	$295.33	Equipment Tax @	0.0%	$0.00		$295.33
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$898**			**$2**	**DIRECT COST SUBTOTALS**	**$900**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$899.99	$135.00
Installing Contractors Profit@	8.0%				$899.99	$72.00
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$207.00**

General Contractors Insurance @	1.0%	on	$1,106.99	$11
Bond @	1.0%	on	$1,106.99	$11
Contingency @	0.0%	on	$1,129.13	$0
			TOTAL COST for pay item	**$1,129**

Additional Pay Item Notes :

Used RS Means : assumption for "Pipe, metal pipe, to 1-1/2" diam., selective demolition, 370 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Steelworkers to cut the pipes and 3 Laborers for hauling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.040	Project	: COPCO 2			
Description	:	Remove & Dispose - 2 - CO2 Systems					
Quantity	:	2,100.00 LBS					
Daily Production	:	6,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	0.4 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.23 per LBS	Probable Low Cost Parameter		6600	$2,316	$1.10
Total Cost	:	$2,573	Probable High Cost Parameter		4800	$3,088	$1.47

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.4	8	3.20	L	$48.27	$0.00		$154.46
Steelworker	Active	2.00	0.4	8	6.40	L	$65.52	$0.00		$419.33
Laborer	Active	2.00	0.4	8	6.40	L	$45.80	$0.00		$293.12
Equipment Operator (medium)	Active	0.00	0.4	8	0.00	L	$66.28	$0.00		$0.00
Loader, FE Rubber Tire (8.6cy)	Active	0.00	0.4	8	0.00	E	$221.50	$221.50		$0.00
Electrician	Active	1.00	0.4	8	3.20	L	$45.23	$0.00		$144.74
Equipment Operator (light)	Active	2.00	0.4	8	6.40	L	$64.90	$0.00		$415.36
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.4	8	3.20	E	$111.64	$111.64		$357.25
Truck Driver (light)	Active	1.00	0.4	8	3.20	L	$56.29	$0.00		$180.13
				Labor Hours	28.8				TOTAL LABOR	$1,607.14
				Equipment Hours	3.2				TOTAL EQUIPMENT	$357.25

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$80.36	$80.36
					TOTAL MATERIAL	$80.36

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,607.14	Labor Burden @	49.7%	$0.00		$1,607.14
Material Cost	$80.36	Material Tax @	7.8%	$6.23		$86.58
Equipment Cost	$357.25	Equipment Tax @	0.0%	$0.00		$357.25
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$2,045			$6	DIRECT COST SUBTOTALS	$2,051

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,050.97	$307.65
Installing Contractors Profit@	8.0%				$2,050.97	$164.08
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$471.72
General Contractors Insurance @	1.0%		on		$2,522.69	$25
Bond @	1.0%		on		$2,522.69	$25
Contingency @	0.0%		on		$2,573.15	$0
					TOTAL COST for pay item	$2,573

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 772 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 2 Laborers to load the pipes in the truck. 1 electrician for tools.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.041	Project	: COPCO2
Description	: Remove & Dispose - Plant Water and Fire Protection		
Quantity	: 3,100.00 LBS		
Daily Production	: 6,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 0.5 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $1.41 per LBS		
Total Cost	: $4,373		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	6600	$3,936	$1.27
Probable High Cost Parameter	4800	$5,248	$1.69

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.5	8	4.00	L	$48.27	$0.00		$193.08
Steelworker	Active	4.00	0.5	8	16.00	L	$65.52	$0.00		$1,048.32
Truck Driver (light)	Active	1.00	0.5	8	4.00	L	$56.29	$0.00		$225.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	$111.64		$446.56
Laborer	Active	4.00	0.5	8	16.00	L	$45.80	$0.00		$732.80
Electrician	Active	1.00	0.5	8	4.00	L	$45.23	$0.00		$180.92
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.5	8	4.00	E	$64.23	$64.23		$256.92
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	$0.00		$259.60

Labor Hours	48	TOTAL LABOR	$2,639.88
Equipment Hours	8	TOTAL EQUIPMENT	$703.48

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$131.99	$131.99
TOTAL MATERIAL						$131.99

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
TOTAL SUBCONTRACTS					$0.00

SUMMARY OF COSTS

Labor Cost	$2,639.88	Labor Burden @	49.7%	$0.00	$2,639.88
Material Cost	$131.99	Material Tax @	7.8%	$10.23	$142.22
Equipment Cost	$703.48	Equipment Tax @	0.0%	$0.00	$703.48
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$3,475			$10	DIRECT COST SUBTOTALS $3,486

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,485.58	$522.84
Installing Contractors Profit@	8.0%				$3,485.58	$278.85
GC Markup on Subs @	5.0%				$0.00	$0.00
TOTAL MARKUP COSTS						$801.68

General Contractors Insurance @	1.0%	on	$4,287.27	$43
Bond @	1.0%	on	$4,287.27	$43
Contingency @	0.0%	on	$4,373.01	$0

TOTAL COST for pay item $4,373

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 1140 LF of 1 1/2" pipes at 2.72 Lbs. Used 2 Forman, 4 Steelworkers to cut the pipes and 4 Laborers to load the pipes in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.042	Project	: COPCO2
Description	: Remove & Dispose - Transformr Oil Fire Protection		
Quantity	: 6,500.00 LBS		
Daily Production	: 18,500.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 0.4 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $0.87 per LBS		
Total Cost	: $5,633		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	20350	$5,070	$0.78
Probable High Cost Parameter	14800	$6,760	$1.04

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.4	8	3.20	L	$48.27	$0.00		$154.46
Laborer	Active	2.00	0.4	8	6.40	L	$45.80	$0.00		$293.12
Steelworker	Active	2.00	0.4	8	6.40	L	$65.52	$0.00		$419.33
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.4	8	3.20	E	$111.64	$111.64		$357.25
Truck Driver (light)	Active	1.00	0.4	8	3.20	L	$56.29	$0.00		$180.13
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.4	8	3.20	E	$221.50	$221.50		$708.80
Equipment Operator (medium)	Active	2.00	0.4	8	6.40	L	$66.28	$0.00		$424.19

Labor Hours	25.6	TOTAL LABOR	$1,471.23
Equipment Hours	6.4	TOTAL EQUIPMENT	$1,066.05

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$73.56	$73.56
					TOTAL MATERIAL	$73.56

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	3.25	ton	1.000	3.25	$595.00	$1,933.75
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	36.00	mile	1.000	36.00	$7.25	$261.00
					TOTAL SUBCONTRACTS	$2,194.75

SUMMARY OF COSTS

Labor Cost	$1,471.23	Labor Burden @	49.7%	$0.00	$1,471.23
Material Cost	$73.56	Material Tax @	7.8%	$5.70	$79.26
Equipment Cost	$1,066.05	Equipment Tax @	0.0%	$0.00	$1,066.05
Subcontractors	$2,194.75				$2,194.75
DIRECT COST SUBTOTALS	$4,806			$6	DIRECT COST SUBTOTALS $4,811

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,616.54	$392.48
Installing Contractors Profit@	8.0%				$2,616.54	$209.32
GC Markup on Subs @	5.0%				$2,194.75	$109.74
					TOTAL MARKUP COSTS	$711.54
General Contractors Insurance @	1.0%		on		$5,522.83	$55
Bond @	1.0%		on		$5,522.83	$55
Contingency @	0.0%		on		$5,633.29	$0
					TOTAL COST for pay item	$5,633

Additional Pay Item Notes :

Based on RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 2390 LF of 1 1/2" fire protection pipes at 2.72 Lbs. Used 1 Forman and 1 Laborers to load in drums and put them in the truck. Calculated 36 miles from Copco 1 to Yreka Transfer Recycling. Each hydropower facility has at least 150,000 gallons to 250,000 gallon of oil currently in use. This oil would have to be properly disposed of in the event of decommissioning. Oil removed from the turbines and other equipment, including transformer oil, would be either a waste oil or used oil, depending on prior use and contaminants found in the oil. Containerized oil containing contaminants such as solvents are commonly encountered at hydropower facilities. Oil sludges are common in tanks. Oil disposal would likely be costly due to the large volumes found at hydropower facilities and the ease of contamination with other regulated hazardous wastes.

PAY ITEM COST DETAIL WORKSHEET — **3.043 Remove & Dispose - Unwatering Piping**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.043	**Project**	: COPCO 2
Description	: Remove & Dispose - Unwatering Piping		
Quantity	: 32,000.00 LBS		
Daily Production	: 18,000.00 LBS per 8 hour shift	**Project #**	: Klamath Dams Removal
Work Days	: 1.8 Days	**Estimator**	: Mihaela Tomulescu
Unit Price	: $0.75 per LBS		
Total Cost	: $24,116		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	19800	$21,704	$0.68
Probable High Cost Parameter	14400	$28,939	$0.90

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.8	8	14.40	L	$48.27	$0.00		$695.09
Laborer	Active	4.00	1.8	8	57.60	L	$45.80	$0.00		$2,638.08
Steelworker	Active	4.00	1.8	8	57.60	L	$65.52	$0.00		$3,773.95
Equipment Operator (medium)	Active	1.00	1.8	8	14.40	L	$66.28	$0.00		$954.43
Welder	Active	1.00	1.8	8	14.40	L	$7.84	$0.00		$112.86
Gas Welding Machine	Active	1.00	1.8	8	14.40	E	$2.88	$2.88		$41.43
Electrician	Active	1.00	1.8	8	14.40	L	$45.23	$0.00		$651.31
Equipment Operator (oiler)	Active	1.00	1.8	8	14.40	L	$62.94	$0.00		$906.34
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.8	8	14.40	E	$111.64	$111.64		$1,607.62
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.8	8	14.40	E	$221.50	$221.50		$3,189.60
Truck Driver (heavy)	Active	1.00	1.8	8	14.40	L	$57.59	$0.00		$829.30
				Labor Hours	**201.6**				**TOTAL LABOR**	**$10,561.36**
				Equipment Hours	**43.2**				**TOTAL EQUIPMENT**	**$4,838.64**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,056.14	$1,056.14
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00
					TOTAL MATERIAL	**$2,756.14**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.60	ton	1.000	1.60	$595.00	$952.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	6.40	mile	1.000	6.40	$7.25	$46.40
					TOTAL SUBCONTRACTS	**$998.40**

SUMMARY OF COSTS

Labor Cost	$10,561.36	Labor Burden @	49.7%	$0.00		$10,561.36
Material Cost	$2,756.14	Material Tax @	7.8%	$213.60		$2,969.74
Equipment Cost	$4,838.64	Equipment Tax @	0.0%	$0.00		$4,838.64
Subcontractors	$998.40					$998.40
DIRECT COST SUBTOTALS	**$19,155**			**$214**	**DIRECT COST SUBTOTALS**	**$19,368**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$18,369.74	$2,755.46
Installing Contractors Profit@	8.0%				$18,369.74	$1,469.58
GC Markup on Subs @	5.0%				$998.40	$49.92
					TOTAL MARKUP COSTS	**$4,274.96**

General Contractors Insurance @	1.0%	on	$23,643.10	$236
Bond @	1.0%	on	$23,643.10	$236
Contingency @	0.0%	on	$24,115.96	$0
			TOTAL COST for pay item	**$24,116**

Additional Pay Item Notes :

Used RS Means : Assumed Pipe, metal pipe, to 1-1/2" diam., selective demolition, around 11765 LF of 1 1/2" pipes at 2.72 Lbs. Used Crew formed of 1 Forman, 2 Steelworkers to cut the pipes, 1 Welder to cut steel in inaccessible places , 2 Laborers to haul the pipes in the truck with the loader, 1 electrician to unplug the power and to assure the temporary power at the construction site. Calculated 36 miles from Copco to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.044		**Project**	: COPCO 2
Description	: Remove & Dispose - Drainage Piping			
Quantity	: 10,000.00 LBS			
Daily Production	: 4,450.00 LBS per 8 hour shift		**Project #**	: Klamath Dams Removal
Work Days	: 2.2 Days		**Estimator**	: Mihaela Tomulescu
Unit Price	: $1.39 per LBS			
Total Cost	: $13,877			

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	4895	$12,489	$1.25
Probable High Cost Parameter	3560	$16,652	$1.67

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.2	8	17.60	L	$48.27	$0.00		$849.55
Steelworker	Active	1.00	2.2	8	17.60	L	$65.52	$0.00		$1,153.15
Truck Driver (light)	Active	1.00	2.2	8	17.60	L	$56.29	$0.00		$990.70
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.2	8	17.60	E	$111.64	$111.64		$1,964.86
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.2	8	17.60	E	$221.50	$221.50		$3,898.40
Electrician	Active	1.00	2.2	8	17.60	L	$45.23	$0.00		$796.05
Equipment Operator (light)	Active	1.00	2.2	8	17.60	L	$64.90	$0.00		$1,142.24

Labor Hours	**88**	**TOTAL LABOR**	**$4,931.70**
Equipment Hours	**35.2**	**TOTAL EQUIPMENT**	**$5,863.26**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$246.58	$246.58
					TOTAL MATERIAL	**$246.58**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$4,931.70	Labor Burden @	49.7%	$0.00	$4,931.70
Material Cost	$246.58	Material Tax @	7.8%	$19.11	$265.70
Equipment Cost	$5,863.26	Equipment Tax @	0.0%	$0.00	$5,863.26
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$11,042**			**$19**	**DIRECT COST SUBTOTALS** **$11,061**

	%	Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$11,060.66	$1,659.10
Installing Contractors Profit@	8.0%				$11,060.66	$884.85
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$2,543.95**

General Contractors Insurance @	1.0%	on	$13,604.61	$136
Bond @	1.0%	on	$13,604.61	$136
Contingency @	0.0%	on	$13,876.70	$0
			TOTAL COST for pay item	**$13,877**

Additional Pay Item Notes :

Assumed 2735 LF of 1 " drainage pipes at 3.66 Lbs. Used 1 Loader and 1 Forman, 1 Steelworkers to cut the pipes and 1 Laborers to load the pipes in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.044a		Project	: #REF!		
Description	: Remove & Dispose - Petroleum Products from Mechanical Equip.					
Quantity	: 3,300.00 GAL					
Daily Production	: 1,100.00 GAL per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 3.0 Days		Estimator	: Mihaela Tomulescu		
				GAL per	Total Cost	Unit Price Per GAL
Unit Price	: $4.54 per GAL		Probable Low Cost Parameter	1210	$13,475	$4.08
Total Cost	: $14,972		Probable High Cost Parameter	935	$17,217	$5.22

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.0	8	24.00	L	$46.27	$0.00		$1,110.48
Carpenters, Journeyman	Active	2.00	3.0	8	48.00	L	$65.37	$0.00		$3,137.76
Laborer	Active	2.00	3.0	8	48.00	L	$45.80	$0.00		$2,198.40
				Labor Hours	120				TOTAL LABOR	$6,446.64
				Equipment Hours	0				TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 20% labor (absorbant materials, drums, etc)	1.00	LS	1.000	1.00	$1,289.33	$1,289.33
					TOTAL MATERIAL	$1,289.33

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, liquid pickup, vacuum truck, stainless steel tank, 5000 gallons, minimum charge, 4 hours, 2 compartment	24.00	hour	1.000	$200.00	$4,800.00
				TOTAL SUBCONTRACTS	$4,800.00

SUMMARY OF COSTS

Labor Cost	$6,446.64	Labor Burden @	49.7%	$0.00		$6,446.64
Material Cost	$1,289.33	Material Tax @	7.8%	$99.92		$1,389.25
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$4,800.00					$4,800.00
DIRECT COST SUBTOTALS	$12,536			$100	DIRECT COST SUBTOTALS	$12,636

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$7,835.89	$1,175.38
Installing Contractors Profit@	8.0%				$7,835.89	$626.87
GC Markup on Subs @	5.0%				$4,800.00	$240.00
					TOTAL MARKUP COSTS	$2,042.25
General Contractors Insurance @	1.0%		on		$14,678.15	$147
Bond @	1.0%		on		$14,678.15	$147
Contingency @	0.0%		on		$14,971.71	$0
					TOTAL COST for pay item	$14,972

Additional Pay Item Notes :

Petroleum-based products, ranging from fuel oil and hydraulic fluid to lubricating greases and oils, are found throughout every type of power generating plant or system. Lubrication supports bearings and moving parts in all sorts of equipment: pumps, conveyors, feeders, scrubbers, cranes, turbines, and more.A good oil/water separation system will result in a flow of concentrated waste oil to a collection area and a flow of oil-free water ready for secondary processing or discharge. Once an oil layer has been separated from free water, it must be removed for recycling or disposal. Many plants use one or more of these oil removal methods, but each has costly limitations:

1. Absorbent materials. Absorbent mats or materials are frequently used to dam up and absorb excess oils and greases resulting from accidents or the routine operation of machinery. These materials are very effective for preventing the spread of a source leak and very efficient in terms of oil pickup. Yet, their use on large volumes of waste oil results in multiple, recurring costs that can make them impractical as an everyday solution:

- the costs of the materials themselves
- the labor costs for ordering, stocking, application, and removal
- the costs of used-media collection, disposal, or re-processing/recycling.

2. Manually operated “slotted pipes.” Many separators feature a “slotted pipe,” a pipe located near the top of the vessel that has a horizontal opening. Oil is removed by turning the horizontal opening downward until it meets the floating oil layer, which drains through the pipe to a collection receptacle. These pipes work well on thick layers of oil, but cannot drain off a sheen of oil without draining off a large amount of water as well.

AECOM assumed the best is Vacuum truck removal method .Used a crew formed of 1 Forman, 2 Laborers and 2 journemen to takeout the petroleum waste, Vacuum-equipped tank trucks are used to remove waste oil from collection points (assumed existing drums or tanks) so that it can be transported to recycling or disposal locations. If the waste oil has been thoroughly separated, highly concentrated, and stored in an appropriate receptacle, this service can be used very efficiently. However, vacuum disposal units are often used to pump oil layers directly off of water. This results in the intake of a significant amount free water along with the waste oil – and a significantly higher cost.

PAY ITEM COST DETAIL WORKSHEET

3.044b Remove & Dispose - Remove Petroleum Products at or near the Power House

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.044b	Project	: #REF!
Description	:	Remove & Dispose - Remove Petroleum Products at or near the Power House		
Quantity	:	3,300.00 GAL		
Daily Production	:	1,100.00 GAL per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	:	3.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	:	$4.54 per GAL		
Total Cost	:	$14,972		

	GAL per	Total Cost	Unit Price Per GAL
Probable Low Cost Parameter	1210	$13,475	$4.08
Probable High Cost Parameter	935	$17,217	$5.22

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.0	8	24.00	L	$46.27	$0.00		$1,110.48
Carpenters, Journeyman	Active	2.00	3.0	8	48.00	L	$65.37	$0.00		$3,137.76
Laborer	Active	2.00	3.0	8	48.00	L	$45.80	$0.00		$2,198.40
				Labor Hours	120				TOTAL LABOR	$6,446.64
				Equipment Hours	0				TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 20% labor (absorbant materials, etc)	1.00	LS	1.000	1.00	$1,289.33	$1,289.33
					TOTAL MATERIAL	$1,289.33

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, liquid pickup, vacuum truck, stainless steel tank, 5000 gallons, minimum charge, 4 hours, 2 compartment	24.00	hour	1.000	$200.00	$4,800.00
				TOTAL SUBCONTRACTS	$4,800.00

SUMMARY OF COSTS

Labor Cost	$6,446.64	Labor Burden @	49.7%	$0.00		$6,446.64
Material Cost	$1,289.33	Material Tax @	7.8%	$99.92		$1,389.25
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$4,800.00					$4,800.00
DIRECT COST SUBTOTALS	$12,536			$100	DIRECT COST SUBTOTALS	$12,636

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$7,835.89	$1,175.38
Installing Contractors Profit@	8.0%				$7,835.89	$626.87
GC Markup on Subs @	5.0%				$4,800.00	$240.00
					TOTAL MARKUP COSTS	$2,042.25
General Contractors Insurance @	1.0%			on	$14,678.15	$147
Bond @	1.0%			on	$14,678.15	$147
Contingency @	0.0%			on	$14,971.71	$0
					TOTAL COST for pay item	$14,972

Additional Pay Item Notes :

Used a crew formed of 1 Forman, 2 journeymen, 2 Laborers to takeout the petroleum waste, Vacuum-equipped tank trucks are used to remove old and new oil and the fuel from collection points so that it can be transported to recycling or disposal locations.

PAY ITEM INFORMATION

PAY ITEM NUMBER	3.045	Project	COPCO 2
Description	Remove & Dispose - AC Generator, Indoor Vertical		
Quantity	2.00 EA		
Daily Production	0.20 EA per 8 hour shift	Project #	Klamath Dams Removal
Work Days	10.0 Days	Estimator	Mihaela Tomulescu
Unit Price	$82,295.42 per EA		
Total Cost	$164,591		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	0.22	$148,132	$74,065.87
Probable High Cost Parameter	0.18	$181,050	$90,524.96

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	10.0	8	80.00	L	$47.23	$0.00		$3,778.40
Electrician	Active	6.00	10.0	8	480.00	L	$45.23	$0.00		$21,710.40
Equipment Operator (oiler)	Active	2.00	10.0	8	160.00	L	$62.94	$0.00		$10,070.40
Equipment Operator (crane)	Active	1.00	10.0	8	80.00	L	$68.41	$0.00		$5,472.80
Crawler Crane (130tn)	Active	1.00	10.0	8	80.00	E	$258.66	$258.66		$20,692.80
Steelworker	Active	6.00	10.0	8	480.00	L	$65.52	$0.00		$31,449.60
Labor Foreman	Active	1.00	10.0	8	80.00	L	$48.27	$0.00		$3,861.60
Welder	Active	2.00	10.0	8	160.00	L	$7.84	$0.00		$1,254.00
Gas Welding Machine	Active	2.00	10.0	8	160.00	E	$2.88	$2.88		$460.32
Truck Driver (heavy)	Active	2.00	10.0	8	160.00	L	$57.59	$0.00		$9,214.40
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	10.0	8	160.00	E	$31.90	$31.90		$5,104.00
Hydraulic Impact Breaker Attachment (2k-3k ft-lb)	Active	2.00	10.0	8	160.00	E	$30.85	$30.85		$4,936.00

Labor Hours	1680	TOTAL LABOR	$86,811.60
Equipment Hours	560	TOTAL EQUIPMENT	$31,193.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$8,681.16	$8,681.16

TOTAL MATERIAL: $8,681.16

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Disposal fee (for 115 tons)	1	EA	1.000	1.00	$4,488.00	$4,488.00

TOTAL SUBCONTRACTS: $4,488.00

SUMMARY OF COSTS

Labor Cost	$86,811.60	Labor Burden @	49.7%	$0.00	$86,811.60
Material Cost	$8,681.16	Material Tax @	7.8%	$672.79	$9,353.95
Equipment Cost	$31,193.12	Equipment Tax @	0.0%	$0.00	$31,193.12
Subcontractors	$4,488.00				$4,488.00
DIRECT COST SUBTOTALS	$131,174			$673	DIRECT COST SUBTOTALS $131,847

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$127,358.67	$19,103.80
Installing Contractors Profit@	8.0%				$127,358.67	$10,188.69
GC Markup on Subs @	5.0%				$4,488.00	$224.40
					TOTAL MARKUP COSTS	$29,516.89

General Contractors Insurance @	1.0%	on	$161,363.56	$1,614
Bond @	1.0%	on	$161,363.56	$1,614
Contingency @	0.0%	on	$164,590.83	$0

TOTAL COST for pay item: $164,591

Additional Pay Item Notes :

Assumed removal of 2 units in 2 weeks, weight per unit around 230000 LBS (stator, rotor, base, exciter assembly). Used RS Means, 2 X R13 Crew formed of 1 Forman, 3 Electricians, 1 Oiler, 0 .25 Equipment Crane, 3 Steelworkers to cut adjacent appurtenances and 1 Welder to cut pipes. Calculated 34 miles from JC Copco1 to Yreka Transfer Recycling (back and forth).

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.046	Project	: #REF!		
Description	: Remove & Dispose - Excitation equipment for 15 MVA Generator				
Quantity	: 2.00 EA				
Daily Production	: 1.50 EA per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	: 1.3 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $8,173.98 per EA	Probable Low Cost Parameter	1.65	$14,713	$7,356.58
Total Cost	: $16,348	Probable High Cost Parameter	1.35	$17,983	$8,991.38

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.3	8	10.40	L	$47.23	$0.00		$491.19
Electrician	Active	2.00	1.3	8	20.80	L	$45.23	$0.00		$940.78
Ironworkers	Active	1.00	1.3	8	10.40	L	$63.95	$0.00		$665.08
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	$221.50		$1,772.00
Truck Driver (heavy)	Active	1.00	1.3	8	10.40	L	$57.59	$0.00		$598.94
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.3	8	10.40	E	$111.64	$111.64		$1,161.06
Hydraulic Crane (120tn)	Active	1.00	1.3	8	10.40	E	$239.06	$239.06		$2,486.22
Laborer	Active	2.00	1.3	8	20.80	L	$45.80	$0.00		$952.64
Equipment Operator (crane)	Active	1.00	1.3	8	10.40	L	$68.41	$0.00		$711.46
Equipment Operator (medium)	Active	1.00	1.3	8	10.40	L	$66.28	$0.00		$689.31

Labor Hours	93.6	TOTAL LABOR	$5,049.41
Equipment Hours	28.8	TOTAL EQUIPMENT	$5,419.28

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$252.47	$252.47
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	2,500.00	LF	1.000	2,500.00	$0.85	$2,125.00

TOTAL MATERIAL $2,377.47

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS $0.00

SUMMARY OF COSTS

Labor Cost	$5,049.41	Labor Burden @	49.7%	$0.00	$5,049.41
Material Cost	$2,377.47	Material Tax @	7.8%	$184.25	$2,561.72
Equipment Cost	$5,419.28	Equipment Tax @	0.0%	$0.00	$5,419.28
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$12,846			$184	DIRECT COST SUBTOTALS $13,030

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$13,030.41	$1,954.56
Installing Contractors Profit@	8.0%				$13,030.41	$1,042.43
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$2,996.99
General Contractors Insurance @	1.0%		on		$16,027.41	$160
Bond @	1.0%		on		$16,027.41	$160
Contingency @	0.0%		on		$16,347.96	$0

TOTAL COST for pay item $16,348

Additional Pay Item Notes :

Production based on 1 Forman, 1 Electrician, 1 Welder to cut to remove the electrical equipment and 1 laborer to haul. Equipment used 1 Loader and 1 Crane for disposal. Assumed 2 sections, weight 1000LBS.

PAY ITEM COST DETAIL WORKSHEET — **3.047 Remove & Dispose - Surge protection equip. for 15 MVA Generator**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.047		**Project**	: COPCO 2		
Description	: Remove & Dispose - Surge protection equip. for 15 MVA Generator					
Quantity	: 2.00 EA					
Daily Production	: 1.50 EA per 8 hour shift		**Project #**	: Klamath Dams Removal		
Work Days	: 1.3 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost** / **Unit Price Per EA**
Unit Price	: $2,582.65 per EA		**Probable Low Cost Parameter**		**1.65**	**$4,649** / **$2,324.39**
Total Cost	: $5,165		**Probable High Cost Parameter**		**1.35**	**$5,682** / **$2,840.92**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.3	8	10.40	L	$47.23	$0.00		$491.19
Electrician	Active	1.00	1.3	8	10.40	L	$45.23	$0.00		$470.39
Truck Driver (heavy)	Active	1.00	1.3	8	10.40	L	$57.59	$0.00		$598.94
Ironworkers	Active	1.00	1.0	8	8.00	L	$63.95	$0.00		$511.60
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	$0.00		$732.80
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.3	8	10.40	E	$111.64	$111.64		$1,161.06
				Labor Hours	**55.2**				**TOTAL LABOR**	**$2,804.92**
				Equipment Hours	**10.4**				**TOTAL EQUIPMENT**	**$1,161.06**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$140.25	$140.25
					TOTAL MATERIAL	**$140.25**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$2,804.92	Labor Burden @	49.7%	$0.00		$2,804.92
Material Cost	$140.25	Material Tax @	7.8%	$10.87		$151.12
Equipment Cost	$1,161.06	Equipment Tax @	0.0%	$0.00		$1,161.06
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$4,106**			**$11**	**DIRECT COST SUBTOTALS**	**$4,117**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,117.09	$617.56
Installing Contractors Profit@	8.0%				$4,117.09	$329.37
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$946.93**
General Contractors Insurance @	1.0%		on		$5,064.02	$51
Bond @	1.0%		on		$5,064.02	$51
Contingency @	0.0%		on		$5,165.30	$0
					TOTAL COST for pay item	**$5,165**

Additional Pay Item Notes :

Assumption for Crew R3: 1 Forman, 1 Electrician, 2 Ironworker to cut rods and 1 laborer to haul in the truck.. Assumed 2 sections, weight 800LBS.

PAY ITEM COST DETAIL WORKSHEET — **3.048 Remove & Dispose - Neutral grounding equip. for 15 MVA Generator**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.048	Project	: COPCO 2
Description	: Remove & Dispose - Neutral grounding equip. for 15 MVA Generator		
Quantity	: 2.00 EA		
Daily Production	: 2.00 EA per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $2,514.72 per EA		
Total Cost	: $5,029		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	2.2	$4,526	$2,263.25
Probable High Cost Parameter	1.7	$5,784	$2,891.93

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	$0.00		$377.84
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Ironworkers	Active	2.00	1.0	8	16.00	L	$63.95	$0.00		$1,023.20
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	$0.00		$732.80
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12

Labor Hours	56	TOTAL LABOR	$2,956.40
Equipment Hours	8	TOTAL EQUIPMENT	$893.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$147.82	$147.82

TOTAL MATERIAL: $147.82

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount

TOTAL SUBCONTRACTS: $0.00

SUMMARY OF COSTS

Labor Cost	$2,956.40	Labor Burden @	49.7%	$0.00	$2,956.40
Material Cost	$147.82	Material Tax @	7.8%	$11.46	$159.28
Equipment Cost	$893.12	Equipment Tax @	0.0%	$0.00	$893.12
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$3,997			$11	DIRECT COST SUBTOTALS $4,009

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,008.80	$601.32
Installing Contractors Profit@	8.0%				$4,008.80	$320.70
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$922.02

General Contractors Insurance @	1.0%	on	$4,930.82	$49
Bond @	1.0%	on	$4,930.82	$49
Contingency @	0.0%	on	$5,029.44	$0

TOTAL COST for pay item $5,029

Additional Pay Item Notes :

Assumption for Crew R3: 1 Forman, 1 Electrician, 2 Ironworker to cut rods and 2 laborer to haul in the truck. (500 lbs)

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.049		Project	: COPCO 2	
Description	: Remove & Dispose - Generator Switchgear, 7.2kV-includes unit breakers				
Quantity	: 1.00 EA				
Daily Production	: 0.50 EA per 8 hour shift		Project #	: Klamath Dams Removal	
Work Days	: 2.0 Days		Estimator	: Mihaela Tomulescu	
Unit Price	: $27,340.22 per EA				
Total Cost	: $27,340				

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	0.55	$24,606	$24,606.19
Probable High Cost Parameter	0.425	$31,441	$31,441.25

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	2.00	2.0	8	32.00	L	$47.23	$0.00		$1,511.36
Electrician	Active	6.00	2.0	8	96.00	L	$45.23	$0.00		$4,342.08
Laborer	Active	3.00	2.0	8	48.00	L	$45.80	$0.00		$2,198.40
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.0	8	16.00	E	$221.50	$221.50		$3,544.00
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	$0.00		$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	$111.64		$1,786.24
Hydraulic Crane (120tn)	Active	1.00	2.0	8	16.00	E	$239.06	$239.06		$3,824.96
Welder	Active	1.00	2.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	1.00	2.0	8	16.00	E	$2.88	$2.88		$46.03
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	$0.00		$1,060.48
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	$0.00		$1,094.56
				Labor Hours	240				TOTAL LABOR	$11,253.72
				Equipment Hours	64				TOTAL EQUIPMENT	$9,201.23

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$562.69	$562.69
					TOTAL MATERIAL	$562.69

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.00	ton	1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	36.00	mile	1.000	36.00	$7.25	$261.00
					TOTAL SUBCONTRACTS	$856.00

SUMMARY OF COSTS

Labor Cost	$11,253.72	Labor Burden @	49.7%	$0.00	$11,253.72
Material Cost	$562.69	Material Tax @	7.8%	$43.61	$606.29
Equipment Cost	$9,201.23	Equipment Tax @	0.0%	$0.00	$9,201.23
Subcontractors	$856.00				$856.00
DIRECT COST SUBTOTALS	$21,874			$44	DIRECT COST SUBTOTALS $21,917

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$21,061.25	$3,159.19
Installing Contractors Profit@	8.0%				$21,061.25	$1,684.90
GC Markup on Subs @	5.0%				$856.00	$42.80
					TOTAL MARKUP COSTS	$4,886.89
General Contractors Insurance @	1.0%			on	$26,804.13	$268
Bond @	1.0%			on	$26,804.13	$268
Contingency @	0.0%			on	$27,340.22	$0
					TOTAL COST for pay item	$27,340

Additional Pay Item Notes :

Used 2 Crews (2 sections each weight around 2400 LBS per crew) formed of 1 Forman, 3 Electrician, 2 laborer to haul with the crane in the truck. Assumed containing hazardous waste that will be disposed at 36 miles away from the construction site to Yreka Transfer Recycling . In normal circumstances, decontaminated residual components could be accepted at landfill sites but Polychlorinated biphenyl, otherwise known as PCB, is a synthetic chemical that is widely used for industrial and commercial use as dielectric fluid in transformers and capacitors because of its high resistance to decomposition, low electrical conductivity, low flammability and high heat capacity. Transformer repair, reconditioning and retro-filling facilities are the major industry sectors that contributes to the spread of PCB contamination. Types of PCB Wastes:
PCB wastes are discarded materials that contain PCB or have been contaminated with PCBs and that are without any commercial, industrial, or economic use. For the purpose of this Code of Practice, PCBs wastes are classified as follows: Liquid PCB wastes
o PCB-based dielectric fluids removed from transformers and other equipment
o PCB-based heat transfer and hydraulic fluids Metallic solid wastes
o PCB equipment such as capacitors, transformers, **switchgears**, circuit breakers, heat transfer systems, etc.
o Contaminated components removed from electrical equipment such as windings;
o PCB-contaminated containers and equipment such as metal drums, tanks, pumps, metal filters, etc.

PAY ITEM COST DETAIL WORKSHEET

3.050 Remove & Dispose - Station Service Switchgear, 600-volt (5 sections)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.050	Project	: COPCO 2			
Description	:	Remove & Dispose - Station Service Switchgear, 600-volt (5 sections)					
Quantity	:	1.00 EA					
Daily Production	:	0.50 EA per 8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	2.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$24,083.60 per EA	Probable Low Cost Parameter		0.55	$21,675	$21,675.24
Total Cost	:	$24,084	Probable High Cost Parameter		0.425	$27,696	$27,696.15

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	3.00	2.0	8	48.00	L	$47.23	$0.00		$2,267.04
Electrician	Active	6.00	2.0	8	96.00	L	$45.23	$0.00		$4,342.08
Laborer	Active	6.00	2.0	8	96.00	L	$45.80	$0.00		$4,396.80
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.0	8	16.00	E	$221.50	$221.50		$3,544.00
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	$0.00		$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	$111.64		$1,786.24
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	$0.00		$1,060.48
Welder	Active	1.00	2.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	1.00	2.0	8	16.00	E	$2.88	$2.88		$46.03
				Labor Hours	288			TOTAL LABOR		$13,113.24
				Equipment Hours	48			TOTAL EQUIPMENT		$5,376.27

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$655.66	$655.66
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	0.00	LF	1.000	0.00	$0.85	$0.00
					TOTAL MATERIAL	$655.66

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.00	ton	1.000	0.00	$595.00	$0.30
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	0.00	mile	1.000	0.00	$7.25	$0.00
					TOTAL SUBCONTRACTS	$0.30

SUMMARY OF COSTS

Labor Cost	$13,113.24	Labor Burden @	49.7%	$0.00		$13,113.24
Material Cost	$655.66	Material Tax @	7.8%	$50.81		$706.48
Equipment Cost	$5,376.27	Equipment Tax @	0.0%	$0.00		$5,376.27
Subcontractors	$0.30					$0.30
DIRECT COST SUBTOTALS	$19,145			$51	DIRECT COST SUBTOTALS	$19,196

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$19,195.99	$2,879.40
Installing Contractors Profit@	8.0%				$19,195.99	$1,535.68
GC Markup on Subs @	5.0%				$0.30	$0.01
					TOTAL MARKUP COSTS	$4,415.09
General Contractors Insurance @	1.0%		on		$23,611.38	$236
Bond @	1.0%		on		$23,611.38	$236
Contingency @	0.0%		on		$24,083.60	$0
					TOTAL COST for pay item	$24,084

Additional Pay Item Notes :

Used 3 Crews (2 sections each, weight around 800Lbs per crew) formed of 1 Forman, 2 Electrician, 1welder to cut, 2 laborer to haul with the loader in the truck. Assumed containing hazardous waste that will be disposed . Calculated 34 miles from Copco 1 to Yreka Transfer Recycling.

PAY ITEM COST DETAIL WORKSHEET — **3.051 Remove & Dispose - Unit and plant control switchboard**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.051	Project	: COPCO 2		
Description	:	Remove & Dispose - Unit and plant control switchboard				
Quantity	:	1.00 EA				
Daily Production	:	1.00 EA per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	1.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$7,551.93 per EA	Probable Low Cost Parameter	1.1	$6,797	$6,796.74
Total Cost	:	$7,552	Probable High Cost Parameter	0.85	$8,685	$8,684.72

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	$0.00		$377.84
Electrician	Active	4.00	1.0	8	32.00	L	$45.23	$0.00		$1,447.36
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	$0.00		$530.24
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	$221.50		$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Laborer	Active	1.00	1.0	8	8.00	L	$45.80	$0.00		$366.40

Labor Hours	64	TOTAL LABOR	$3,182.56
Equipment Hours	16	TOTAL EQUIPMENT	$2,665.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$159.13	$159.13
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	0.00	LF	1.000	0.00	$0.85	$0.00

TOTAL MATERIAL $159.13

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.00	ton	1.000	0.00	$595.00	$0.30
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	0.00	mile	1.000	0.00	$7.25	$0.00

TOTAL SUBCONTRACTS $0.30

SUMMARY OF COSTS

Labor Cost	$3,182.56	Labor Burden @	49.7%	$0.00	$3,182.56
Material Cost	$159.13	Material Tax @	7.8%	$12.33	$171.46
Equipment Cost	$2,665.12	Equipment Tax @	0.0%	$0.00	$2,665.12
Subcontractors	$0.30				$0.30
DIRECT COST SUBTOTALS	$6,007			$12	**DIRECT COST SUBTOTALS** $6,019

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,019.14	$902.87
Installing Contractors Profit@	8.0%				$6,019.14	$481.53
GC Markup on Subs @	5.0%				$0.30	$0.01
					TOTAL MARKUP COSTS	$1,384.42
General Contractors Insurance @	1.0%		on		$7,403.86	$74
Bond @	1.0%		on		$7,403.86	$74
Contingency @	0.0%		on		$7,551.93	$0
					TOTAL COST for pay item	**$7,552**

Additional Pay Item Notes :

Assumed 2 day of work to dispose unit and plant control switchboard with R3 electrical crew and laborers for hauling with the loader in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.052		Project	: COPCO 2			
Description	: Remove & Dispose - Battery system						
Quantity	: 1.00 EA						
Daily Production	: 0.50 EA per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	: 2.0	Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $10,473.21	per EA	Probable Low Cost Parameter		0.55	$9,426	$9,425.89
Total Cost	: $10,473		Probable High Cost Parameter		0.425	$12,044	$12,044.19

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	$0.00		$740.32
Electrician	Active	2.00	2.0	8	32.00	L	$45.23	$0.00		$1,447.36
Laborer	Active	4.00	2.0	8	64.00	L	$45.80	$0.00		$2,931.20
Loader, FE Rubber Tire (3.5cy)	Active	1.00	1.0	8	8.00	E	$64.23	$64.23		$513.84
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Equipment Operator (light)	Active	1.00	1.0	8	8.00	L	$64.90	$0.00		$519.20
Welder	Active	1.00	2.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	1.00	2.0	8	16.00	E	$2.88	$2.88		$46.03
				Labor Hours	144				TOTAL LABOR	$6,224.20
				Equipment Hours	32				TOTAL EQUIPMENT	$1,452.99

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$622.42	$622.42
					TOTAL MATERIAL	$622.42

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$6,224.20	Labor Burden @		49.7%	$0.00		$6,224.20
Material Cost	$622.42	Material Tax @		7.8%	$48.24		$670.66
Equipment Cost	$1,452.99	Equipment Tax @		0.0%	$0.00		$1,452.99
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$8,300				$48	DIRECT COST SUBTOTALS	$8,348

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,347.85		$1,252.18
Installing Contractors Profit@	8.0%				$8,347.85		$667.83
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$1,920.01
General Contractors Insurance @	1.0%		on		$10,267.85		$103
Bond @	1.0%		on		$10,267.85		$103
Contingency @	0.0%		on		$10,473.21		$0
						TOTAL COST for pay item	$10,473

Additional Pay Item Notes :

Assuming 2 days of work disposing around 100 batteries, racks and supports. Using Crews E-19 for metals demolition, E-12 and E-25 for cutting steel and A-3H for equipment disposal, B-34A for hauling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.053		**Project**	: COPCO 2			
Description	: Remove & Dispose - Raceways, Conduit and Cable						
Quantity	: 1.00 EA						
Daily Production	: 0.50 EA per 8 hour shift		**Project #**	: Klamath Dams Removal			
Work Days	: 2.0 Days		**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	: $15,384.27 per EA		**Probable Low Cost Parameter**		**0.55**	**$13,846**	**$13,845.84**
Total Cost	: $15,384		**Probable High Cost Parameter**		**0.425**	**$17,692**	**$17,691.91**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.0	8	16.00	L	$48.27	$0.00		$772.32
Electrician	Active	4.00	2.0	8	64.00	L	$45.23	$0.00		$2,894.72
Laborer	Active	6.00	2.0	8	96.00	L	$45.80	$0.00		$4,396.80
Loader, FE Rubber Tire (3.5cy)	Active	1.00	1.0	8	8.00	E	$64.23	$64.23		$513.84
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Equipment Operator (light)	Active	1.00	1.0	8	8.00	L	$64.90	$0.00		$519.20
Electrician Foreman	Active	1.00	2.0	8	16.00	L	$47.23	$0.00		$755.68
				Labor Hours	**208**				**TOTAL LABOR**	**$9,799.44**
				Equipment Hours	**16**				**TOTAL EQUIPMENT**	**$1,406.96**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$979.94	$979.94
					TOTAL MATERIAL	**$979.94**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$9,799.44	Labor Burden @	49.7%	$0.00	$9,799.44
Material Cost	$979.94	Material Tax @	7.8%	$75.95	$1,055.89
Equipment Cost	$1,406.96	Equipment Tax @	0.0%	$0.00	$1,406.96
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$12,186**			**$76**	**DIRECT COST SUBTOTALS** **$12,262**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$12,262.29	$1,839.34
Installing Contractors Profit@	8.0%				$12,262.29	$980.98
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$2,820.33**

General Contractors Insurance @	1.0%	on	$15,082.62	$151
Bond @	1.0%	on	$15,082.62	$151
Contingency @	0.0%	on	$15,384.27	$0
			TOTAL COST for pay item	**$15,384**

Additional Pay Item Notes :

Assumption for removal of control power cable, conduit (3000 LF) and cable tray (300 LF) - using R3 electrical crew and laborers for hauling with the loader.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.054	Project	: COPCO 2
Description	: Remove & Dispose - Misc. Power & Control Boards		
Quantity	: 1.00 EA		
Daily Production	: 1.00 EA per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $5,724.44 per EA		
Total Cost	: $5,724		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	1.1	$5,152	$5,152.00
Probable High Cost Parameter	0.85	$6,583	$6,583.11

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	$0.00		$370.16
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	$0.00		$732.80
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Hydraulic Crane (35tn)	Active	1.00	1.0	8	8.00	E	$116.30	$116.30		$930.40

Labor Hours	48	TOTAL LABOR	$2,472.80
Equipment Hours	16	TOTAL EQUIPMENT	$1,823.52

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$247.28	$247.28
					TOTAL MATERIAL	$247.28

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,472.80	Labor Burden @	49.7%	$0.00	$2,472.80
Material Cost	$247.28	Material Tax @	7.8%	$19.16	$266.44
Equipment Cost	$1,823.52	Equipment Tax @	0.0%	$0.00	$1,823.52
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$4,544			$19	DIRECT COST SUBTOTALS $4,563

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$4,562.76	$684.41
Installing Contractors Profit@	8.0%				$4,562.76	$365.02
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,049.44

General Contractors Insurance @	1.0%	on	$5,612.20	$56
Bond @	1.0%	on	$5,612.20	$56
Contingency @	0.0%	on	$5,724.44	$0
			TOTAL COST for pay item	$5,724

Additional Pay Item Notes :

Assumption for removal of 3' x 2' x 9" boards - 10 each using R3 electrical crew and laborers for hauling with the loader.

PAY ITEM COST DETAIL WORKSHEET

3.055 Remove & Dispose - 7 - 40-Ton Travelling Crane motors-hoist (2-30Hp)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.055		**Project**	: COPCO 2			
Description	:	Remove & Dispose - 7 - 40-Ton Travelling Crane motors-hoist (2-30Hp)						
Quantity	:	1.00	EA					
Daily Production	:	2.00	EA per 8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	0.5	Days	**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$3,548.91	per EA	**Probable Low Cost Parameter**		**2.2**	**$3,194**	**$3,194.02**
Total Cost	:	$3,549		**Probable High Cost Parameter**		**1.7**	**$4,081**	**$4,081.25**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (80tn)	Active	1.00	0.5	8	4.00	E	$190.46	$190.46		$761.84
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	$111.64		$446.56
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	$0.00		$366.40
Equipment Operator (crane)	Active	1.00	0.5	8	4.00	L	$68.41	$0.00		$273.64
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	$0.00		$230.36
Steelworker	Active	1.00	0.5	8	4.00	L	$65.52	$0.00		$262.08

Labor Hours	**20**	**TOTAL LABOR**	**$1,132.48**
Equipment Hours	**8**	**TOTAL EQUIPMENT**	**$1,208.40**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$56.62	$56.62
					TOTAL MATERIAL	**$56.62**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Disposal fee	1	EA	1	$1.00	$500.00
				TOTAL SUBCONTRACTS	**$500.00**

SUMMARY OF COSTS

Labor Cost	$1,132.48	Labor Burden @	49.7%	$0.00	$1,132.48
Material Cost	$56.62	Material Tax @	7.8%	$4.39	$61.01
Equipment Cost	$1,208.40	Equipment Tax @	0.0%	$0.00	$1,208.40
Subcontractors	$500.00				$500.00
DIRECT COST SUBTOTALS	**$2,898**			**$4**	**DIRECT COST SUBTOTALS** **$2,902**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,401.89	$360.28
Installing Contractors Profit@	8.0%				$2,401.89	$192.15
GC Markup on Subs @	5.0%				$500.00	$25.00
					TOTAL MARKUP COSTS	**$577.44**
General Contractors Insurance @	1.0%		on		$3,479.33	$35
Bond @	1.0%		on		$3,479.33	$35
Contingency @	0.0%		on		$3,548.91	$0
					TOTAL COST for pay item	**$3,549**

Additional Pay Item Notes :

Assumed removal of hoist, hoist trolley, gantry: 1 Steelworker and 1 Laborers to load the overhead crane motors in the truck using the crane.

PAY ITEM COST DETAIL WORKSHEET — **3.056 Remove & Dispose - 40-Ton Travelling Crane control equipment**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.056		**Project**	: COPCO 2
Description	: Remove & Dispose - 40-Ton Travelling Crane control equipment			
Quantity	: 1.00 EA			
Daily Production	: 0.50 EA per	8 hour shift	**Project #**	: Klamath Dams Removal
Work Days	: 2.0	Days	**Estimator**	: Mihaela Tomulescu
Unit Price	: $11,203.08	per EA		
Total Cost	: $11,203			

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	0.55	$10,083	$10,082.77
Probable High Cost Parameter	0.425	$12,884	$12,883.54

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	$111.64		$1,786.24
Hydraulic Crane (80tn)	Active	1.00	2.0	8	16.00	E	$190.46	$190.46		$3,047.36
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	$0.00		$1,465.60
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	$0.00		$1,094.56
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	$0.00		$921.44

Labor Hours	64	TOTAL LABOR	$3,481.60
Equipment Hours	32	TOTAL EQUIPMENT	$4,833.60

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$174.08	$174.08
					TOTAL MATERIAL	$174.08

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$500.00	$500.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	$500.00

SUMMARY OF COSTS

Labor Cost	$3,481.60	Labor Burden @	49.7%	$0.00	$3,481.60
Material Cost	$174.08	Material Tax @	7.8%	$13.49	$187.57
Equipment Cost	$4,833.60	Equipment Tax @	0.0%	$0.00	$4,833.60
Subcontractors	$500.00				$500.00
DIRECT COST SUBTOTALS	**$8,989**			**$13**	**DIRECT COST SUBTOTALS** **$9,003**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$8,502.77	$1,275.42
Installing Contractors Profit@	8.0%				$8,502.77	$680.22
GC Markup on Subs @	5.0%				$500.00	$25.00
					TOTAL MARKUP COSTS	**$1,980.64**
General Contractors Insurance @	1.0%		on		$10,983.41	$110
Bond @	1.0%		on		$10,983.41	$110
Contingency @	0.0%		on		$11,203.08	$0
					TOTAL COST for pay item	**$11,203**

Additional Pay Item Notes :

Assumed 5 cubicles: 2 Laborers and 1 Electrician will load in the truck with the crane the control equipment.

PAY ITEM COST DETAIL WORKSHEET

3.057 Remove & Dispose - 40-Ton Travelling Crane Festoon Cable

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.057		Project	: COPCO 2		
Description	: Remove & Dispose - 40-Ton Travelling Crane Festoon Cable					
Quantity	: 1.00 EA					
Daily Production	: 2.00 EA per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 0.5 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $2,557.66 per EA		Probable Low Cost Parameter		2.2	$2,302	$2,301.89
Total Cost	: $2,558		Probable High Cost Parameter		1.7	$2,941	$2,941.30

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	2.00	0.5	8	8.00	L	$45.80	$0.00		$366.40
Equipment Operator (medium)	Active	1.00	0.5	8	4.00	L	$66.28	$0.00		$265.12
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.5	8	4.00	E	$64.23	$64.23		$256.92
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	$111.64		$446.56
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	$0.00		$230.36

Labor Hours	16	TOTAL LABOR	$861.88
Equipment Hours	8	TOTAL EQUIPMENT	$703.48

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$43.09	$43.09
					TOTAL MATERIAL	$43.09

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Disposal fee (Allowance)	1.00	EA	1.000	1.00	$500.00	$500.00
					TOTAL SUBCONTRACTS	$500.00

SUMMARY OF COSTS

Labor Cost	$861.88	Labor Burden @	49.7%	$0.00	$861.88
Material Cost	$43.09	Material Tax @	7.8%	$3.34	$46.43
Equipment Cost	$703.48	Equipment Tax @	0.0%	$0.00	$703.48
Subcontractors	$500.00				$500.00
DIRECT COST SUBTOTALS	$2,108			$3	DIRECT COST SUBTOTALS $2,112

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,611.79	$241.77
Installing Contractors Profit@	8.0%				$1,611.79	$128.94
GC Markup on Subs @	5.0%				$500.00	$25.00
					TOTAL MARKUP COSTS	$395.71
General Contractors Insurance @	1.0%		on		$2,507.51	$25
Bond @	1.0%		on		$2,507.51	$25
Contingency @	0.0%		on		$2,557.66	$0
					TOTAL COST for pay item	$2,558

Additional Pay Item Notes :

Assumed 200 LF of cable: 2 Laborers will load in the truck with the loader the overhead crane cable.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.058a		Project	: COPCO 2		
Description	: Remove Oil from Oil-Filled Step-up Transformers					
Quantity	: 23,000.00 GAL					
Daily Production	: 10,000.00 GAL per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 2.3 Days		Estimator	: Mihaela Tomulescu	GAL per	Total Cost	Unit Price Per GAL
Unit Price	: $10.59 per GAL		Probable Low Cost Parameter		11000	$219,288	$9.53
Total Cost	: $243,653		Probable High Cost Parameter		9000	$268,019	$11.65

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.3	8	18.40	L	$46.27	$0.00		$851.37
Electrician	Active	2.00	2.3	8	36.80	L	$45.23	$0.00		$1,664.46
Laborer	Active	2.00	2.3	8	36.80	L	$45.80	$0.00		$1,685.44
				Labor Hours	92				TOTAL LABOR	$4,201.27
				Equipment Hours	0				TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 20% labor (absorbant materials, etc)	1.00	LS	1.000	1.00	$840.25	$840.25
Waste handling equipment, for handling hazardous waste materials, w/charcoal & HEPA filter, 55 gallon drum packer	5.00	EA	1.000	5.00	$35,100.00	$175,500.00
					TOTAL MATERIAL	$176,340.25

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, liquid pickup, vacuum truck, stainless steel tank, 5000 gallons, minimum charge, 4 hours, 2 compartment	18.40	hour	1.000	$200.00	$3,680.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$4,201.27	Labor Burden @		49.7%	$0.00		$4,201.27
Material Cost	$176,340.25	Material Tax @		7.8%	$13,666.37		$190,006.62
Equipment Cost	$0.00	Equipment Tax @		0.0%	$0.00		$0.00
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$180,542				$13,666	DIRECT COST SUBTOTALS	$194,208

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$194,207.90	$29,131.18
Installing Contractors Profit@	8.0%				$194,207.90	$15,536.63
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$44,667.82
General Contractors Insurance @	1.0%		on		$238,875.71	$2,389
Bond @	1.0%		on		$238,875.71	$2,389
Contingency @	0.0%		on		$243,653.23	$0
					TOTAL COST for pay item	$243,653

Additional Pay Item Notes :

Used a crew formed of 1 Forman, 2 Electricians, 2 Laborers to takeout the petroleum waste, Vacuum-equipped tank trucks are used to remove waste oil from collection points at plants so that it can be transported to recycling or disposal locations. Assumed new waste handling equipment, for handling hazardous waste materials, w/charcoal & HEPA filter, 55 gallon drum packer is new to storage the oil from 8 transformers.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.061		Project	: COPCO 2		
Description	:	Remove Intake Structure Concrete					
Quantity	:	1,650.00	cy				
Daily Production	:	50.00	cy per 8 hour shift	Project #	: 3		
Work Days	:	33.0	Days	Estimator	: Felipe Poletto	cy per	Total Cost	Unit Price Per cy
Unit Price	:	$299.68	per cy	Probable Low Cost Parameter	57.5	$420,307	$254.73
Total Cost	:	$494,479		Probable High Cost Parameter	40	$593,374	$359.62

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	33.0	8	528.00	L	$48.27	incl. in rate	incl. in rate	$25,486.56
Laborer	Active	8.00	33.0	8	2,112.00	L	$45.80	incl. in rate	incl. in rate	$96,729.60
Equipment Operator (medium)	Active	2.00	33.0	8	528.00	L	$66.28	incl. in rate	incl. in rate	$34,995.84
Truck Driver (heavy)	Active	1.00	33.0	8	264.00	L	$57.59	incl. in rate	incl. in rate	$15,203.76
Air Compressor 900 cfm	Active	1.00	33.0	8	264.00	E	$38.87	incl. in rate	incl. in rate	$10,261.40
Air Compressor 600 cfm	Active	1.00	33.0	8	264.00	E	$21.74	incl. in rate	incl. in rate	$5,739.08
Air Tool, Chipping Hammer	Active	4.00	33.0	8	1,056.00	E	$1.64	incl. in rate	incl. in rate	$1,730.82
Generator, Small Generator, 10 - 15 kW	Active	2.00	33.0	8	528.00	E	$7.04	incl. in rate	incl. in rate	$3,717.12
Hydraulic Excavator (2.5cy)	Active	2.00	33.0	8	528.00	E	$203.63	incl. in rate	incl. in rate	$107,516.64
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	33.0	8	264.00	E	$62.72	incl. in rate	incl. in rate	$16,558.08
Hydraulic Thumbs/Shear Attachment	Active	1.00	33.0	8	264.00	E	$16.39	incl. in rate	incl. in rate	$4,326.96
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	33.0	8	264.00	E	$111.64	incl. in rate	incl. in rate	$29,472.96
			33.0	8	0.00					$0.00
			33.0	8	0.00					$0.00
			33.0	8	0.00					$0.00
			33.0	8	0.00					$0.00
			33.0	8	0.00					$0.00
				Labor Hours	3,432				TOTAL LABOR	$172,415.76
				Equipment Hours	3,432				TOTAL EQUIPMENT	$179,323.05

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$8,620.79	$8,620.79
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	$8,620.79

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	9	EA	Cost per Mob	$2,500.00	$22,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$22,500.00

SUMMARY OF COSTS

Labor Cost	$172,415.76	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$172,415.76
Material Cost	$8,620.79	Material Tax @	7.75%	$668.11		$9,288.90
Equipment Cost	$179,323.05	Equipment Tax @	7.75%	$13,897.54		$193,220.59
Subcontractors	$22,500.00					$22,500.00
DIRECT COST SUBTOTALS	$382,860			$14,566	DIRECT COST SUBTOTALS	$397,425

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$374,925.25	$56,238.79
Installing Contractors Profit@	8.0%				$374,925.25	$29,994.02
GC Markup on Subs @	5.0%				$22,500.00	$1,125.00
					TOTAL MARKUP COSTS	$87,357.81
General Contractors Insurance @	1.0%			on	$484,783.05	$4,848
Bond @	1.0%			on	$484,783.05	$4,848
Contingency @	0.0%			on	$494,478.71	$0
					TOTAL COST for pay item	$494,479

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposable site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.062	Project	: COPCO 2			
Description	:	Remove Concrete Items associated with 16-foot I.D. Wood Stave Pipe					
Quantity	:	1,310.00 cy					
Daily Production	:	50.00 cy per 8 hour shift	Project #	: 3			
Work Days	:	26.2 Days	Estimator	: Felipe Poletto	cy per	Total Cost	Unit Price Per cy
Unit Price	:	$299.39 per cy	Probable Low Cost Parameter		57.5	$333,367	$254.48
Total Cost	:	$392,197	Probable High Cost Parameter		40	$470,636	$359.26

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	26.2	8	419.20	L	$48.27	incl. in rate	incl. in rate	$20,234.78
Laborer	Active	8.00	26.2	8	1,676.80	L	$45.80	incl. in rate	incl. in rate	$76,797.44
Equipment Operator (medium)	Active	2.00	26.2	8	419.20	L	$66.28	incl. in rate	incl. in rate	$27,784.58
Truck Driver (heavy)	Active	1.00	26.2	8	209.60	L	$57.59	incl. in rate	incl. in rate	$12,070.86
Air Compressor 900 cfm	Active	1.00	26.2	8	209.60	E	$38.87	incl. in rate	incl. in rate	$8,146.93
Air Compressor 600 cfm	Active	1.00	26.2	8	209.60	E	$21.74	incl. in rate	incl. in rate	$4,556.48
Air Tool, Chipping Hammer	Active	4.00	26.2	8	838.40	E	$1.64	incl. in rate	incl. in rate	$1,374.17
Generator, Small Generator, 10 - 15 kW	Active	2.00	26.2	8	419.20	E	$7.04	incl. in rate	incl. in rate	$2,951.17
Hydraulic Excavator (2.5cy)	Active	2.00	26.2	8	419.20	E	$203.63	incl. in rate	incl. in rate	$85,361.70
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	26.2	8	209.60	E	$62.72	incl. in rate	incl. in rate	$13,146.11
Hydraulic Thumbs/Shear Attachment	Active	1.00	26.2	8	209.60	E	$16.39	incl. in rate	incl. in rate	$3,435.34
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	26.2	8	209.60	E	$111.64	incl. in rate	incl. in rate	$23,399.74
			26.2	8	0.00					$0.00
			26.2	8	0.00					$0.00
			26.2	8	0.00					$0.00
			26.2	8	0.00					$0.00
			26.2	8	0.00					$0.00
				Labor Hours	2,725				TOTAL LABOR	$136,887.66
				Equipment Hours	2,725				TOTAL EQUIPMENT	$142,371.63

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$6,844.38	$6,844.38
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	$6,844.38

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	7	EA	Cost per Mob	$2,500.00	$17,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$17,500.00

SUMMARY OF COSTS

Labor Cost	$136,887.66	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$136,887.66
Material Cost	$6,844.38	Material Tax @	7.75%	$530.44		$7,374.82
Equipment Cost	$142,371.63	Equipment Tax @	7.75%	$11,033.80		$153,405.44
Subcontractors	$17,500.00					$17,500.00
DIRECT COST SUBTOTALS	$303,604			$11,564	DIRECT COST SUBTOTALS	$315,168

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$297,667.92		$44,650.19
Installing Contractors Profit@	8.0%				$297,667.92		$23,813.43
GC Markup on Subs @	5.0%				$17,500.00		$875.00
						TOTAL MARKUP COSTS	$69,338.62
General Contractors Insurance @	1.0%			on	$384,506.54		$3,845
Bond @	1.0%			on	$384,506.54		$3,845
Contingency @	0.0%			on	$392,196.68		$0
						TOTAL COST for pay item	$392,197

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposable site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.063		Project	: COPCO 2		
Description	:	Place Concrete Plugs for Tunnels					
Quantity	:	100.00	cy				
Daily Production	:	11.00	cy per 8 hour shift	Project #	: 3		
Work Days	:	9.1	Days	Estimator	: Felipe Poletto	cy per	Total Cost	Unit Price Per cy
Unit Price	:	$1,827.07	per cy	Probable Low Cost Parameter		12.65	$155,301	$1,553.01
Total Cost	:	$182,707		Probable High Cost Parameter		9.35	$210,113	$2,101.13

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Carpenter Foreman (out)	Active	2.00	9.1	8	145.60	L	$74.60	incl. in rate	incl. in rate	$10,861.76
Carpenters	Active	6.00	9.1	8	436.80	L	$72.60	incl. in rate	incl. in rate	$31,711.68
Carpenters, Journeyman	Active	4.00	9.1	8	291.20	L	$65.37	incl. in rate	incl. in rate	$19,035.74
Equipment Operator (medium)	Active	1.00	9.1	8	72.80	L	$66.28	incl. in rate	incl. in rate	$4,825.18
Truck Driver (heavy)	Active	1.00	9.1	8	72.80	L	$57.59	incl. in rate	incl. in rate	$4,192.55
Loader, FE Rubber Tire (5.25cy)	Active	2.00	9.1	8	145.60	E	$75.42	incl. in rate	incl. in rate	$10,981.15
Hydraulic Excavator (5.0cy)	Active	1.00	9.1	8	72.80	E	$274.63	incl. in rate	incl. in rate	$19,993.06
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	9.1	8	72.80	E	$31.90	incl. in rate	incl. in rate	$2,322.32
Truck, Pickup (4x4, 3/4tn)	Active	2.00	9.1	8	145.60	E	$16.94	incl. in rate	incl. in rate	$2,466.46
0		0.00	9.1	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		3.00	9.1	8	218.40	0	$0.00	incl. in rate	incl. in rate	$0.00
0		1.00	9.1	8	72.80	0	$0.00	incl. in rate	incl. in rate	$0.00
			9.1	8.0	0.00					$0.00
			9.1	8.0	0.00					$0.00
			9.1	8.0	0.00					$0.00
			9.1	8.0	0.00					$0.00
			9.1	8.0	0.00					$0.00
				Labor Hours	1,019				TOTAL LABOR	$70,626.92
				Equipment Hours	437				TOTAL EQUIPMENT	$35,763.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (25% labor)	1.00	LS	1.000	1.00	$17,656.73	$17,656.73
Concrete	100.00	CY	1.200	120.00	$150.00	$15,000.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	$32,656.73

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Pump	1	LS	1 Mobilization	$1,500.00	$1,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$1,500.00

SUMMARY OF COSTS

Labor Cost	$70,626.92	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.		$70,626.92
Material Cost	$32,656.73	Material Tax @	7.75%	$2,530.90			$35,187.63
Equipment Cost	$35,763.00	Equipment Tax @	7.75%	$2,771.63			$38,534.63
Subcontractors	$1,500.00						$1,500.00
DIRECT COST SUBTOTALS	$140,547			$5,303		DIRECT COST SUBTOTALS	$145,849

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$144,349.18	$21,652.38
Installing Contractors Profit@	8.0%				$144,349.18	$11,547.93
GC Markup on Subs @	5.0%				$1,500.00	$75.00
					TOTAL MARKUP COSTS	$33,275.31
General Contractors Insurance @	1.0%			on	$179,124.49	$1,791
Bond @	1.0%			on	$179,124.49	$1,791
Contingency @	0.0%			on	$182,706.98	$0
					TOTAL COST for pay item	$182,707

Additional Pay Item Notes :

There will be 2 crews work in two locations at 1 time. The loaders will support crews for providing materials/ equipment that a pick up truck can not handle.There is a total of 9 plugs and figured roughly 1 day per plug.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.064	Project	: COPCO 2		
Description	: Remove Concrete Items associated with Penstocks D/S from Tunnel No. 2				
Quantity	: 3,500.00 cy				
Daily Production	: 50.00 cy per 8 hour shift	Project #	: 3		
Work Days	: 70.0 Days	Estimator	: Felipe Poletto	cy per	Total Cost	Unit Price Per cy
Unit Price	: $298.85 per cy	Probable Low Cost Parameter		57.5	$889,077	$254.02
Total Cost	: $1,045,973	Probable High Cost Parameter		40	$1,255,168	$358.62

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	70.0	8	1,120.00	L	$48.27	incl. in rate	incl. in rate	$54,062.40
Laborer	Active	8.00	70.0	8	4,480.00	L	$45.80	incl. in rate	incl. in rate	$205,184.00
Equipment Operator (medium)	Active	2.00	70.0	8	1,120.00	L	$66.28	incl. in rate	incl. in rate	$74,233.60
Truck Driver (heavy)	Active	1.00	70.0	8	560.00	L	$57.59	incl. in rate	incl. in rate	$32,250.40
Air Compressor 900 cfm	Active	1.00	70.0	8	560.00	E	$38.87	incl. in rate	incl. in rate	$21,766.60
Air Compressor 600 cfm	Active	1.00	70.0	8	560.00	E	$21.74	incl. in rate	incl. in rate	$12,173.80
Air Tool, Chipping Hammer	Active	4.00	70.0	8	2,240.00	E	$1.64	incl. in rate	incl. in rate	$3,671.44
Generator, Small Generator, 10 - 15 kW	Active	2.00	70.0	8	1,120.00	E	$7.04	incl. in rate	incl. in rate	$7,884.80
Hydraulic Excavator (2.5cy)	Active	2.00	70.0	8	1,120.00	E	$203.63	incl. in rate	incl. in rate	$228,065.60
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	70.0	8	560.00	E	$62.72	incl. in rate	incl. in rate	$35,123.20
Hydraulic Thumbs/Shear Attachment	Active	1.00	70.0	8	560.00	E	$16.39	incl. in rate	incl. in rate	$9,178.40
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	70.0	8	560.00	E	$111.64	incl. in rate	incl. in rate	$62,518.40
			70.0	8	0.00					$0.00
			70.0	8	0.00					$0.00
			70.0	8	0.00					$0.00
			70.0	8	0.00					$0.00
			70.0	8	0.00					$0.00
				Labor Hours	7,280				TOTAL LABOR	$365,730.40
				Equipment Hours	7,280				TOTAL EQUIPMENT	$380,382.23

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$18,286.52	$18,286.52
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	$18,286.52

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	18	EA	Cost per Mob	$2,500.00	$45,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$45,000.00

SUMMARY OF COSTS

Labor Cost	$365,730.40	Labor Burden @		0.0%	$0.00	Included in hourly labor rate.	$365,730.40
Material Cost	$18,286.52	Material Tax @		7.75%	$1,417.21		$19,703.73
Equipment Cost	$380,382.23	Equipment Tax @		7.75%	$29,479.62		$409,861.85
Subcontractors	$45,000.00						$45,000.00
DIRECT COST SUBTOTALS	$809,399				$30,897	DIRECT COST SUBTOTALS	$840,296
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$795,295.98		$119,294.40
Installing Contractors Profit@	8.0%				$795,295.98		$63,623.68
GC Markup on Subs @	5.0%				$45,000.00		$2,250.00
						TOTAL MARKUP COSTS	$185,168.07
General Contractors Insurance @	1.0%			on	$1,025,464.05		$10,255
Bond @	1.0%			on	$1,025,464.05		$10,255
Contingency @	0.0%			on	$1,045,973.33		$0
						TOTAL COST for pay item	$1,045,973

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposable site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.065	Project	: COPCO2
Description	: Remove & Dispose of Caterpiller Gate (steel)		
Quantity	: 50,000.00 LBS		
Daily Production	: 25,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 2.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $0.92 per LBS		
Total Cost	: $45,874		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	27500	$41,287	$0.83
Probable High Cost Parameter	22500	$50,461	$1.01

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	$0.00		$740.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	$0.00		$723.68
Steelworker	Active	6.00	2.0	8	96.00	L	$65.52	$0.00		$6,289.92
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.0	8	16.00	E	$221.50	$221.50		$3,544.00
Truck Driver (heavy)	Active	2.00	2.0	8	32.00	L	$57.59	$0.00		$1,842.88
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	2.0	8	32.00	E	$31.90	$31.90		$1,020.80
Hydraulic Crane (120tn)	Active	1.00	2.0	8	16.00	E	$239.06	$239.06		$3,824.96
Welder	Active	2.00	2.0	8	32.00	L	$7.84	$0.00		$250.80
Gas Welding Machine	Active	2.00	2.0	8	32.00	E	$2.88	$2.88		$92.06
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	$0.00		$1,060.48
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	$0.00		$1,094.56

Labor Hours	224	TOTAL LABOR	$12,002.64
Equipment Hours	96	TOTAL EQUIPMENT	$8,481.82

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$600.13	$600.13
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	2,500.00	LF	1.000	2,500.00	$0.85	$2,125.00
TOTAL MATERIAL						$2,725.13

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	25.00	ton	1.000	25.00	$595.00	$14,875.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	72.00	mile	1.000	72.00	$7.25	$522.00
TOTAL SUBCONTRACTS						$15,397.00

SUMMARY OF COSTS

Labor Cost	$12,002.64	Labor Burden @	49.7%	$0.00	$12,002.64
Material Cost	$2,725.13	Material Tax @	7.8%	$211.20	$2,936.33
Equipment Cost	$8,481.82	Equipment Tax @	0.0%	$0.00	$8,481.82
Subcontractors	$15,397.00				$15,397.00
DIRECT COST SUBTOTALS	$38,607			$211	DIRECT COST SUBTOTALS $38,818

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$23,420.79	$3,513.12
Installing Contractors Profit@	8.0%				$23,420.79	$1,873.66
GC Markup on Subs @	5.0%				$15,397.00	$769.85
TOTAL MARKUP COSTS						$6,156.63
General Contractors Insurance @	1.0%			on	$44,974.43	$450
Bond @	1.0%			on	$44,974.43	$450
Contingency @	0.0%			on	$45,873.91	$0
TOTAL COST for pay item						$45,874

Additional Pay Item Notes :

The removal of gate, frame and hoist is done by one 9-men crew (1 foreman, 6 steelworkers, 1 welder, 1 electrician and 2 equipment operators). Based on the current production rate and the fact that we dispose big pieces of steel we use 2 trucks per day. Assumed hazardous waste cleanup 100% disposal because of the engine Oil and Transmission Oil used for cranes .

PAY ITEM COST DETAIL WORKSHEET — **3.066 Remove & Dispose of Trash rack and trash rake (steel)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.066	Project	: COPCO2		
Description	:	Remove & Dispose of Trash rack and trash rake (steel)				
Quantity	:	86,000.00 LBS				
Daily Production	:	30,000.00 LBS per 8 hour shift	Project #	: 0		
Work Days	:	2.9 Days	Estimator	: Mihaela Tomulescu		
				LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.63 per LBS	Probable Low Cost Parameter	33000	$48,937	$0.57
Total Cost	:	$54,375	Probable High Cost Parameter	24000	$65,250	$0.76

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.9	8	23.20	L	$46.27	$0.00		$1,073.46
Electrician	Active	1.00	2.9	8	23.20	L	$45.23	$0.00		$1,049.34
Steelworker	Active	6.00	2.9	8	139.20	L	$65.52	$0.00		$9,120.38
Hydraulic Excavator (6.0cy)	Active	1.00	2.9	8	23.20	E	$322.48	$322.48		$7,481.54
Truck Driver (heavy)	Active	1.00	2.9	8	23.20	L	$57.59	$0.00		$1,336.09
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.9	8	23.20	E	$111.64	$111.64		$2,590.05
Hydraulic Crane (120tn)	Active	1.00	2.9	8	23.20	E	$239.06	$239.06		$5,546.19
Welder	Active	2.00	2.9	8	46.40	L	$7.84	$0.00		$363.66
Gas Welding Machine	Active	2.00	2.9	8	46.40	E	$2.88	$2.88		$133.49
Equipment Operator (medium)	Active	2.00	2.9	8	46.40	L	$66.28	$0.00		$3,075.39
Equipment Operator (crane)	Active	1.00	2.9	8	23.20	L	$68.41	$0.00		$1,587.11
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	2.9	8	23.20	E	$62.72	$62.72		$1,455.10
				Labor Hours	324.8				TOTAL LABOR	$17,605.44
				Equipment Hours	139.2				TOTAL EQUIPMENT	$17,206.37

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, electrodes, wrenches, hard hats etc)	1.00	LS	1.000	1.00	$2,640.82	$2,640.82
					TOTAL MATERIAL	$2,640.82

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (25%)	10.75	ton	1.000	10.75	$595.00	$6,396.25
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	36.00	mile	1.000	36.00	$7.25	$261.00
					TOTAL SUBCONTRACTS	$6,657.25

SUMMARY OF COSTS

Labor Cost	$17,605.44	Labor Burden @	49.7%	$0.00		$17,605.44
Material Cost	$2,640.82	Material Tax @	7.8%	$204.66		$2,845.48
Equipment Cost	$17,206.37	Equipment Tax @	0.0%	$0.00		$17,206.37
Subcontractors	$6,657.25					$6,657.25
DIRECT COST SUBTOTALS	$44,110			$205	DIRECT COST SUBTOTALS	$44,315

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$37,657.29	$5,648.59
Installing Contractors Profit@	8.0%				$37,657.29	$3,012.58
GC Markup on Subs @	5.0%				$6,657.25	$332.86
					TOTAL MARKUP COSTS	$8,994.04
General Contractors Insurance @	1.0%		on		$53,308.58	$533
Bond @	1.0%		on		$53,308.58	$533
Contingency @	0.0%		on		$54,374.75	$0
					TOTAL COST for pay item	$54,375

Additional Pay Item Notes :

The removal of gate, frame and hoist is done by one 9-men crew (1 foreman, 6 steelworkers, 1 welder, 1 electrician and 2 equipment operators). Based on the current production rate and the fact that we dispose big pieces of steel we use 1 trucks per day. Assumed hazardous waste cleanup 25% of total weight disposal.

PAY ITEM COST DETAIL WORKSHEET — **3.067 Remove & Dispose of Stop Logs and slots for intake (steel)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.067	Project	: COPCO 2		
Description	: Remove & Dispose of Stop Logs and slots for intake (steel)				
Quantity	: 220,000.00 LBS				
Daily Production	: 20,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	: 11.0 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $0.78 per LBS	Probable Low Cost Parameter		22000	$153,716	$0.70
Total Cost	: $170,795	Probable High Cost Parameter		16000	$204,954	$0.93

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Crawler Crane (90tn)	Active	1.00	11.0	8	88.00	E	$208.09	$208.09		$18,311.92
Equipment Operator (medium)	Active	1.00	11.0	8	88.00	L	$66.28	$0.00		$5,832.64
Equipment Operator (oiler)	Active	1.00	11.0	8	88.00	L	$62.94	$0.00		$5,538.72
Carpenters, Journeyman	Active	4.00	11.0	8	352.00	L	$65.37	$0.00		$23,010.24
Truck Driver (heavy)	Active	2.00	11.0	8	176.00	L	$57.59	$0.00		$10,135.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	11.0	8	176.00	E	$31.90	$31.90		$5,614.40
Hydraulic Impact Breaker Attachment (3k-4k ft-lb)	Active	1.00	11.0	8	88.00	E	$36.58	$36.58		$3,219.04
Hydraulic Excavator (6.0cy)	Active	1.00	11.0	8	88.00	E	$322.48	$322.48		$28,378.24
Steelworker	Active	4.00	11.0	8	352.00	L	$65.52	$0.00		$23,063.04
				Labor Hours	1056				TOTAL LABOR	$67,580.48
				Equipment Hours	440				TOTAL EQUIPMENT	$55,523.60

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$3,379.02	$3,379.02
					TOTAL MATERIAL	$3,379.02

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Stop log lifter - Rent per day	11.00	day	1.000	11.00	$1,000.00	$11,000.00
					TOTAL SUBCONTRACTS	$11,000.00

SUMMARY OF COSTS

Labor Cost	$67,580.48	Labor Burden @	49.7%	$0.00		$67,580.48
Material Cost	$3,379.02	Material Tax @	7.8%	$261.87		$3,640.90
Equipment Cost	$55,523.60	Equipment Tax @	0.0%	$0.00		$55,523.60
Subcontractors	$11,000.00					$11,000.00
DIRECT COST SUBTOTALS	$137,483			$262	DIRECT COST SUBTOTALS	$137,745

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$126,744.98	$19,011.75
Installing Contractors Profit@	8.0%				$126,744.98	$10,139.60
GC Markup on Subs @	5.0%				$11,000.00	$550.00
					TOTAL MARKUP COSTS	$29,701.35
General Contractors Insurance @	1.0%		on		$167,446.32	$1,674
Bond @	1.0%		on		$167,446.32	$1,674
Contingency @	0.0%		on		$170,795.25	$0
					TOTAL COST for pay item	**$170,795**

Additional Pay Item Notes :

The process of removing top logs is not manual, but done with hydraulic stop log lifters and hoists is done by one 11-men crew (6 steelworkers, 4 journeymen and 4 equipment operators). Based on the current production rate and the fact that we dispose big pieces of material we use 2 trucks per day. The gate side guides and invert shall have a minimum weight of 4 lbs./ft. for wall mounted and 3 lbs./ft. for embedded in concrete that we assume we have. The gate invert should contain a removable neoprene seal. Including stop log grooves, lifter, guide - weight around 220,000 lbs.

PAY ITEM COST DETAIL WORKSHEET

3.068 Remove & Dispose of Wood Staves Soaked in Creosote

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.068	**Project**	: COPCO 2
Description	: Remove & Dispose of Wood Staves Soaked in Creosote		
Quantity	: 1,100,000.00 LBS		
Daily Production	: 90,000.00 LBS per 8 hour shift	**Project #**	: Klamath Dams Removal
Work Days	: 12.2 Days	**Estimator**	: Mihaela Tomulescu
Unit Price	: $0.93 per LBS		
Total Cost	: $1,021,716		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	**108000**	**$817,373**	**$0.74**
Probable High Cost Parameter	**72000**	**$1,226,059**	**$1.11**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	7.00	12.2	8	683.20	L	$46.27	$0.00		$31,611.66
Loader, FE Rubber Tire (8.6cy)	Active	7.00	12.2	8	683.20	E	$221.50	$221.50		$151,328.80
Electrician	Active	7.00	12.2	8	683.20	L	$45.23	$0.00		$30,901.14
Carpenters	Active	21.00	12.2	8	2,049.60	L	$72.60	$0.00		$148,800.96
Truck, Off-Road, Articulated Rear, 20cy	Active	3.00	12.2	8	292.80	E	$111.64	$111.64		$32,688.19
Hydraulic Excavator (6.0cy)	Active	3.00	12.2	8	292.80	E	$322.48	$322.48		$94,422.14
Equipment Operator (crane)	Active	3.00	12.2	8	292.80	L	$68.41	$0.00		$20,030.45
Truck Driver (heavy)	Active	3.00	12.2	8	292.80	L	$57.59	$0.00		$16,862.35
Steelworker	Active	7.00	12.2	8	683.20	L	$65.52	$0.00		$44,763.26
Crawler Crane (270tn)	Active	3.00	12.2	8	292.80	E	$399.50	$446.84		$116,973.60
Equipment Operator (medium)	Active	10.00	12.2	8	976.00	L	$66.28	$0.00		$64,689.28

Labor Hours	**5660.8**	**TOTAL LABOR**	**$357,659.10**
Equipment Hours	**1561.6**	**TOTAL EQUIPMENT**	**$395,412.74**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$17,882.96	$17,882.96
					TOTAL MATERIAL	**$17,882.96**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min load/wait/unload, 18 C.Y. 8 wheel truck, cycle 50 miles, 50 MPH, excludes loading equipment	652	L.C.Y.	1.000	652.00	$13.10	$8,541.20
Disposal fees -RCRA hazardous waste treated to be a non-RCRA or nonhazardous waste	550	Ton	1.000	550.00	$74.00	$40,700.00
					TOTAL SUBCONTRACTS	**$49,241.20**

SUMMARY OF COSTS

Labor Cost	$357,659.10	Labor Burden @	49.7%	$0.00	$357,659.10
Material Cost	$17,882.96	Material Tax @	7.8%	$1,385.93	$19,268.88
Equipment Cost	$395,412.74	Equipment Tax @	0.0%	$0.00	$395,412.74
Subcontractors	$49,241.20				$49,241.20
DIRECT COST SUBTOTALS	**$820,196**			**$1,386**	**DIRECT COST SUBTOTALS** **$821,582**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$772,340.72	$115,851.11
Installing Contractors Profit@	8.0%				$772,340.72	$61,787.26
GC Markup on Subs @	5.0%				$49,241.20	$2,462.06
					TOTAL MARKUP COSTS	**$180,100.43**

General Contractors Insurance @	1.0%	on	$1,001,682.35	$10,017
Bond @	1.0%	on	$1,001,682.35	$10,017
Contingency @	0.0%	on	$1,021,716.00	$0
			TOTAL COST for pay item	**$1,021,716**

Additional Pay Item Notes :

Assumed the process of removing around 1,100000 lbs wood staves is done in 12 days by 7 crew formed of 1 foreman, 1 electrician, 3 carpenters, 1 steelworkers ; 12 equipment operators 3 for the crane, 3 for the excavator and 6 loader. Based on the current production rate and the fact that we dispose big pieces of material we use 3 trucks per day.

PAY ITEM COST DETAIL WORKSHEET — **3.069 Remove & Dispose of Cradles (steel)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.069	Project	: COPCO 2
Description	: Remove & Dispose of Cradles (steel)		
Quantity	: 290,000.00 LBS		
Daily Production	: 25,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 11.6 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $0.94 per LBS		
Total Cost	: $273,748		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	30000	$218,998	$0.76
Probable High Cost Parameter	20000	$328,497	$1.13

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	11.6	8	185.60	L	$46.27	$0.00		$8,587.71
Steelworker	Active	2.00	11.6	8	185.60	L	$65.52	$0.00		$12,160.51
Equipment Operator (medium)	Active	2.00	11.6	8	185.60	L	$66.28	$0.00		$12,301.57
Carpenters, Journeyman	Active	10.00	11.6	8	928.00	L	$65.37	$0.00		$60,663.36
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	11.6	8	185.60	E	$111.64	$111.64		$20,720.38
Hydraulic Impact Breaker Attachment (2k-3k ft-lb)	Active	2.00	11.6	8	185.60	E	$30.85	$30.85		$5,725.76
Welder	Active	2.00	11.6	8	185.60	L	$7.84	$0.00		$1,454.64
Gas Welding Machine	Active	2.00	11.6	8	185.60	E	$2.88	$2.88		$533.97
Hydraulic Excavator (6.0cy)	Active	2.00	11.6	8	185.60	E	$322.48	$322.48		$59,852.29
Truck Driver (heavy)	Active	2.00	11.6	8	185.60	L	$57.59	$0.00		$10,688.70
Electrician	Active	2.00	11.6	8	185.60	L	$45.23	$0.00		$8,394.69

Labor Hours	2041.6	TOTAL LABOR	$114,251.18
Equipment Hours	742.4	TOTAL EQUIPMENT	$86,832.40

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	1,500.00	LF	1.000	1,500.00	$0.85	$1,275.00
					TOTAL MATERIAL	$1,275.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	29.00	ton	1.000	29.00	$595.00	$17,255.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	115.20	mile	1.000	115.20	$10.25	$1,180.80
					TOTAL SUBCONTRACTS	$18,435.80

SUMMARY OF COSTS

Labor Cost	$114,251.18	Labor Burden @	49.7%	$0.00	$114,251.18
Material Cost	$1,275.00	Material Tax @	7.8%	$98.81	$1,373.81
Equipment Cost	$86,832.40	Equipment Tax @	0.0%	$0.00	$86,832.40
Subcontractors	$18,435.80				$18,435.80
DIRECT COST SUBTOTALS	$220,794			$99	DIRECT COST SUBTOTALS $220,893

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$202,457.40	$30,368.61
Installing Contractors Profit@	8.0%				$202,457.40	$16,196.59
GC Markup on Subs @	5.0%				$18,435.80	$921.79
					TOTAL MARKUP COSTS	$47,486.99
General Contractors Insurance @	1.0%		on		$268,380.19	$2,684
Bond @	1.0%		on		$268,380.19	$2,684
Contingency @	0.0%		on		$273,747.79	$0
					TOTAL COST for pay item	$273,748

Additional Pay Item Notes :

Assumed the process of removing steel cradles is done in around 12 days by 2 crew formed of 1 foreman, 1 electrician, 5 journeymen, 1 steelworkers ;2 equipment operators 1 for each excavator. We dispose cradles with 1 trucks per day for each crew.

PAY ITEM COST DETAIL WORKSHEET **3.070 Remove & Dispose of Bands (steel)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.070	Project	: COPCO 2			
Description	:	Remove & Dispose of Bands (steel)					
Quantity	:	463,000.00 LBS					
Daily Production	:	65,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	6.0 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.92 per LBS	Probable Low Cost Parameter		78000	$341,422	$0.74
Total Cost	:	$426,777	Probable High Cost Parameter		52000	$512,133	$1.11

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	5.00	6.0	8	240.00	L	$48.27	$0.00		$11,584.80
Steelworker	Active	15.00	6.0	8	720.00	L	$65.52	$0.00		$47,174.40
Equipment Operator (crane)	Active	3.00	6.0	8	144.00	L	$68.41	$0.00		$9,851.04
Crawler Crane (130tn)	Active	5.00	6.0	8	240.00	E	$258.66	$258.66		$62,078.40
Welder	Active	5.00	6.0	8	240.00	L	$7.84	$0.00		$1,881.00
Gas Welding Machine	Active	5.00	6.0	8	240.00	E	$2.88	$2.88		$690.48
Hydraulic Excavator (6.0cy)	Active	5.00	6.0	8	240.00	E	$322.48	$322.48		$77,395.20
Truck Driver (heavy)	Active	4.00	6.0	8	192.00	L	$57.59	$0.00		$11,057.28
Truck, Off-Road, Articulated Rear, 20cy	Active	4.00	6.0	8	192.00	E	$111.64	$111.64		$21,434.88
Equipment Operator (medium)	Active	5.00	6.0	8	240.00	L	$66.28	$0.00		$15,907.20
Loader, FE Rubber Tire (8.6cy)	Active	5.00	6.0	8	240.00	E	$221.50	$221.50		$53,160.00
				Labor Hours	1776				TOTAL LABOR	$97,455.72
				Equipment Hours	1152				TOTAL EQUIPMENT	$214,758.96

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$14,618.36	$14,618.36
					TOTAL MATERIAL	$14,618.36

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (10%)	23.15	ton	1.000	23.15	$595.00	$13,774.25
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	72.00	mile	1.000	72.00	$7.25	$522.00
					TOTAL SUBCONTRACTS	$14,296.25

SUMMARY OF COSTS

Labor Cost	$97,455.72	Labor Burden @	49.7%	$0.00		$97,455.72
Material Cost	$14,618.36	Material Tax @	7.8%	$1,132.92		$15,751.28
Equipment Cost	$214,758.96	Equipment Tax @	0.0%	$0.00		$214,758.96
Subcontractors	$14,296.25					$14,296.25
DIRECT COST SUBTOTALS	$341,129			$1,133	DIRECT COST SUBTOTALS	$342,262

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$327,965.96		$49,194.89
Installing Contractors Profit@	8.0%				$327,965.96		$26,237.28
GC Markup on Subs @	5.0%				$14,296.25		$714.81
						TOTAL MARKUP COSTS	$76,146.98
General Contractors Insurance @	1.0%		on		$418,409.19		$4,184
Bond @	1.0%		on		$418,409.19		$4,184
Contingency @	0.0%		on		$426,777.37		$0
						TOTAL COST for pay item	$426,777

Additional Pay Item Notes :

Based on RSMeans we used Crew E-19 for metals demolition, banding the material into bundles and dispose to the staging area, E-12 for welding cut and E-25 for cutting steel. Assumed contains paint with heavy metals 10% of the total lbs, 36 miles from Copco lake to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, excavator and welding machine.

PAY ITEM COST DETAIL WORKSHEET — **3.071 Remove & Dispose of Penstock after bifurcation to butterfly valves**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 3.071	Project	: COPCO 2
Description	: Remove & Dispose of Penstock after bifurcation to butterfly valves		
Quantity	: 860,000.00 LBS		
Daily Production	: 43,000.00 LBS per 10 hour shift	Project #	: Klamath Dams Removal
Work Days	: 20.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $1.08 per LBS		
Total Cost	: $925,612		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	51600	$740,490	$0.86
Probable High Cost Parameter	34400	$1,110,734	$1.29

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	3.00	20.0	10	600.00	L	$46.27	$0.00		$27,762.00
Steelworker	Active	12.00	20.0	10	2,400.00	L	$65.52	$0.00		$157,248.00
Equipment Operator (crane)	Active	2.00	20.0	10	400.00	L	$68.41	$0.00		$27,364.00
Crawler Crane (130tn)	Active	2.00	20.0	10	400.00	E	$258.66	$258.66		$103,464.00
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	20.0	10	400.00	E	$111.64	$111.64		$44,656.00
Hydraulic Excavator (5.0cy)	Active	2.00	20.0	10	400.00	E	$274.63	$274.63		$109,852.00
Welder	Active	3.00	20.0	10	600.00	L	$7.84	$0.00		$4,702.50
Gas Welding Machine	Active	3.00	20.0	10	600.00	E	$2.88	$2.88		$1,726.19
Carpenters, Journeyman	Active	12.00	20.0	10	2,400.00	L	$65.37	$0.00		$156,888.00
Loader, FE Rubber Tire (5.25cy)	Active	2.00	20.0	10	400.00	E	$75.42	$75.42		$30,168.00
Hydraulic Impact Breaker Attachment (2k-3k ft-lb)	Active	2.00	20.0	10	400.00	E	$30.85	$30.85		$12,340.00
Truck Driver (heavy)	Active	2.00	20.0	10	400.00	L	$57.59	$0.00		$23,036.00
				Labor Hours	6800				TOTAL LABOR	$397,000.50
				Equipment Hours	2600				TOTAL EQUIPMENT	$302,206.19

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$15,110.31	$15,110.31
					TOTAL MATERIAL	$15,110.31

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	43.00	ton	1.000	43.00	$595.00	$25,585.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	72.00	mile	1.000	72.00	$7.25	$522.00
					TOTAL SUBCONTRACTS	$26,107.00

SUMMARY OF COSTS

Labor Cost	$397,000.50	Labor Burden @	49.7%	$0.00		$397,000.50
Material Cost	$15,110.31	Material Tax @	7.8%	$1,171.05		$16,281.36
Equipment Cost	$302,206.19	Equipment Tax @	0.0%	$0.00		$302,206.19
Subcontractors	$26,107.00					$26,107.00
DIRECT COST SUBTOTALS	$740,424			$1,171	DIRECT COST SUBTOTALS	$741,595

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$715,488.05	$107,323.21
Installing Contractors Profit@	8.0%				$715,488.05	$57,239.04
GC Markup on Subs @	5.0%				$26,107.00	$1,305.35
					TOTAL MARKUP COSTS	$165,867.60
General Contractors Insurance @	1.0%			on	$907,462.65	$9,075
Bond @	1.0%			on	$907,462.65	$9,075
Contingency @	0.0%			on	$925,611.91	$0
					TOTAL COST for pay item	$925,612

Additional Pay Item Notes :

Assumed the process of removing pipes, expansion joints and support rings encased in concrete is done in around 20 days by 3 crew formed of 1 foreman, 4 journeymen, 4 steelworkers ;6 equipment operators 1 for each excavator, crane and loader. We dispose pipes with 1 trucks per day for each crew. Assumed contains paint with heavy metals 10% of the total lbs, 36 miles from Copco lake to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, excavator and welding machine.

PAY ITEM COST DETAIL WORKSHEET — **3.072 Remove & Dispose of Bifurcated vent pipes and support structure**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.072	Project	: COPCO 2		
Description	:	Remove & Dispose of Bifurcated vent pipes and support structure				
Quantity	:	19,500.00 LBS				
Daily Production	:	43,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	0.5 Days	Estimator	: Mihaela Tomulescu	LBS per / Total Cost / Unit Price Per LBS	
Unit Price	:	$1.13 per LBS	Probable Low Cost Parameter	51600	$17,627	$0.90
Total Cost	:	$22,033	Probable High Cost Parameter	34400	$26,440	$1.36

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	3.00	0.5	8	12.00	L	$48.27	$0.00		$579.24
Steelworker	Active	12.00	0.5	8	48.00	L	$65.52	$0.00		$3,144.96
Crawler Crane (270tn)	Active	2.00	0.5	8	8.00	E	$399.50	$446.84		$3,196.00
Equipment Operator (crane)	Active	2.00	0.5	8	8.00	L	$68.41	$0.00		$547.28
Welder	Active	3.00	0.5	8	12.00	L	$7.84	$0.00		$94.05
Gas Welding Machine	Active	3.00	0.5	8	12.00	E	$2.88	$2.88		$34.52
Electrician	Active	1.00	0.5	8	4.00	L	$45.23	$0.00		$180.92
Carpenters, Journeyman	Active	12.00	0.5	8	48.00	L	$65.37	$0.00		$3,137.76
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.5	8	8.00	E	$111.64	$111.64		$893.12
Loader, FE Rubber Tire (8.6cy)	Active	2.00	0.5	8	8.00	E	$221.50	$221.50		$1,772.00
Truck Driver (heavy)	Active	2.00	0.5	8	8.00	L	$57.59	$0.00		$460.72
	Active	2.00	0.5	8	8.00	E	$36.58	$36.58		$292.64
				Labor Hours	140			TOTAL LABOR		$8,144.93
				Equipment Hours	44			TOTAL EQUIPMENT		$6,188.28

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$814.49	$814.49
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00
					TOTAL MATERIAL	$2,514.49

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.98	ton	1.000	0.98	$595.00	$580.13
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	3.90	mile	1.000	3.90	$7.25	$28.28
					TOTAL SUBCONTRACTS	$608.40

SUMMARY OF COSTS

Labor Cost	$8,144.93	Labor Burden @	49.7%	$0.00	$8,144.93
Material Cost	$2,514.49	Material Tax @	7.8%	$194.87	$2,709.37
Equipment Cost	$6,188.28	Equipment Tax @	0.0%	$0.00	$6,188.28
Subcontractors	$608.40				$608.40
DIRECT COST SUBTOTALS	$17,456			$195	DIRECT COST SUBTOTALS $17,651

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$17,042.58	$2,556.39
Installing Contractors Profit@	8.0%				$17,042.58	$1,363.41
GC Markup on Subs @	5.0%				$608.40	$30.42
					TOTAL MARKUP COSTS	$3,950.21
General Contractors Insurance @	1.0%		on		$21,601.19	$216
Bond @	1.0%		on		$21,601.19	$216
Contingency @	0.0%		on		$22,033.22	$0
					TOTAL COST for pay item	$22,033

Additional Pay Item Notes :

Assumed the process of removing pipes, expansion joints and support rings encased in concrete is done in around 20 days by 3 crew formed of 1 foreman, 4 journeymen, 4 steelworkers ;6 equipment operators 1 for each excavator, crane and loader. We dispose pipes with 1 trucks per day for each crew. Assumed contains paint with heavy metals 10% of the total lbs, 36 miles from Copco lake to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, excavator and welding machine.

PAY ITEM COST DETAIL WORKSHEET | **3.073 Remove & Dispose of 2 - 138" Butterfly valves**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	3.073	**Project**	: COPCO 2		
Description	:	Remove & Dispose of 2 - 138" Butterfly valves				
Quantity	:	148,000.00 LBS				
Daily Production	:	25,000.00 LBS per 8 hour shift	**Project #**	: Klamath Dams Removal		
Work Days	:	5.9 Days	**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost** / **Unit Price Per LBS**
Unit Price	:	$0.88 per LBS	**Probable Low Cost Parameter**		**30000**	**$103,925** / **$0.70**
Total Cost	:	$129,906	**Probable High Cost Parameter**		**20000**	**$155,888** / **$1.05**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	5.9	8	94.40	L	$46.27	$0.00		$4,367.89
Steelworker	Active	4.00	5.9	8	188.80	L	$65.52	$0.00		$12,370.18
Laborer	Active	4.00	5.9	8	188.80	L	$45.80	$0.00		$8,647.04
Crawler Crane (90tn)	Active	1.00	5.9	8	47.20	E	$208.09	$208.09		$9,821.85
Carpenters, Journeyman	Active	4.00	5.9	8	188.80	L	$65.37	$0.00		$12,341.86
Welder	Active	2.00	5.9	8	94.40	L	$7.84	$0.00		$739.86
Gas Welding Machine	Active	2.00	5.9	8	94.40	E	$2.88	$2.88		$271.59
Truck Driver (heavy)	Active	2.00	5.9	8	94.40	L	$57.59	$0.00		$5,436.50
Equipment Operator (crane)	Active	1.00	5.9	8	47.20	L	$68.41	$0.00		$3,228.95
				Labor Hours	**896.8**				**TOTAL LABOR**	**$47,132.27**
				Equipment Hours	**141.6**				**TOTAL EQUIPMENT**	**$10,093.44**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, electrodes, drill bits, etc)	1.00	LS	1.000	1.00	$7,069.84	$7,069.84
					TOTAL MATERIAL	**$7,069.84**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit	Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	74.00	ton	1.000	74.00	$595.00	$44,030.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	180.00	mile	1.000	180.00	$7.25	$1,305.00
					TOTAL SUBCONTRACTS	**$45,335.00**

SUMMARY OF COSTS

Labor Cost	$47,132.27	Labor Burden @	49.7%	$0.00		$47,132.27
Material Cost	$7,069.84	Material Tax @	7.8%	$547.91		$7,617.75
Equipment Cost	$10,093.44	Equipment Tax @	0.0%	$0.00		$10,093.44
Subcontractors	$45,335.00					$45,335.00
DIRECT COST SUBTOTALS	**$109,631**			**$548**	**DIRECT COST SUBTOTALS**	**$110,178**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$64,843.46		$9,726.52
Installing Contractors Profit@	8.0%				$64,843.46		$5,187.48
GC Markup on Subs @	5.0%				$45,335.00		$2,266.75
						TOTAL MARKUP COSTS	**$17,180.75**
General Contractors Insurance @	1.0%		on		$127,359.20		$1,274
Bond @	1.0%		on		$127,359.20		$1,274
Contingency @	0.0%		on		$129,906.39		$0
						TOTAL COST for pay item	**$129,906**

Additional Pay Item Notes :

Assumed the process of removing 138" butterfly valves is done in around 6 days by 2 crew formed of 1 foreman, 2 journeymen, 2 steelworkers ;We dispose cradles with 1 trucks per day for each crew. Assumed contains paint with heavy metals 100% of the total lbs, 36 miles from Copco lake to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, excavator and welding machine.

PAY ITEM INFORMATION

PAY ITEM NUMBER :	4.001	**Project** : Iron Gate				
Description :	Furnish, Install, and Remove Barge-Mounted Crane in Reservoir					
Quantity :	1.00 ls					
Daily Production :	0.10 ls per 8 hour shift	**Project #** : 4				
Work Days :	10.0 Days	**Estimator** : Michael Barba		**ls per**	**Total Cost**	**Unit Price Per ls**
Unit Price :	$191,823.14 per ls	**Probable Low Cost Parameter**		**0.11**	**$172,641**	**$172,640.83**
Total Cost :	$191,823	**Probable High Cost Parameter**		**0.085**	**$220,597**	**$220,596.61**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Barge (400T)	Active	1.00	10.0	8	80.00	E	$99.50	incl. in rate	incl. in rate	$7,960.00
Crawler Crane (130tn)	Active	1.00	10.0	8	80.00	E	$258.66	incl. in rate	incl. in rate	$20,692.80
Crawler Crane (270tn)	Active	1.00	10.0	8	80.00	E	$399.50	incl. in rate	incl. in rate	$31,960.00
Tugboat (250hp)	Active	1.00	10.0	8	80.00	E	$88.74	incl. in rate	incl. in rate	$7,099.20
Equipment Operator (crane)	Active	2.00	10.0	8	160.00	L	$68.41	incl. in rate	incl. in rate	$10,945.60
Equipment Operator (oiler)	Active	2.00	10.0	8	160.00	L	$62.94	incl. in rate	incl. in rate	$10,070.40
Tugboat Captain	Active	1.00	10.0	8	80.00	L	$67.76	incl. in rate	incl. in rate	$5,420.80
Tugboat Hand	Active	1.00	10.0	8	80.00	L	$45.80	incl. in rate	incl. in rate	$3,664.00
Laborer	Active	2.00	10.0	8	160.00	L	$45.80	incl. in rate	incl. in rate	$7,328.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
				Labor Hours	**640**				**TOTAL LABOR**	**$37,428.80**
				Equipment Hours	**320**				**TOTAL EQUIPMENT**	**$67,712.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Barge Rental 3 months	3.00	months	1.000	3.00	$9,600.00	$28,800.00
Tug Boat Rental 3 months	3.00	months	1.000	3.00	$3,550.00	$10,650.00
		ea	1.000	0.00	$0.00	$0.00
		ea	1.000	0.00	$0.00	$0.00
		ls	1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$39,450.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$37,428.80	Labor Burden @	49.7%	$0.00		$37,428.80
Material Cost	$39,450.00	Material Tax @	7.75%	$3,057.38		$42,507.38
Equipment Cost	$67,712.00	Equipment Tax @	7.75%	$5,247.68		$72,959.68
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$144,591**			**$8,305**	**DIRECT COST SUBTOTALS**	**$152,896**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$152,895.86		$22,934.38
Installing Contractors Profit@	8.0%				$152,895.86		$12,231.67
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$35,166.05**
General Contractors Insurance @	1.0%		on		$188,061.90		$1,881
Bond @	1.0%		on		$188,061.90		$1,881
Contingency @	0.0%		on		$191,823.14		$0
						TOTAL COST for pay item	**$191,823**

Additional Pay Item Notes :

270 tn Crane is to lift 130 tn crane onto and off of barge. 10 work days total.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.002	**Project**	: Iron Gate		
Description	:	Furnish, Install, and Remove Temporary Air Vent Hose from Barge to Diversion Tunnel Intake Structure				
Quantity	:	50.00 LS				
Daily Production	:	50.00 LS per 8 hour shift	**Project #**	: 4		
Work Days	:	1.0 Days	**Estimator**	: Eric Jones	**LS per**	**Total Cost**	**Unit Price Per LS**
Unit Price	:	$315.45 per LS	**Probable Low Cost Parameter**	**57.5**	**$13,407**	**$268.13**
Total Cost	:	$15,773	**Probable High Cost Parameter**	**40**	**$18,927**	**$378.54**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	1.0	8.00	16.00	L	$48.27	incl. in rate	incl. in rate	$772.32
Laborer	Active	8.00	1.0	8.00	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Equipment Operator (medium)	Active	2.00	1.0	8.00	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Truck Driver (heavy)	Active	1.00	1.0	8.00	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Air Compressor 900 cfm	Active	1.00	1.0	8.00	8.00	E	$38.87	incl. in rate	incl. in rate	$310.95
Air Compressor 600 cfm	Active	1.00	1.0	8.00	8.00	E	$21.74	incl. in rate	incl. in rate	$173.91
Air Tool, Chipping Hammer	Active	4.00	1.0	8.00	32.00	E	$1.64	incl. in rate	incl. in rate	$52.45
Generator, Small Generator, 10 - 15 kW	Active	2.00	1.0	8.00	16.00	E	$7.04	incl. in rate	incl. in rate	$112.64
Hydraulic Excavator (2.5cy)	Active	2.00	1.0	8.00	16.00	E	$203.63	incl. in rate	incl. in rate	$3,258.08
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	1.0	8.00	8.00	E	$62.72	incl. in rate	incl. in rate	$501.76
Hydraulic Thumbs/Shear Attachment	Active	1.00	1.0	8.00	8.00	E	$16.39	incl. in rate	incl. in rate	$131.12
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8.00	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	**104**				**TOTAL LABOR**	**$5,224.72**
				Equipment Hours	**104**				**TOTAL EQUIPMENT**	**$5,434.03**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
	1.00	LS	1.000	1.00	$261.24	$261.24
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$261.24**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	1	EA	**Cost per Mob**	$2,500.00	$2,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$2,500.00**

SUMMARY OF COSTS

Labor Cost	$5,224.72	Labor Burden @		0.0%	$0.00	Included in hourly labor rate.	$5,224.72
Material Cost	$261.24	Material Tax @		7.75%	$20.25		$281.48
Equipment Cost	$5,434.03	Equipment Tax @		7.75%	$421.14		$5,855.17
Subcontractors	$2,500.00						$2,500.00
DIRECT COST SUBTOTALS	**$13,420**				**$441**	**DIRECT COST SUBTOTALS**	**$13,861**
		Crew	**Material**	**Subs**	**Cost Basis**		
Installing Contractors Overhead@	5.0%				$11,361.37		$568.07
Installing Contractors Profit@	8.0%				$11,361.37		$908.91
GC Markup on Subs @	5.0%				$2,500.00		$125.00
						TOTAL MARKUP COSTS	**$1,601.98**
General Contractors Insurance @	1.0%			on	$15,463.35		$155
Bond @	1.0%			on	$15,463.35		$155
Contingency @	0.0%			on	$15,772.62		$0
						TOTAL COST for pay item	**$15,773**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposable site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET **4.003 Remove Reinforced Concrete Ring Located D/S of Closure Gate and U/S for Flap Gate**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.003		Project	: Iron Gate			
Description	:	Remove Reinforced Concrete Ring Located D/S of Closure Gate and U/S for Flap Gate						
Quantity	:	46.00	CY					
Daily Production	:	9.25	CY per 8 hour shift	Project #	: 4			
Work Days	:	5.0	Days	Estimator	: Eric Jones	CY per	Total Cost	Unit Price Per CY
Unit Price	:	$1,012.49	per CY	Probable Low Cost Parameter		10.6375	$39,589	$860.62
Total Cost	:	$46,575		Probable High Cost Parameter		6.9375	$58,218	$1,265.62

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	5.0	8	40.00	L	$48.27	incl. in rate	incl. in rate	$1,930.80
Laborer	Active	4.00	5.0	8	160.00	L	$45.80	incl. in rate	incl. in rate	$7,328.00
Equipment Operator (medium)	Active	1.00	5.0	8	40.00	L	$66.28	incl. in rate	incl. in rate	$2,651.20
Truck Driver (heavy)	Active	1.00	5.0	8	40.00	L	$57.59	incl. in rate	incl. in rate	$2,303.60
Equipment Operator (crane)	Active	1.00	5.0	*8*	40.00	L	$68.41	incl. in rate	incl. in rate	$2,736.40
Air Tool, Chipping Hammer	Active	4.00	5.0	*8*	160.00	E	$1.64	incl. in rate	incl. in rate	$262.25
Crawler Crane (130tn)	Active	1.00	5.0	*8*	40.00	E	$258.66	incl. in rate	incl. in rate	$10,346.40
Air Compressor 600 cfm	Active	2.00	5.0	*8*	80.00	E	$21.74	incl. in rate	incl. in rate	$1,739.11
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	5.0	*8*	40.00	E	$111.64	incl. in rate	incl. in rate	$4,465.60
Loader, FE Rubber Tire (5.25cy)	Active	1.00	5.0	*8*	40.00	E	$75.42	incl. in rate	incl. in rate	$3,016.80
0	Active	4.00	5.0	8	160.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	2.00	5.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
Crane Bucket (Loading DEMO Material)	Active	1.00	5.0	*8*	40.00	E	$6.15	incl. in rate	incl. in rate	$246.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
				Labor Hours	**320**				**TOTAL LABOR**	**$16,950.00**
				Equipment Hours	**400**				**TOTAL EQUIPMENT**	**$20,076.16**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (10% labor)	1.00	LS	1.000	1.00	$1,695.00	$1,695.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$1,695.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA	**Cost per Mob**	$2,500.00	$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$16,950.00	Labor Burden @		0.0%	$0.00	Included in hourly labor rate.	$16,950.00
Material Cost	$1,695.00	Material Tax @		7.75%	$131.36		$1,826.36
Equipment Cost	$20,076.16	Equipment Tax @		7.75%	$1,555.90		$21,632.06
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	**$38,721**				**$1,687**	**DIRECT COST SUBTOTALS**	**$40,408**
		Crew	**Material**	**Subs**	**Cost Basis**		
Installing Contractors Overhead@	5.0%				$40,408.42		$2,020.42
Installing Contractors Profit@	8.0%				$40,408.42		$3,232.67
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$5,253.10**
General Contractors Insurance @	1.0%			on	$45,661.52		$457
Bond @	1.0%			on	$45,661.52		$457
Contingency @	0.0%			on	$46,574.75		$0
						TOTAL COST for pay item	**$46,575**

Additional Pay Item Notes :

This work will conducted in dry using chipping hammers, Demolished material will be loaded in crane bucket and loaded into trucks. Material will have to be moved down diversion tunnel. This operation will take a week due to the location of the collar and tghe limited space to move materials

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.004	Project	: Iron Gate			
Description	: Remove Reinforced Concrete Stoplog Structure					
Quantity	: 6.00 CY					
Daily Production	: 6.00 CY per 8 hour shift	Project #	: 4			
Work Days	: 1.0 Days	Estimator	: Eric Jones	CY per	Total Cost	Unit Price Per CY
Unit Price	: $1,738.55 per CY	Probable Low Cost Parameter		6.6	$9,388	$1,564.69
Total Cost	: $10,431	Probable High Cost Parameter		5.1	$11,996	$1,999.33

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	incl. in rate	incl. in rate	$386.16
Laborer	Active	3.00	1.0	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Hydraulic Excavator (5.0cy)	Active	2.00	1.0	8	16.00	E	$274.63	incl. in rate	incl. in rate	$4,394.08
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	1.0	8	8.00	E	$62.72	incl. in rate	incl. in rate	$501.76
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	1.0	8	8.00	E	$70.35	incl. in rate	incl. in rate	$562.80
0	Active	1.00	1.0	8	8.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	1.0	8	8.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	4.00	1.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	4.00	1.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	2.00	1.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
			1.0	8	0.00					$0.00
				Labor Hours	56				TOTAL LABOR	$3,006.56
				Equipment Hours	32				TOTAL EQUIPMENT	$5,458.64

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$150.33	$150.33
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	$150.33

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA	Cost per Mob	$2,500.00	$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$3,006.56	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$3,006.56
Material Cost	$150.33	Material Tax @	7.75%	$11.65		$161.98
Equipment Cost	$5,458.64	Equipment Tax @	7.75%	$423.04		$5,881.68
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$8,616			$435	DIRECT COST SUBTOTALS	$9,050

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	5.0%				$9,050.22		$452.51
Installing Contractors Profit@	8.0%				$9,050.22		$724.02
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$1,176.53
General Contractors Insurance @	1.0%			on	$10,226.75		$102
Bond @	1.0%			on	$10,226.75		$102
Contingency @	0.0%			on	$10,431.29		$0
						TOTAL COST for pay item	$10,431

Additional Pay Item Notes :

This work will be done using 2 excavators, 1 with a breaker and 1 with a bucket for loading the demolished material. The material will be loaded in 1 12CY dump truck and sent to dump site. Laborers will be used to flag and direct equipment and trucks. Foreman will be running the operation.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.005		Project	: Iron Gate			
Description	: Remove Water from behind Tailrace Cofferdam						
Quantity	: 300,000.00	GAL					
Daily Production	: 153,120.00	GAL per 8 hour shift	Project #	: 4			
Work Days	: 2.0	Days	Estimator	: Eric Jones	GAL per	Total Cost	Unit Price Per GAL
Unit Price	: $0.01	per GAL	Probable Low Cost Parameter		176088	$2,662	$0.01
Total Cost	: $3,132		Probable High Cost Parameter		130152	$3,602	$0.01

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.0	8	16.00	L	$48.27	incl. in rate	incl. in rate	$772.32
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Truck, Pickup (4x4, 3/4tn)	Active	1.00	2.0	8	16.00	E	$16.94	incl. in rate	incl. in rate	$271.04
Pump, Submersible Trash Pump, 3" & 4"	Active	1.00	2.0	8	16.00	E	$3.87	incl. in rate	incl. in rate	$61.92
0	Active	1.00	1.0	8	8.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	4.00	2.0	8	64.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	4.00	2.0	8	64.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	2.00	2.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
			2.0	8	0.00					$0.00
				Labor Hours	48				TOTAL LABOR	$2,237.92
				Equipment Hours	32				TOTAL EQUIPMENT	$332.96

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$111.90	$111.90
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	$111.90

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		EA	Cost per Mob	$2,500.00	$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,237.92	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$2,237.92
Material Cost	$111.90	Material Tax @	7.75%	$8.67		$120.57
Equipment Cost	$332.96	Equipment Tax @	7.75%	$25.80		$358.76
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$2,683			$34	DIRECT COST SUBTOTALS	$2,717

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	5.0%				$2,717.25	$135.86
Installing Contractors Profit@	8.0%				$2,717.25	$217.38
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$353.24
General Contractors Insurance @	1.0%		on		$3,070.50	$31
Bond @	1.0%		on		$3,070.50	$31
Contingency @	0.0%		on		$3,131.91	$0
					TOTAL COST for pay item	$3,132

Additional Pay Item Notes :

Truck to drive pump to position laborers to place pump and run discharge hoses. The pump will take 2 shifts to dewater 300,000 gals of water and a crew will need to be there the whole time to adjust the pump as the water level changes.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.006	Project	: IRONGATE			
Description	:	Provide Dewatering behind Tailrace Cofferdam for removal of Powerhouse in the dry					
Quantity	:	3,000,000.00 GAL					
Daily Production	:	96,000.00 GAL per 8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	31.3 Days	Estimator	: Mihaela Tomulescu	GAL per	Total Cost	Unit Price Per GAL
Unit Price	:	$0.01 per GAL	Probable Low Cost Parameter		110400	$25,044	$0
Total Cost	:	$29,463	Probable High Cost Parameter		81600	$33,882	$0

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Pump, Centrifugal, 3"	Active	1.00	31.3	8	250.40	E	$2.76	incl. in rate	incl. in rate	$690.02
Electrician	Active	1.00	31.3	8	250.40	L	$45.23	incl. in rate	incl. in rate	$11,325.59
Laborer	Active	1.00	31.3	8	250.40	L	$45.80	incl. in rate	incl. in rate	$11,468.32
				Labor Hours	500.8				TOTAL LABOR	$22,793.91
				Equipment Hours	250.4				TOTAL EQUIPMENT	$690.02

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

Labor Cost	$22,793.91	Labor Burden @	49.7%	$0.00		$22,793.91
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$690.02	Equipment Tax @	0.0%	$0.00		$690.02
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$23,484			$0	DIRECT COST SUBTOTALS	$23,484

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$23,483.93		$3,522.59
Installing Contractors Profit@	8.0%				$23,483.93		$1,878.71
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$5,401.30
General Contractors Insurance @	1.0%			on	$28,885.24		$289
Bond @	1.0%			on	$28,885.24		$289
Contingency @	0.0%			on	$29,462.94		$0
						TOTAL COST for pay item	$29,463

Additional Pay Item Notes :

Assumed 3 Mil gal of water to be pumped out. Dewatering, pumping 8 hours, attended 2 hrs per day, 3" diaphragm pump, includes 20 LF of suction hose and 100 LF of discharge hose. Assumed Maximum Flow 200 GPM

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.007		Project	: Iron Gate			
Description	:	Construct Embankment Cofferdam across Tailrace to remove Powerhouse						
Quantity	:	1,650.00	cy					
Daily Production	:	250.00	cy per 8 hour shift	Project #	: 4			
Work Days	:	6.6	Days	Estimator	: Michael Barba	cy per	Total Cost	Unit Price Per cy
Unit Price	:	$112.09	per cy	Probable Low Cost Parameter		275	$166,451	$100.88
Total Cost	:	$184,946		Probable High Cost Parameter		212.5	$212,687	$128.90

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (235hp)(CATD7)	Active	1.00	6.6	8	52.80	E	$165.11	incl. in rate	incl. in rate	$8,717.81
Truck, On-Highway Dump (6x4, 12cy)	Active	4.00	6.6	8	211.20	E	$70.35	incl. in rate	incl. in rate	$14,857.92
Hydraulic Excavator (5.0cy)	Active	1.00	***4.6***	8	36.80	E	$274.63	incl. in rate	incl. in rate	$10,106.38
Truck, Pickup (4x4, 3/4tn)	Active	1.00	6.6	8	52.80	E	$16.94	incl. in rate	incl. in rate	$894.43
Crawler Crane (130tn)	Active	1.00	***2.0***	8	16.00	E	$258.66	incl. in rate	incl. in rate	$4,138.56
Equipment Operator (medium)	Active	2.00	6.6	8	105.60	L	$66.28	incl. in rate	incl. in rate	$6,999.17
Labor Foreman (out)	Active	1.00	6.6	8	52.80	L	$46.27	incl. in rate	incl. in rate	$2,443.06
Truck Driver (heavy)	Active	4.00	6.6	8	211.20	L	$57.59	incl. in rate	incl. in rate	$12,163.01
Equipment Operator (crane)	Active	1.00	***2.0***	8	16.00	L	$68.41	incl. in rate	incl. in rate	$1,094.56
		1.00	6.6	8	52.80	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	6.6	8	52.80	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	6.6	8	52.80	0	$0.00	incl. in rate	incl. in rate	$0.00
			6.6	8	0.00					$0.00
			6.6	8	0.00					$0.00
			6.6	8	0.00					$0.00
			6.6	8	0.00					$0.00
			6.6	8	0.00					$0.00
				Labor Hours	**385.6**				**TOTAL LABOR**	**$22,699.79**
				Equipment Hours	**369.6**				**TOTAL EQUIPMENT**	**$38,715.10**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		cy	1.300	0.00	$25.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Cofferdam Sheet Piling Drive and Extract	3,900	SF	**RSMs Data**	$24.93	$97,227.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$97,227.00**

SUMMARY OF COSTS

Labor Cost	$22,699.79	Labor Burden @	49.7%	$0.00			$22,699.79
Material Cost	$0.00	Material Tax @	7.75%	$0.00			$0.00
Equipment Cost	$38,715.10	Equipment Tax @	7.75%	$3,000.42			$41,715.52
Subcontractors	$97,227.00						$97,227.00
DIRECT COST SUBTOTALS	**$158,642**			**$3,000**		**DIRECT COST SUBTOTALS**	**$161,642**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$64,415.32		$9,662.30
Installing Contractors Profit@	8.0%				$64,415.32		$5,153.23
GC Markup on Subs @	5.0%				$97,227.00		$4,861.35
						TOTAL MARKUP COSTS	**$19,676.87**
General Contractors Insurance @	1.0%			on	$181,319.19		$1,813
Bond @	1.0%			on	$181,319.19		$1,813
Contingency @	0.0%			on	$184,945.57		$0
						TOTAL COST for pay item	**$184,946**

Additional Pay Item Notes :

Figuring 4 trucks hauling material for 7 days, which would be 8 loads per truck each day, Laborers will direct trucks and support equipement, Foreman with truck will oversee operation. Dozer will push material is support from excavator. Sheet piling will be installed due to high flow of the river. Backfill material from dam excavation will be used behide sheet pile. Sheetpile will be 25' long 8' to 10' will be driven into river bed.

PAY ITEM INFORMATION

PAY ITEM NUMBER :	4.01	Project : Iron Gate				
Description :	Upstream Cofferdam to be Removed in the Wet					
Quantity :	20,000.00 cy					
Daily Production :	2,000.00 cy per 8 hour shift	Project # : 4				
Work Days :	10.0 Days	Estimator : Michael Barba		cy per	Total Cost	Unit Price Per cy
Unit Price :	$14.70 per cy	Probable Low Cost Parameter		2300	$249,910	$12.50
Total Cost :	$294,012	Probable High Cost Parameter		1700	$338,114	$16.91

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	2.00	10.0	8	160.00	E	$274.63	incl. in rate	incl. in rate	$43,940.80
Truck, Off-Road, Articulated Rear, 20cy	Active	8.00	10.0	8	640.00	E	$111.64	incl. in rate	incl. in rate	$71,449.60
Dozer (235hp)(CATD7)	Active	2.00	10.0	8	160.00	E	$165.11	incl. in rate	incl. in rate	$26,417.60
Truck, Pickup (4x4, 3/4tn)	Active	1.00	10.0	8	80.00	E	$16.94	incl. in rate	incl. in rate	$1,355.20
Truck Driver (heavy)	Active	8.00	10.0	8	640.00	L	$57.59	incl. in rate	incl. in rate	$36,857.60
Labor Foreman (out)	Active	1.00	10.0	8	80.00	L	$46.27	incl. in rate	incl. in rate	$3,701.60
Laborer	Active	5.00	10.0	8	400.00	L	$45.80	incl. in rate	incl. in rate	$18,320.00
Equipment Operator (medium)	Active	4.00	10.0	8	320.00	L	$66.28	incl. in rate	incl. in rate	$21,209.60
0	Active	1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	10.0	8	80.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
				Labor Hours	1440				TOTAL LABOR	$80,088.80
				Equipment Hours	1040				TOTAL EQUIPMENT	$143,163.20

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.300	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$80,088.80	Labor Burden @	49.7%	$0.00		$80,088.80
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$143,163.20	Equipment Tax @	7.75%	$11,095.15		$154,258.35
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$223,252			$11,095	DIRECT COST SUBTOTALS	$234,347

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$234,347.15		$35,152.07
Installing Contractors Profit@	8.0%				$234,347.15		$18,747.77
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$53,899.84
General Contractors Insurance @	1.0%			on	$288,246.99		$2,882
Bond @	1.0%			on	$288,246.99		$2,882
Contingency @	0.0%			on	$294,011.93		$0
						TOTAL COST for pay item	$294,012

Additional Pay Item Notes :

Figuring this cofferdam will be removed once reservoir is drawn down, which will allow access for equipment to remove the coffer dam in the wet using excavators and dozer equipment.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.011		Project	: IRON GATE		
Description	:	Remove 9' dia. hinged blind flange					
Quantity	:	19,000.00 lbs					
Daily Production	:	2,000.00 lbs per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	:	9.5 Days		Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$6.49 per lbs		Probable Low Cost Parameter		2300	$104,866	$5.52
Total Cost	:	$123,371		Probable High Cost Parameter		1600	$148,046	$7.79

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	9.5	8	76.00	L	$48.27	incl. in rate	incl. in rate	$3,668.52
Steelworker	Active	4.00	9.5	8	304.00	L	$65.52	incl. in rate	incl. in rate	$19,918.08
Loader, FE Rubber Tire (8.6cy)	Active	2.00	9.5	8	152.00	E	$221.50	incl. in rate	incl. in rate	$33,668.00
Equipment Operator (medium)	Active	2.00	9.5	8	152.00	L	$66.28	incl. in rate	incl. in rate	$10,074.56
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	9.5	8	152.00	E	$31.90	incl. in rate	incl. in rate	$4,848.80
Truck Driver (heavy)	Active	2.00	9.5	8	152.00	L	$57.59	incl. in rate	incl. in rate	$8,753.68
Hydraulic Crane (17tn)	Active	1.00	9.5	8	76.00	E	$81.52	incl. in rate	incl. in rate	$6,195.52
Welder	Active	1.00	9.5	8	76.00	L	$7.84	incl. in rate	incl. in rate	$595.65
Gas Welding Machine	Active	1.00	9.5	8	76.00	E	$2.88	incl. in rate	incl. in rate	$218.65
Equipment Operator (crane)	Active	1.00	9.5	8	76.00	L	$68.41	incl. in rate	incl. in rate	$5,199.16
				Labor Hours	836				TOTAL LABOR	$48,209.65
				Equipment Hours	456				TOTAL EQUIPMENT	$44,930.97

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$4,820.97	$4,820.97
					TOTAL MATERIAL	$4,820.97

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$48,209.65	Labor Burden @	49.7%	$0.00	$48,209.65
Material Cost	$4,820.97	Material Tax @	7.8%	$373.62	$5,194.59
Equipment Cost	$44,930.97	Equipment Tax @	0.0%	$0.00	$44,930.97
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$97,962			$374	DIRECT COST SUBTOTALS $98,335

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$98,335.21	$14,750.28
Installing Contractors Profit@	8.0%				$98,335.21	$7,866.82
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$22,617.10
General Contractors Insurance @	1.0%			on	$120,952.31	$1,210
Bond @	1.0%			on	$120,952.31	$1,210
Contingency @	0.0%			on	$123,371.36	$0
					TOTAL COST for pay item	$123,371

Additional Pay Item Notes :

Turning of the actuating bolts and nuts - accomplished by steelworker / weder crew using only standard hand tools - spreads the yoke halves until they are fully separated, allowing the head to be swung open on its hinge. Contact surfaces of the clamping yokes, head and hub are tapered and when the head is closed and the yoke bolts are tightened, the head and hub are wedged together, compressing the 0-ring and effecting a leakproof seal. Removing flanges is cumbersome and time consuming because of the tunnel work and the rusted fasteners. There is need to tug or hammer at bulky flanges or to struggle with bulky lugs and threads. Using loader, crane to load the flange and associated metal work in the truck. Included 5' of pipe spool.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.012	Project	: Iron Gate		
Description	: Remove 18" plug valve and 7' of 18" drainage pipe				
Quantity	: 2,620.00 LBS				
Daily Production	: 2,620.00 LBS per 8 hour shift	Project #	: 4		
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu		
			LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $2.70 per LBS	Probable Low Cost Parameter	3013	$6,002	$2.29
Total Cost	: $7,061	Probable High Cost Parameter	2096	$8,473	$3.23

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Trencher	Active	2.00	1.0	8	16.00	E	$4.07	incl. in rate	incl. in rate	$65.12
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Hydraulic Crane (17tn)	Active	1.00	1.0	8	8.00	E	$81.52	incl. in rate	incl. in rate	$652.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Hydraulic Excavator (1.5cy)	Active	1.00	1.0	8	8.00	E	$141.92	incl. in rate	incl. in rate	$1,135.36
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	incl. in rate	incl. in rate	$1,048.32
				Labor Hours	40				TOTAL LABOR	$2,586.56
				Equipment Hours	40				TOTAL EQUIPMENT	$2,745.76

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$274.58	$274.58
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$274.58

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,586.56	Labor Burden @	49.7%	$0.00		$2,586.56
Material Cost	$274.58	Material Tax @	7.8%	$21.28		$295.86
Equipment Cost	$2,745.76	Equipment Tax @	0.0%	$0.00		$2,745.76
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$5,607			$21	DIRECT COST SUBTOTALS	$5,628

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,628.18	$844.23
Installing Contractors Profit@	8.0%				$5,628.18	$450.25
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,294.48
General Contractors Insurance @	1.0%		on		$6,922.66	$69
Bond @	1.0%		on		$6,922.66	$69
Contingency @	0.0%		on		$7,061.11	$0
					TOTAL COST for pay item	$7,061

Additional Pay Item Notes :

This is tunnel work. Assumed 7' ductile iron 18" pipe at 78.5LBS /LF= 550 LBS, weight of the valve assumed API 600 gate valve for 18" is 2070 LBS.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.013 (1)		Project	: IRON GATE
Description	: Furnish and Install 1-16.5'x18' roller gate, stem, and operator in Wet			
Quantity	: 110,000.00 LBS			
Daily Production	: 4,400.00 LBS per 8 hour shift		Project #	: 4
Work Days	: 25.0 Days		Estimator	: Mihaela Tomulescu
Unit Price	: $34.16 per LBS			
Total Cost	: $3,757,547			

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	4840	$3,381,793	$31
Probable High Cost Parameter	3960	$4,133,302	$38

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Equipment Operator (crane)	Active	1.00	25.0	8	200.00	L	$68.41	incl. in rate	incl. in rate	$13,682.00
Barge Operator	Active	1.00	25.0	8	200.00	L	$40.30	incl. in rate	incl. in rate	$8,060.00
Diver, Tender	Active	3.00	25.0	8	600.00	L	$79.22	incl. in rate	incl. in rate	$47,532.00
Diver, Wet	Active	3.00	25.0	8	600.00	L	$124.57	incl. in rate	incl. in rate	$74,742.00
Loader, FE Rubber Tire (8.6cy)	Active	1.00	25.0	8	200.00	E	$221.50	incl. in rate	incl. in rate	$44,300.00
Crawler Crane (270tn)	Active	1.00	25.0	8	200.00	E	$399.50	incl. in rate	incl. in rate	$79,900.00
Equipment Operator (medium)	Active	3.00	25.0	8	600.00	L	$66.28	incl. in rate	incl. in rate	$39,768.00
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	25.0	8	400.00	E	$70.35	incl. in rate	incl. in rate	$28,140.00
Barge (400T)	Active	1.00	25.0	8	200.00	E	$99.50	incl. in rate	incl. in rate	$19,900.00
Ironworkers	Active	4.00	25.0	8	800.00	L	$63.95	incl. in rate	incl. in rate	$51,160.00
Labor Foreman	Active	1.00	25.0	8	200.00	L	$48.27	incl. in rate	incl. in rate	$9,654.00
				Labor Hours	3200				TOTAL LABOR	$244,598.00
				Equipment Hours	1000				TOTAL EQUIPMENT	$172,240.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Furnish one-16.5'x18' roller gate (based on quote from JM Works)	1.00	LS	1.000	1.00	$2,331,511.00	$2,331,511.00
Welding structural steel in field, cost per welder, 8# per ton, 1/8" dia, type 6011, incl 1 operating engineer	55.00	ton	1.000	55.00	$18.85	$1,036.75
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$24,459.80	$24,459.80
Misc Mats Allowance 1.5% of Gate Material	1.00	LS	1.000	1.00	$34,972.67	$34,972.67
						$0.00
						$0.00
					TOTAL MATERIAL	$2,391,980.22

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
	2.00	EA	1.000	2.00	$480.00	$960.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	$960.00

SUMMARY OF COSTS

Labor Cost	$244,598.00	Labor Burden @	49.7%	$0.00	$244,598.00
Material Cost	$2,391,980.22	Material Tax @	7.8%	$185,378.47	$2,577,358.68
Equipment Cost	$172,240.00	Equipment Tax @	0.0%	$0.00	$172,240.00
Subcontractors	$960.00				$960.00
DIRECT COST SUBTOTALS	$2,809,778			$185,378	DIRECT COST SUBTOTALS $2,995,157

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,994,196.68	$449,129.50
Installing Contractors Profit@	8.0%				$2,994,196.68	$239,535.73
GC Markup on Subs @	5.0%				$960.00	$48.00
					TOTAL MARKUP COSTS	$688,713.24
General Contractors Insurance @	1.0%			on	$3,683,869.92	$36,839
Bond @	1.0%			on	$3,683,869.92	$36,839
Contingency @	0.0%			on	$3,757,547.32	$0
					TOTAL COST for pay item	$3,757,547

Additional Pay Item Notes :

Based on RSMeans we used Crew L-5A for installation of the roller gate in 8 days. Added welding inspection tehnician for the installation of the gate. Price of the gate based on quote by Johnson Machine Works Inc.Amounts based on similar projects from the past and an actual design was not done. JMW also assumes that existing frames will be reused.

PAY ITEM INFORMATION

PAY ITEM NUMBER	4.013 (2)	Project	IRON GATE
Description	Remove Existing sluice and diversion gates from shaft by divers		
Quantity	110,000.00 LBS		
Daily Production	6,000.00 LBS per 8 hour shift	Project #	4
Work Days	18.3 Days	Estimator	Mihaela Tomulescu
Unit Price	$4.38 per LBS		
Total Cost	$482,328		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	6600	$434,095	$4
Probable High Cost Parameter	5400	$530,561	$5

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (80tn)	Active	2.00	18.3	8	292.80	E	$190.46	incl. in rate	incl. in rate	$55,766.69
Barge Operator	Active	1.00	18.3	8	146.40	L	$40.30	incl. in rate	incl. in rate	$5,899.92
Diver, Tender	Active	2.00	18.3	8	292.80	L	$79.22	incl. in rate	incl. in rate	$23,195.62
Diver, Wet	Active	2.00	18.3	8	292.80	L	$124.57	incl. in rate	incl. in rate	$36,474.10
Loader, FE Rubber Tire (8.6cy)	Active	1.00	18.3	8	146.40	E	$221.50	incl. in rate	incl. in rate	$32,427.60
Crawler Crane (270tn)	Active	2.00	18.3	8	292.80	E	$399.50	incl. in rate	incl. in rate	$116,973.60
Equipment Operator (light)	Active	2.00	18.3	8	292.80	L	$64.90	incl. in rate	incl. in rate	$19,002.72
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	18.3	8	292.80	E	$70.35	incl. in rate	incl. in rate	$20,598.48
Barge (400T)	Active	1.00	18.3	8	146.40	E	$99.50	incl. in rate	incl. in rate	$14,566.80
Ironworkers	Active	4.00	18.3	8	585.60	L	$63.95	incl. in rate	incl. in rate	$37,449.12
Labor Foreman	Active	1.00	18.3	8	146.40	L	$48.27	incl. in rate	incl. in rate	$7,066.73
				Labor Hours	1756.8				TOTAL LABOR	$129,088.20
				Equipment Hours	1171.2				TOTAL EQUIPMENT	$240,333.17

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Welding structural steel in field, cost per welder, 8# per ton, 1/8" dia, type 6011, incl 1 operating engineer	55.00	ton	1.000	55.00	$18.85	$1,036.75
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$12,908.82	$12,908.82
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$13,945.57

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$129,088.20	Labor Burden @	49.7%	$0.00		$129,088.20
Material Cost	$13,945.57	Material Tax @	7.8%	$1,080.78		$15,026.35
Equipment Cost	$240,333.17	Equipment Tax @	0.0%	$0.00		$240,333.17
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$383,367			$1,081	DIRECT COST SUBTOTALS	$384,448

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$384,447.72		$57,667.16
Installing Contractors Profit@	8.0%				$384,447.72		$30,755.82
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$88,422.98
General Contractors Insurance @	1.0%		on		$472,870.70		$4,729
Bond @	1.0%		on		$472,870.70		$4,729
Contingency @	0.0%		on		$482,328.11		$0
						TOTAL COST for pay item	$482,328

Additional Pay Item Notes :

Remove sluice and diversion gates from shaft by divers, based on RSMeans we used a crew of 4 divers for demolition in 10 days. Hauling to disposable site - based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, a welding machine and barge.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.013 (3)	Project	: IRON GATE		
Description	:	Remove 16.5'X 18' sluice and diversion gates from shaft in Dry				
Quantity	:	110,000.00 LBS				
Daily Production	:	12,000.00 LBS per 8 hour shift	Project #	: 4		
Work Days	:	9.2 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.58 per LBS	Probable Low Cost Parameter		13200	$57,794	$1
Total Cost	:	$64,216	Probable High Cost Parameter		10800	$70,637	$1

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Crawler Crane (130tn)	Active	1.00	9.2	8	73.60	E	$258.66	incl. in rate	incl. in rate	$19,037.38
Ironworkers	Active	4.00	9.2	8	294.40	L	$63.95	incl. in rate	incl. in rate	$18,826.88
Labor Foreman (out)	Active	1.00	9.2	8	73.60	L	$46.27	incl. in rate	incl. in rate	$3,405.47
Equipment Operator (crane)	Active	1.00	9.2	8	73.60	L	$68.41	incl. in rate	incl. in rate	$5,034.98
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
				Labor Hours	449.6				TOTAL LABOR	$27,728.05
				Equipment Hours	89.6				TOTAL EQUIPMENT	$21,064.58

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Welding structural steel in field, cost per welder, 8# per ton, 1/8" dia, type 6011, incl 1 operating engineer	6.00	ton	1.000	6.00	$18.85	$113.10
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$2,106.46	$2,106.46
					TOTAL MATERIAL	$2,219.56

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$27,728.05	Labor Burden @		49.7%	$0.00		$27,728.05
Material Cost	$2,219.56	Material Tax @		7.8%	$172.02		$2,391.57
Equipment Cost	$21,064.58	Equipment Tax @		0.0%	$0.00		$21,064.58
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$51,012				$172	DIRECT COST SUBTOTALS	$51,184

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$51,184.20		$7,677.63
Installing Contractors Profit@	8.0%				$51,184.20		$4,094.74
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$11,772.37
General Contractors Insurance @	1.0%			on	$62,956.56		$630
Bond @	1.0%			on	$62,956.56		$630
Contingency @	0.0%			on	$64,215.69		$0
						TOTAL COST for pay item	$64,216

Additional Pay Item Notes :

Based on RSMeans we used Crew L-5A for installation of the roller gate in 8 days. Added welding inspection tehnician for the installation of the gate. Price of the gate based on quote by Johnson Machine Works Inc.Amounts based on similar projects from the past and an actual design was not done. JMW also assumes that existing frames will be reused.

PAY ITEM COST DETAIL WORKSHEET

4.014 Remove Concrete in Observation Platform, Crest Wall and Wall Extension

PAY ITEM INFORMATION

PAY ITEM NUMBER :	4.014		**Project** : Iron Gate			
Description :	Remove Concrete in Observation Platform, Crest Wall and Wall Extension					
Quantity :	780.00	cy				
Daily Production :	50.00	cy per 8 hour shift	**Project #** : 4			
Work Days :	15.6	Days	**Estimator** : Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price :	$298.81	per cy	**Probable Low Cost Parameter**	**55**	**$209,765**	**$268.93**
Total Cost :	$233,072		**Probable High Cost Parameter**	**45**	**$256,379**	**$328.69**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	15.6	8	249.60	L	$48.27	incl. in rate	incl. in rate	$12,048.19
Laborer	Active	8.00	15.6	8	998.40	L	$45.80	incl. in rate	incl. in rate	$45,726.72
Equipment Operator (medium)	Active	2.00	15.6	8	249.60	L	$66.28	incl. in rate	incl. in rate	$16,543.49
Truck Driver (heavy)	Active	1.00	15.6	8	124.80	L	$57.59	incl. in rate	incl. in rate	$7,187.23
Air Compressor 900 cfm	Active	1.00	15.6	8	124.80	E	$38.87	incl. in rate	incl. in rate	$4,850.84
Air Compressor 600 cfm	Active	1.00	15.6	8	124.80	E	$21.74	incl. in rate	incl. in rate	$2,713.02
Air Tool, Chipping Hammer	Active	4.00	15.6	8	499.20	E	$1.64	incl. in rate	incl. in rate	$818.21
Generator, Small Generator, 10 - 15 kW	Active	2.00	15.6	8	249.60	E	$7.04	incl. in rate	incl. in rate	$1,757.18
Hydraulic Excavator (2.5cy)	Active	2.00	15.6	8	249.60	E	$203.63	incl. in rate	incl. in rate	$50,826.05
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	15.6	8	124.80	E	$62.72	incl. in rate	incl. in rate	$7,827.46
Hydraulic Thumbs/Shear Attachment	Active	1.00	15.6	8	124.80	E	$16.39	incl. in rate	incl. in rate	$2,045.47
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	15.6	8	124.80	E	$111.64	incl. in rate	incl. in rate	$13,932.67
			15.6	8	0.00					$0.00
			15.6	8	0.00					$0.00
			15.6	8	0.00					$0.00
			15.6	8	0.00					$0.00
			15.6	8	0.00					$0.00
				Labor Hours	**1,622**				**TOTAL LABOR**	**$81,505.63**
				Equipment Hours	**1,622**				**TOTAL EQUIPMENT**	**$84,770.90**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$4,075.28	$4,075.28
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$4,075.28**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	4	EA	**Cost per Mob**	$2,500.00	$10,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$10,000.00**

SUMMARY OF COSTS

Labor Cost	$81,505.63	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$81,505.63
Material Cost	$4,075.28	Material Tax @	7.75%	$315.83		$4,391.12
Equipment Cost	$84,770.90	Equipment Tax @	7.75%	$6,569.74		$91,340.64
Subcontractors	$10,000.00					$10,000.00
DIRECT COST SUBTOTALS	**$180,352**			**$6,886**	**DIRECT COST SUBTOTALS**	**$187,237**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$177,237.39	$26,585.61
Installing Contractors Profit@	8.0%				$177,237.39	$14,178.99
GC Markup on Subs @	5.0%				$10,000.00	$500.00
					TOTAL MARKUP COSTS	**$41,264.60**
General Contractors Insurance @	1.0%			on	$228,501.99	$2,285
Bond @	1.0%			on	$228,501.99	$2,285
Contingency @	0.0%			on	$233,072.03	$0
					TOTAL COST for pay item	**$233,072**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposal site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.015	**Project**	: Iron Gate			
Description	:	Remove Concrete in Diversion Tunnel Intake Structure					
Quantity	:	715.00 cy					
Daily Production	:	50.00 cy per 8 hour shift	**Project #**	: 4			
Work Days	:	14.3 Days	**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$300.06 per cy	**Probable Low Cost Parameter**		**55**	**$193,088**	**$270.05**
Total Cost	:	$214,542	**Probable High Cost Parameter**		**42.5**	**$246,723**	**$345.07**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	14.3	8	228.80	L	$48.27	incl. in rate	incl. in rate	$11,044.18
Laborer	Active	8.00	14.3	8	915.20	L	$45.80	incl. in rate	incl. in rate	$41,916.16
Equipment Operator (medium)	Active	2.00	14.3	8	228.80	L	$66.28	incl. in rate	incl. in rate	$15,164.86
Truck Driver (heavy)	Active	1.00	14.3	8	114.40	L	$57.59	incl. in rate	incl. in rate	$6,588.30
Air Compressor 900 cfm	Active	1.00	14.3	8	114.40	E	$38.87	incl. in rate	incl. in rate	$4,446.60
Air Compressor 600 cfm	Active	1.00	14.3	8	114.40	E	$21.74	incl. in rate	incl. in rate	$2,486.93
Air Tool, Chipping Hammer	Active	4.00	14.3	8	457.60	E	$1.64	incl. in rate	incl. in rate	$750.02
Generator, Small Generator, 10 - 15 kW	Active	2.00	14.3	8	228.80	E	$7.04	incl. in rate	incl. in rate	$1,610.75
Hydraulic Excavator (2.5cy)	Active	2.00	14.3	8	228.80	E	$203.63	incl. in rate	incl. in rate	$46,590.54
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	14.3	8	114.40	E	$62.72	incl. in rate	incl. in rate	$7,175.17
Hydraulic Thumbs/Shear Attachment	Active	1.00	14.3	8	114.40	E	$16.39	incl. in rate	incl. in rate	$1,875.02
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	14.3	8	114.40	E	$111.64	incl. in rate	incl. in rate	$12,771.62
			14.3	8	0.00					$0.00
			14.3	8	0.00					$0.00
			14.3	8	0.00					$0.00
			14.3	8	0.00					$0.00
			14.3	8	0.00					$0.00
				Labor Hours	**1,487**				**TOTAL LABOR**	**$74,713.50**
				Equipment Hours	**1,487**				**TOTAL EQUIPMENT**	**$77,706.66**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$3,735.67	$3,735.67
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$3,735.67**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	4	EA	**Cost per Mob**	$2,500.00	$10,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$10,000.00**

SUMMARY OF COSTS

Labor Cost	$74,713.50	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$74,713.50
Material Cost	$3,735.67	Material Tax @	7.75%	$289.51		$4,025.19
Equipment Cost	$77,706.66	Equipment Tax @	7.75%	$6,022.27		$83,728.92
Subcontractors	$10,000.00					$10,000.00
DIRECT COST SUBTOTALS	**$166,156**			**$6,312**	**DIRECT COST SUBTOTALS**	**$172,468**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$162,467.61	$24,370.14
Installing Contractors Profit@	8.0%				$162,467.61	$12,997.41
GC Markup on Subs @	5.0%				$10,000.00	$500.00
					TOTAL MARKUP COSTS	**$37,867.55**
General Contractors Insurance @	1.0%			on	$210,335.16	$2,103
Bond @	1.0%			on	$210,335.16	$2,103
Contingency @	0.0%			on	$214,541.86	$0
					TOTAL COST for pay item	**$214,542**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposal site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.016	Project	: IRONGATE
Description	: Remove Concrete in Diversion Tunnel Gate Tower		
Quantity	: 650.00 CY		
Daily Production	: 75.00 CY per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 8.7 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $196.63 per CY		
Total Cost	: $127,809		

	CY per	Total Cost	Unit Price Per CY
Probable Low Cost Parameter	86.25	$108,637	$167
Probable High Cost Parameter	63.75	$146,980	$226

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	8.7	8	69.60	L	$46.27	incl. in rate	incl. in rate	$3,220.39
Equipment Operator (medium)	Active	3.00	8.7	8	208.80	L	$66.28	incl. in rate	incl. in rate	$13,839.26
Steelworker	Active	3.00	8.7	8	208.80	L	$65.52	incl. in rate	incl. in rate	$13,680.58
Electrician	Active	1.00	8.7	8	69.60	L	$45.23	incl. in rate	incl. in rate	$3,148.01
Truck Driver (heavy)	Active	2.00	8.7	8	139.20	L	$57.59	incl. in rate	incl. in rate	$8,016.53
Vibratory Hammer & Extractor	Active	1.00	8.7	8	69.60	E	$94.34	incl. in rate	incl. in rate	$6,566.06
Hydraulic Excavator (6.0cy)	Active	1.00	8.7	8	69.60	E	$322.48	incl. in rate	incl. in rate	$22,444.61
Loader, FE Rubber Tire (8.6cy)	Active	1.00	8.7	8	69.60	E	$221.50	incl. in rate	incl. in rate	$15,416.40
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	8.7	8	139.20	E	$111.64	incl. in rate	incl. in rate	$15,540.29
				Labor Hours	696				TOTAL LABOR	$41,904.77
				Equipment Hours	348				TOTAL EQUIPMENT	$59,967.36

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$41,904.77	Labor Burden @	49.7%	$0.00	$41,904.77
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$59,967.36	Equipment Tax @	0.0%	$0.00	$59,967.36
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$101,872			$0	DIRECT COST SUBTOTALS $101,872

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$101,872.13	$15,280.82
Installing Contractors Profit@	8.0%				$101,872.13	$8,149.77
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$23,430.59
General Contractors Insurance @	1.0%		on		$125,302.72	$1,253
Bond @	1.0%		on		$125,302.72	$1,253
Contingency @	0.0%		on		$127,808.77	$0
					TOTAL COST for pay item	$127,809

Additional Pay Item Notes :

Based on RS.Means - Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9 and B34B - Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.017	Project	: IRONGATE
Description	: Remove Steel Footbridge to Gate Tower		
Quantity	: 13,000.00 LBS		
Daily Production	: 10,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 1.3 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $1.10 per LBS		
Total Cost	: $14,259		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	11500	$12,120	$0.93
Probable High Cost Parameter	8500	$16,398	$1.26

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.3	8	10.40	L	$46.27	incl. in rate	incl. in rate	$481.21
Electrician	Active	1.00	1.3	8	10.40	L	$45.23	incl. in rate	incl. in rate	$470.39
Hydraulic Crane (50tn)	Active	1.00	1.3	8	10.40	E	$134.32	incl. in rate	incl. in rate	$1,396.93
Equipment Operator (crane)	Active	1.00	1.3	8	10.40	L	$68.41	incl. in rate	incl. in rate	$711.46
Vibratory Hammer & Extractor	Active	1.00	1.3	8	10.40	E	$94.34	incl. in rate	incl. in rate	$981.14
Laborer	Active	2.00	1.3	8	20.80	L	$45.80	incl. in rate	incl. in rate	$952.64
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.3	8	20.80	E	$111.64	incl. in rate	incl. in rate	$2,322.11
Truck Driver (heavy)	Active	2.00	1.3	8	20.80	L	$57.59	incl. in rate	incl. in rate	$1,197.87
Equipment Operator (light)	Active	1.00	1.3	8	10.40	L	$64.90	incl. in rate	incl. in rate	$674.96
Steelworker	Active	2.00	1.3	8	20.80	L	$65.52	incl. in rate	incl. in rate	$1,362.82
				Labor Hours	104				TOTAL LABOR	$5,851.35
				Equipment Hours	41.6				TOTAL EQUIPMENT	$4,700.18

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$292.57	$292.57
					TOTAL MATERIAL	$292.57

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Rent aerial lift, articulating boom, to 80' high, 500 lb. capacity, diesel - Rent per day (RS Means 01543340)	1.00	days	1.000	1.00	$584.00	$584.00
					TOTAL SUBCONTRACTS	$584.00

SUMMARY OF COSTS

Labor Cost	$5,851.35	Labor Burden @	49.7%	$0.00		$5,851.35
Material Cost	$292.57	Material Tax @	7.8%	$22.67		$315.24
Equipment Cost	$4,700.18	Equipment Tax @	0.0%	$0.00		$4,700.18
Subcontractors	$584.00					$584.00
DIRECT COST SUBTOTALS	$11,428			$23	DIRECT COST SUBTOTALS	$11,451

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$10,866.77	$1,630.02
Installing Contractors Profit@	8.0%				$10,866.77	$869.34
GC Markup on Subs @	5.0%				$584.00	$29.20
					TOTAL MARKUP COSTS	$2,528.56
General Contractors Insurance @	1.0%			on	$13,979.33	$140
Bond @	1.0%			on	$13,979.33	$140
Contingency @	0.0%			on	$14,258.91	$0
					TOTAL COST for pay item	$14,259

Additional Pay Item Notes :

The bridge steel grid, excess steel members and similar materials shall be removed from each span prior to removing the main supporting beams, girders or trusses over land. Assumed crew is formed of 1 Forman, 1 Electrician (tempoary power for tools), 2 steelworkers to cut steel in the articulated boom and 2 Laborers (Load, Haul, help with the crane rops, etc).

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.018		Project	: IRONGATE		
Description	: Remove Concrete in Diversion Tunnel Footbridge Abutment					
Quantity	: 39.00 CY					
Daily Production	: 50.00 CY per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 0.8 Days		Estimator	: Mihaela Tomulescu	CY per	Total Cost	Unit Price Per CY
Unit Price	: $197.94 per CY		Probable Low Cost Parameter		57.5	$6,562	$168
Total Cost	: $7,720		Probable High Cost Parameter		42.5	$8,878	$228

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	0.8	8	6.40	L	$46.27	incl. in rate	incl. in rate	$296.13
Equipment Operator (medium)	Active	2.00	0.8	8	12.80	L	$66.28	incl. in rate	incl. in rate	$848.38
Steelworker	Active	3.00	0.8	8	19.20	L	$65.52	incl. in rate	incl. in rate	$1,257.98
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.8	8	6.40	E	$111.64	incl. in rate	incl. in rate	$714.50
Truck Driver (heavy)	Active	1.00	0.8	8	6.40	L	$57.59	incl. in rate	incl. in rate	$368.58
Vibratory Hammer & Extractor	Active	1.00	0.8	8	6.40	E	$94.34	incl. in rate	incl. in rate	$603.78
Hydraulic Excavator (6.0cy)	Active	1.00	0.8	8	6.40	E	$322.48	incl. in rate	incl. in rate	$2,063.87
				Labor Hours	44.8				TOTAL LABOR	$2,771.07
				Equipment Hours	19.2				TOTAL EQUIPMENT	$3,382.14

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,771.07	Labor Burden @		49.7%	$0.00		$2,771.07
Material Cost	$0.00	Material Tax @		7.8%	$0.00		$0.00
Equipment Cost	$3,382.14	Equipment Tax @		0.0%	$0.00		$3,382.14
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$6,153				$0	DIRECT COST SUBTOTALS	$6,153
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$6,153.22		$922.98
Installing Contractors Profit@	8.0%				$6,153.22		$492.26
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$1,415.24
General Contractors Insurance @	1.0%			on	$7,568.46		$76
Bond @	1.0%			on	$7,568.46		$76
Contingency @	0.0%			on	$7,719.82		$0
						TOTAL COST for pay item	$7,720

Additional Pay Item Notes :

Based on RS.Means - Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9 and B34B - Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.019	Project	: IRONGATE		
Description	: Place Concrete Plugs for Diversion Tunnel				
Quantity	: 43.00 CY				
Daily Production	: 15.00 CY per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	: 2.9 Days	Estimator	: Mihaela Tomulescu		
			CY per	Total Cost	Unit Price Per CY
Unit Price	: $1,672.11 per CY	Probable Low Cost Parameter	16.5	$64,711	$1,505
Total Cost	: $71,901	Probable High Cost Parameter	13.5	$79,091	$1,839

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Carpenter Foreman (out)	Active	1.00	2.9	8	23.20	L	$46.40	incl. in rate	incl. in rate	$1,076.48
Equipment Operator (medium)	Active	1.00	2.9	8	23.20	L	$66.28	incl. in rate	incl. in rate	$1,537.70
Carpenters	Active	18.00	2.9	8	417.60	L	$72.60	incl. in rate	incl. in rate	$30,317.76
Electrician	Active	1.00	2.9	8	23.20	L	$45.23	incl. in rate	incl. in rate	$1,049.34
Laborer	Active	2.00	2.9	8	46.40	L	$45.80	incl. in rate	incl. in rate	$2,125.12
Ironworkers	Active	2.00	2.9	8	46.40	L	$63.95	incl. in rate	incl. in rate	$2,967.28
Equipment Operator (crane)	Active	1.00	2.9	8	23.20	L	$68.41	incl. in rate	incl. in rate	$1,587.11
Loader, FE Rubber Tire (8.6cy)	Active	1.00	2.9	8	23.20	E	$221.50	incl. in rate	incl. in rate	$5,138.80
Hydraulic Crane (17tn)	Active	1.00	2.9	8	23.20	E	$81.52	incl. in rate	incl. in rate	$1,891.26
				Labor Hours	603.2				TOTAL LABOR	$40,660.78
				Equipment Hours	46.4				TOTAL EQUIPMENT	$7,030.06

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Structural concrete, ready mix, heavyweight, 4500 psi, includes local aggregate, sand, Portland cement (Type I) and water, delivered, excludes all additives and treatments	43.00	CY	1.000	43.00	$128.00	$5,504.00
C.I.P. concrete forms, wall, job built, plywood, over 16' high, 1 use, includes erecting, bracing, stripping and cleaning	232.50	sfca	1.000	232.50	$2.69	$625.43
C.I.P. concrete forms, wall, radial, curved, below grade, job built plywood, over 8' to 16' high, 2 ' chords, 1 use, includes erecting, bracing, stripping and cleaning	1,024.00	sfca	1.000	1,024.00	$0.94	$962.56
Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1.00	ton	1.000	1.00	$940.00	$1,835.00
					TOTAL MATERIAL	$8,926.99

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$40,660.78	Labor Burden @		49.7%	$0.00		$40,660.78
Material Cost	$8,926.99	Material Tax @		7.8%	$691.84		$9,618.83
Equipment Cost	$7,030.06	Equipment Tax @		0.0%	$0.00		$7,030.06
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$56,618				$692	DIRECT COST SUBTOTALS	$57,310
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$57,309.67		$8,596.45
Installing Contractors Profit@	8.0%				$57,309.67		$4,584.77
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$13,181.23
General Contractors Insurance @	1.0%		on		$70,490.90		$705
Bond @	1.0%		on		$70,490.90		$705
Contingency @	0.0%		on		$71,900.72		$0
						TOTAL COST for pay item	$71,901

Additional Pay Item Notes :

Plugs for openings 15.5' x 16.5' curved formes and 15.5' x 7.5' rectangulare formes is based on RS.Means - Crew C2, Crew RODM4, Crew C7.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.020		**Project**	: IRONGATE		
Description	:	Remove Concrete Closure Gates in Gate Tower					
Quantity	:	85.00 CY					
Daily Production	:	6.00 CY per 8 hour shift		**Project #**	: Klamath Dams Removal		
Work Days	:	14.2 Days		**Estimator**	: Mihaela Tomulescu	**CY per**	**Total Cost**
Unit Price	:	$894.09 per CY		**Probable Low Cost Parameter**	**6.9**	**$64,598**	**$760**
Total Cost	:	$75,998		**Probable High Cost Parameter**	**5.1**	**$87,397**	**$1,028**

(Last column header: **Unit Price Per CY**)

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	14.2	8	113.60	L	$46.27	incl. in rate	incl. in rate	$5,256.27
Equipment Operator (medium)	Active	4.00	14.2	8	454.40	L	$66.28	incl. in rate	incl. in rate	$30,117.63
Steelworker	Active	8.00	0.2	8	12.80	L	$65.52	incl. in rate	incl. in rate	$838.66
Electrician	Active	1.00	0.2	8	1.60	L	$45.23	incl. in rate	incl. in rate	$72.37
Truck Driver (heavy)	Active	1.00	0.2	8	1.60	L	$57.59	incl. in rate	incl. in rate	$92.14
Vibratory Hammer & Extractor	Active	2.00	0.2	8	3.20	E	$94.34	incl. in rate	incl. in rate	$301.89
Hydraulic Excavator (6.0cy)	Active	1.00	4.0	8	32.00	E	$322.48	incl. in rate	incl. in rate	$10,319.36
Loader, FE Rubber Tire (8.6cy)	Active	1.00	4.0	8	32.00	E	$221.50	incl. in rate	incl. in rate	$7,088.00
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Diver, Wet	Active	2.00	2.0	8	32.00	L	$124.57	incl. in rate	incl. in rate	$3,986.24
Barge, Sectional, 20'x10'	Active	1.00	2.0	8	16.00	E	$4.48	incl. in rate	incl. in rate	$71.68
Barge Operator	Active	1.00	2.0	8	16.00	L	$40.30	incl. in rate	incl. in rate	$644.80
				Labor Hours	**632**				**TOTAL LABOR**	**$41,008.11**
				Equipment Hours	**99.2**				**TOTAL EQUIPMENT**	**$19,567.17**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$41,008.11	Labor Burden @	49.7%	$0.00	$41,008.11
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$19,567.17	Equipment Tax @	0.0%	$0.00	$19,567.17
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$60,575**			**$0**	**DIRECT COST SUBTOTALS** **$60,575**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$60,575.28	$9,086.29
Installing Contractors Profit@	8.0%				$60,575.28	$4,846.02
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$13,932.31**
General Contractors Insurance @	1.0%		on		$74,507.59	$745
Bond @	1.0%		on		$74,507.59	$745
Contingency @	0.0%		on		$75,997.75	$0
					TOTAL COST for pay item	**$75,998**

Additional Pay Item Notes :

Requires dive depth 150 feet. Based on RS.Means - Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9 and B34B - Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment

PAY ITEM COST DETAIL WORKSHEET

4.021 Remove Upstream Riprap (10' thick upstream side of Dam)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.021	Project	: Iron Gate			
Description	:	Remove Upstream Riprap (10' thick upstream side of Dam)					
Quantity	:	92,400.00 cy					
Daily Production	:	2,000.00 cy per 8 hour shift	Project #	: 4			
Work Days	:	46.2 Days	Estimator	: Michael Barba	cy per	Total Cost	Unit Price Per cy
Unit Price	:	$21.05 per cy	Probable Low Cost Parameter		2300	$1,652,978	$17.89
Total Cost	:	$1,944,680	Probable High Cost Parameter		1600	$2,333,616	$25.26

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	4.00	46.2	8	1,478.40	E	$274.63	incl. in rate	incl. in rate	$406,012.99
Dozer (310hp)(CATD8)	Active	2.00	46.2	8	739.20	E	$197.60	incl. in rate	incl. in rate	$146,065.92
Truck, Off-Road, Articulated Rear, 20cy	Active	10.00	46.2	8	3,696.00	E	$111.64	incl. in rate	incl. in rate	$412,621.44
Truck, Pickup (4x4, 3/4tn)	Active	2.00	46.2	8	739.20	E	$16.94	incl. in rate	incl. in rate	$12,522.05
Truck Driver (heavy)	Active	10.00	46.2	8	3,696.00	L	$57.59	incl. in rate	incl. in rate	$212,852.64
Laborer	Active	6.00	46.2	8	2,217.60	L	$45.80	incl. in rate	incl. in rate	$101,566.08
Labor Foreman	Active	2.00	46.2	8	739.20	L	$48.27	incl. in rate	incl. in rate	$35,681.18
Equipment Operator (medium)	Active	6.00	46.2	8	2,217.60	L	$66.28	incl. in rate	incl. in rate	$146,982.53
		1.00	46.2	8	369.60	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	46.2	8	369.60	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	46.2	8	369.60	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	46.2	8	369.60	0	$0.00	incl. in rate	incl. in rate	$0.00
			46.2	8	0.00					$0.00
			46.2	8	0.00					$0.00
			46.2	8	0.00					$0.00
			46.2	8	0.00					$0.00
			46.2	8	0.00					$0.00
				Labor Hours	8870.4				TOTAL LABOR	$497,082.43
				Equipment Hours	6652.8				TOTAL EQUIPMENT	$977,222.40

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$497,082.43	Labor Burden @	49.7%	$0.00		$497,082.43
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$977,222.40	Equipment Tax @	7.75%	$75,734.74		$1,052,957.14
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$1,474,305			$75,735	DIRECT COST SUBTOTALS	$1,550,040

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,550,039.57		$232,505.94
Installing Contractors Profit@	8.0%				$1,550,039.57		$124,003.17
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$356,509.10
General Contractors Insurance @	1.0%			on	$1,906,548.67		$19,065
Bond @	1.0%			on	$1,906,548.67		$19,065
Contingency @	0.0%			on	$1,944,679.64		$0
						TOTAL COST for pay item	$1,944,680

Additional Pay Item Notes :

Production is based on using 20CY trucks, Material will be used for temporary coffer dams and hauled to disposal area. Excavators will load material into 20CY trucks that we aniticipate will be able to haul 18CY per load. This will be roughly 14 loads per truck per day.Dozers will be used to push material in to piles for load out. Laborers will direct truck traffic and laborer foreman will oversee operation. During Dam construction the rip rap was placed on the upstream slope at a thickness of 10'.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.022	Project	: Iron Gate	
Description	: Remove Downstream Riprap			
Quantity	: 23,400.00 cy			
Daily Production	: 2,500.00 cy per 8 hour shift	Project #	: 4	
Work Days	: 9.4 Days	Estimator	: Michael Barba	

	cy per	Total Cost	Unit Price Per cy
Unit Price : $15.64 per cy — Probable Low Cost Parameter	2875	$310,997	$13.29
Total Cost : $365,879 — Probable High Cost Parameter	2000	$439,054	$18.76

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	4.00	9.4	8	300.80	E	$274.63	incl. in rate	incl. in rate	$82,608.70
Dozer (310hp)(CATD8)	Active	2.00	9.4	8	150.40	E	$197.60	incl. in rate	incl. in rate	$29,719.04
Truck, Off-Road, Articulated Rear, 20cy	Active	10.00	9.4	8	752.00	E	$111.64	incl. in rate	incl. in rate	$83,953.28
Equipment Operator (medium)	Active	6.00	9.4	8	451.20	L	$66.28	incl. in rate	incl. in rate	$29,905.54
Truck Driver (heavy)	Active	10.00	9.4	8	752.00	L	$57.59	incl. in rate	incl. in rate	$43,307.68
Labor Foreman (out)	Active	1.00	9.4	8	75.20	L	$46.27	incl. in rate	incl. in rate	$3,479.50
Laborer	Active	1.00	9.4	8	75.20	L	$45.80	incl. in rate	incl. in rate	$3,444.16
		1.00	9.4	8	75.20	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	9.4	8	75.20	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	9.4	8	75.20	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	9.4	8	75.20	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	9.4	8	75.20	0	$0.00	incl. in rate	incl. in rate	$0.00
			9.4	8	0.00					$0.00
			9.4	8	0.00					$0.00
			9.4	8	0.00					$0.00
			9.4	8	0.00					$0.00
			9.4	8	0.00					$0.00
				Labor Hours	1353.6				TOTAL LABOR	$80,136.88
				Equipment Hours	1203.2				TOTAL EQUIPMENT	$196,281.02

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$80,136.88	Labor Burden @	49.7%	$0.00	$80,136.88
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$196,281.02	Equipment Tax @	7.75%	$15,211.78	$211,492.80
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$276,418			$15,212	DIRECT COST SUBTOTALS $291,630

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$291,629.68	$43,744.45
Installing Contractors Profit@	8.0%				$291,629.68	$23,330.37
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$67,074.83
General Contractors Insurance @	1.0%			on	$358,704.51	$3,587
Bond @	1.0%			on	$358,704.51	$3,587
Contingency @	0.0%			on	$365,878.60	$0

TOTAL COST for pay item $365,879

Additional Pay Item Notes :

Production is based on using 20CY trucks, Material will be used for temporary coffer dams and hauled to disposal area. Excavators will load material into 20CY trucks that we aniticipate will be able to haul 18CY per load. This will be roughly 11 loads per truck per day.Dozers will be used to push material in to piles for load out. Laborers will direct truck traffic and laborer foreman will oversee operation. During Dam construction the rip rap was placed on the udown stream slope at a thickness of 5'.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.023	Project	: Iron Gate		
Description	:	Miscellaneous Excavation (Dam Fill to Spillway)				
Quantity	:	270,000.00 cy				
Daily Production	:	10,000.00 cy per 10 hour shift	Project #	: 4		
Work Days	:	27.0 Days	Estimator	: Michael Barba	cy per	Total Cost	Unit Price Per cy
Unit Price	:	$6.72 per cy	Probable Low Cost Parameter		11500	$1,543,132	$5.72
Total Cost	:	$1,815,450	Probable High Cost Parameter		8000	$2,178,539	$8.07

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (310hp)(CATD8)	Active	3.00	27.0	10	810.00	E	$197.60	incl. in rate	incl. in rate	$160,056.00
Hydraulic Excavator (6.0cy)	Active	4.00	27.0	10	1,080.00	E	$322.48	incl. in rate	incl. in rate	$348,278.40
Loader, FE Rubber Tire (8.6cy)	Active	2.00	27.0	10	540.00	E	$221.50	incl. in rate	incl. in rate	$119,610.00
Truck, Off-Road, Articulated Rear, 20cy	Active	10.00	27.0	10	2,700.00	E	$111.64	incl. in rate	incl. in rate	$301,428.00
Truck, Pickup (4x4, 3/4tn)	Active	1.00	27.0	10	270.00	E	$16.94	incl. in rate	incl. in rate	$4,573.80
Truck Driver (heavy)	Active	14.00	27.0	10	3,780.00	L	$57.59	incl. in rate	incl. in rate	$217,690.20
Labor Foreman (out)	Active	1.00	27.0	10	270.00	L	$46.27	incl. in rate	incl. in rate	$12,492.90
Laborer	Active	4.00	27.0	10	1,080.00	L	$45.80	incl. in rate	incl. in rate	$49,464.00
Equipment Operator (medium)	Active	9.00	27.0	10	2,430.00	L	$66.28	incl. in rate	incl. in rate	$161,060.40
		1.00	27.0	10	270.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	27.0	10	270.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	27.0	10	270.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			27.0	10	0.00					$0.00
			27.0	10	0.00					$0.00
			27.0	10	0.00					$0.00
			27.0	10	0.00					$0.00
			27.0	10	0.00					$0.00
				Labor Hours	7560				TOTAL LABOR	$440,707.50
				Equipment Hours	5400				TOTAL EQUIPMENT	$933,946.20

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$440,707.50	Labor Burden @		49.7%	$0.00		$440,707.50
Material Cost	$0.00	Material Tax @		7.75%	$0.00		$0.00
Equipment Cost	$933,946.20	Equipment Tax @		7.75%	$72,380.83		$1,006,327.03
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$1,374,654				$72,381	DIRECT COST SUBTOTALS	$1,447,035
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,447,034.53		$217,055.18
Installing Contractors Profit@	8.0%				$1,447,034.53		$115,762.76
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$332,817.94
General Contractors Insurance @	1.0%			on	$1,779,852.47		$17,799
Bond @	1.0%			on	$1,779,852.47		$17,799
Contingency @	0.0%			on	$1,815,449.52		$0
						TOTAL COST for pay item	$1,815,450

Additional Pay Item Notes :

Price is based on hauling material to spillway using both dozers and haul trucks. Figured 1/4 of the material will be placed using Dozer and excavators only and the other half of the material will need haul trucks to move material to spillway from opposite side of dam. Figuring 10 trucks moving 14 loads a day.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.023	Project	: Iron Gate			
Description	:	Miscellaneous Excavation (Dam Fill to Disposal Site)					
Quantity	:	761,159.00 cy					
Daily Production	:	6,000.00 cy per 10 hour shift	Project #	: 4			
Work Days	:	126.9 Days	Estimator	: Michael Barba	cy per	Total Cost	Unit Price Per cy
Unit Price	:	$15.55 per cy	Probable Low Cost Parameter		6900	$10,061,276	$13.22
Total Cost	:	$11,836,796	Probable High Cost Parameter		4800	$14,204,155	$18.66

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (310hp)(CATD8)	Active	4.00	126.9	10	5,076.00	E	$197.60	incl. in rate	incl. in rate	$1,003,017.60
Hydraulic Excavator (6.0cy)	Active	4.00	126.9	10	5,076.00	E	$322.48	incl. in rate	incl. in rate	$1,636,908.48
Loader, FE Rubber Tire (8.6cy)	Active	2.00	126.9	10	2,538.00	E	$221.50	incl. in rate	incl. in rate	$562,167.00
Truck, Off-Road, Articulated Rear, 20cy	Active	20.00	126.9	10	25,380.00	E	$111.64	incl. in rate	incl. in rate	$2,833,423.20
Truck, Pickup (4x4, 3/4tn)	Active	2.00	126.9	10	2,538.00	E	$16.94	incl. in rate	incl. in rate	$42,993.72
Truck Driver (heavy)	Active	20.00	126.9	10	25,380.00	L	$57.59	incl. in rate	incl. in rate	$1,461,634.20
Labor Foreman (out)	Active	2.00	126.9	10	2,538.00	L	$46.27	incl. in rate	incl. in rate	$117,433.26
Laborer	Active	8.00	126.9	10	10,152.00	L	$45.80	incl. in rate	incl. in rate	$464,961.60
Equipment Operator (medium)	Active	10.00	126.9	10	12,690.00	L	$66.28	incl. in rate	incl. in rate	$841,093.20
		1.00	126.9	10	1,269.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	126.9	10	1,269.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	126.9	10	1,269.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			126.9	10	0.00					$0.00
			126.9	10	0.00					$0.00
			126.9	10	0.00					$0.00
			126.9	10	0.00					$0.00
			126.9	10	0.00					$0.00
				Labor Hours	50760				TOTAL LABOR	$2,885,122.26
				Equipment Hours	40608				TOTAL EQUIPMENT	$6,078,510.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,885,122.26	Labor Burden @	49.7%	$0.00		$2,885,122.26
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$6,078,510.00	Equipment Tax @	7.75%	$471,084.53		$6,549,594.53
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$8,963,632			$471,085	DIRECT COST SUBTOTALS	$9,434,717

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$9,434,716.79	$1,415,207.52
Installing Contractors Profit@	8.0%				$9,434,716.79	$754,777.34
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$2,169,984.86
General Contractors Insurance @	1.0%		on		$11,604,701.65	$116,047
Bond @	1.0%		on		$11,604,701.65	$116,047
Contingency @	0.0%		on		$11,836,795.68	$0
					TOTAL COST for pay item	$11,836,796

Additional Pay Item Notes :

Price is based on using 2 crews working 10 hours per day, a total of 20 trucks (10 trucks per crew) will haul material from dam location to disposal site. Each truck is expected to haul 15 loads per day for a total of 139 days. Excavators will load trucks with dozers assisting. Loaders will maintain hauling roads for trucks.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.024	**Project** : Iron Gate			
Description	:	Cutoff Wall Concrete Demolition				
Quantity	:	2,440.00 cy				
Daily Production	:	150.00 cy per 8 hour shift	**Project #** : 4			
Work Days	:	16.3 Days	**Estimator** : Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$112.84 per cy	**Probable Low Cost Parameter**	**165**	**$247,803**	**$101.56**
Total Cost	:	$275,336	**Probable High Cost Parameter**	**127.5**	**$316,637**	**$129.77**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	16.3	8	260.80	L	$48.27	incl. in rate	incl. in rate	$12,588.82
Laborer	Active	8.00	16.3	8	1,043.20	L	$45.80	incl. in rate	incl. in rate	$47,778.56
Equipment Operator (medium)	Active	2.00	16.3	8	260.80	L	$66.28	incl. in rate	incl. in rate	$17,285.82
Truck Driver (heavy)	Active	2.00	16.3	8	260.80	L	$57.59	incl. in rate	incl. in rate	$15,019.47
Air Compressor 900 cfm	Active	1.00	16.3	8	130.40	E	$38.87	incl. in rate	incl. in rate	$5,068.51
Air Compressor 600 cfm	Active	1.00	16.3	8	130.40	E	$21.74	incl. in rate	incl. in rate	$2,834.76
Air Tool, Chipping Hammer	Active	4.00	16.3	8	521.60	E	$1.64	incl. in rate	incl. in rate	$854.92
Generator, Small Generator, 10 - 15 kW	Active	2.00	16.3	8	260.80	E	$7.04	incl. in rate	incl. in rate	$1,836.03
Hydraulic Excavator (2.5cy)	Active	2.00	16.3	8	260.80	E	$203.63	incl. in rate	incl. in rate	$53,106.70
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	16.3	8	130.40	E	$62.72	incl. in rate	incl. in rate	$8,178.69
Hydraulic Thumbs/Shear Attachment	Active	1.00	16.3	8	130.40	E	$16.39	incl. in rate	incl. in rate	$2,137.26
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	16.3	8	260.80	E	$111.64	incl. in rate	incl. in rate	$29,115.71
			16.3	8	0.00					$0.00
			16.3	8	0.00					$0.00
			16.3	8	0.00					$0.00
			16.3	8	0.00					$0.00
			16.3	8	0.00					$0.00
				Labor Hours	**1,826**				**TOTAL LABOR**	**$92,672.67**
				Equipment Hours	**1,826**				**TOTAL EQUIPMENT**	**$103,132.57**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$4,633.63	$4,633.63
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$4,633.63**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	5	EA	**Cost per Mob**	$2,500.00	$12,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$12,500.00**

SUMMARY OF COSTS

Labor Cost	$92,672.67	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$92,672.67
Material Cost	$4,633.63	Material Tax @	7.75%	$359.11		$4,992.74
Equipment Cost	$103,132.57	Equipment Tax @	7.75%	$7,992.77		$111,125.35
Subcontractors	$12,500.00					$12,500.00
DIRECT COST SUBTOTALS	**$212,939**			**$8,352**	**DIRECT COST SUBTOTALS**	**$221,291**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$208,790.76	$31,318.61
Installing Contractors Profit@	8.0%				$208,790.76	$16,703.26
GC Markup on Subs @	5.0%				$12,500.00	$625.00
					TOTAL MARKUP COSTS	**$48,646.88**
General Contractors Insurance @	1.0%			on	$269,937.64	$2,699
Bond @	1.0%			on	$269,937.64	$2,699
Contingency @	0.0%			on	$275,336.39	$0
					TOTAL COST for pay item	**$275,336**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposal site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.025		Project	: Iron Gate		
Description	: Earth Fill Crest Raise Demolition					
Quantity	: 13,000.00 cy					
Daily Production	: 1,100.00 cy per	8 hour shift	Project #	: 4		
Work Days	: 11.8 Days		Estimator	: Michael Barba	cy per	Total Cost	Unit Price Per cy
Unit Price	: $15.68 per cy		Probable Low Cost Parameter		1265	$173,265	$13.33
Total Cost	: $203,841		Probable High Cost Parameter		935	$234,417	$18.03

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (310hp)(CATD8)	Active	2.00	11.8	8	188.80	E	$197.60	incl. in rate	incl. in rate	$37,306.88
Loader, FE Rubber Tire (5.25cy)	Active	2.00	11.8	8	188.80	E	$75.42	incl. in rate	incl. in rate	$14,239.30
Truck, Off-Road, Articulated Rear, 20cy	Active	4.00	11.8	8	377.60	E	$111.64	incl. in rate	incl. in rate	$42,155.26
Truck, Pickup (4x4, 3/4tn)	Active	1.00	11.8	8	94.40	E	$16.94	incl. in rate	incl. in rate	$1,599.14
Truck Driver (heavy)	Active	4.00	11.8	8	377.60	L	$57.59	incl. in rate	incl. in rate	$21,745.98
Equipment Operator (medium)	Active	4.00	11.8	8	377.60	L	$66.28	incl. in rate	incl. in rate	$25,027.33
Labor Foreman (out)	Active	1.00	11.8	8	94.40	L	$46.27	incl. in rate	incl. in rate	$4,367.89
Laborer	Active	2.00	11.8	8	188.80	L	$45.80	incl. in rate	incl. in rate	$8,647.04
		1.00	11.8	8	94.40	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	11.8	8	94.40	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	11.8	8	94.40	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	11.8	8	94.40	0	$0.00	incl. in rate	incl. in rate	$0.00
			11.8	8	0.00					$0.00
			11.8	8	0.00					$0.00
			11.8	8	0.00					$0.00
			11.8	8	0.00					$0.00
			11.8	8	0.00					$0.00
				Labor Hours	1038.4				TOTAL LABOR	$59,788.24
				Equipment Hours	849.6				TOTAL EQUIPMENT	$95,300.58

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
		-			$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$59,788.24	Labor Burden @	49.7%	$0.00		$59,788.24
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$95,300.58	Equipment Tax @	7.75%	$7,385.79		$102,686.37
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$155,089			$7,386	DIRECT COST SUBTOTALS	$162,475

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$162,474.61	$24,371.19
Installing Contractors Profit@	8.0%				$162,474.61	$12,997.97
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$37,369.16
General Contractors Insurance @	1.0%			on	$199,843.77	$1,998
Bond @	1.0%			on	$199,843.77	$1,998
Contingency @	0.0%			on	$203,840.65	$0
					TOTAL COST for pay item	$203,841

Additional Pay Item Notes :

Production is based on 4 trucks hauling 15 loads a day. Dozers will stock pile material and loaders will load trucks.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.026		Project : Iron Gate			
Description	: Sheetpile Crest Raise Demolition					
Quantity	: 800.00 lf					
Daily Production	: 160.00 lf per 8 hour shift		Project # : 4			
Work Days	: 5.0 Days		Estimator : Michael Barba	lf per	Total Cost	Unit Price Per lf
Unit Price	: $281.18 per lf		Probable Low Cost Parameter	184	$191,204	$239.01
Total Cost	: $224,946		Probable High Cost Parameter	136	$258,688	$323.36

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Excavator (5.0cy)	Active	2.00	5.0	8	80.00	E	$274.63	incl. in rate	incl. in rate	$21,970.40
Equipment Operator (medium)	Active	2.00	5.0	8	80.00	L	$66.28	incl. in rate	incl. in rate	$5,302.40
Laborer	Active	4.00	5.0	8	160.00	L	$45.80	incl. in rate	incl. in rate	$7,328.00
Labor Foreman (out)	Active	1.00	5.0	8	40.00	L	$46.27	incl. in rate	incl. in rate	$1,850.80
Steelworker	Active	4.00	5.0	8	160.00	L	$65.52	incl. in rate	incl. in rate	$10,483.20
Equipment Operator (medium)	Active	2.00	5.0	8	80.00	L	$66.28	incl. in rate	incl. in rate	$5,302.40
Welder	Active	2.00	5.0	8	80.00	E	$7.84	incl. in rate	incl. in rate	$627.00
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	5.0	8	80.00	E	$31.90	incl. in rate	incl. in rate	$2,552.00
Truck Driver (heavy)	Active	2.00	5.0	8	80.00	L	$57.59	incl. in rate	incl. in rate	$4,607.20
Equipment Operator (crane)	Active	1.00	5.0	8	40.00	L	$68.41	incl. in rate	incl. in rate	$2,736.40
Crawler Crane (130tn)	Active	1.00	5.0	8	40.00	E	$258.66	incl. in rate	incl. in rate	$10,346.40
		1.00	5.0	8	40.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
			5.0	8	0.00					$0.00
				Labor Hours	640				TOTAL LABOR	$37,610.40
				Equipment Hours	280				TOTAL EQUIPMENT	$35,495.80

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Sheetpiling 800' x 20'	4,800.00	sf	1.000	4,800.00	$20.00	$96,000.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
			1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	$96,000.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$37,610.40	Labor Burden @	49.7%	$0.00	$37,610.40
Material Cost	$96,000.00	Material Tax @	7.75%	$7,440.00	$103,440.00
Equipment Cost	$35,495.80	Equipment Tax @	7.75%	$2,750.92	$38,246.72
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$169,106			$10,191	DIRECT COST SUBTOTALS $179,297

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$179,297.12	$26,894.57
Installing Contractors Profit@	8.0%				$179,297.12	$14,343.77
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$41,238.34
General Contractors Insurance @	1.0%			on	$220,535.46	$2,205
Bond @	1.0%			on	$220,535.46	$2,205
Contingency @	0.0%			on	$224,946.17	$0

TOTAL COST for pay item $224,946

Additional Pay Item Notes :

Production is based on having two operations at 1 time pulling sheets with an excavator, crane will be on site for support for half of the duration to load sheets and support pulling operaton.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.027		Project	: IRONGATE		
Description	: Remove 5 Reservoir Monitoring Wells					
Quantity	: 5.00 EA					
Daily Production	: 2.00 EA per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 2.5 Days		Estimator	: Mihaela Tomulescu		
				EA per	Total Cost	Unit Price Per EA
Unit Price	: $2,332.81 per EA		Probable Low Cost Parameter	2.2	$10,498	$2,099.53
Total Cost	: $11,664		Probable High Cost Parameter	1.7	$13,414	$2,682.73

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.5	8	20.00	L	$46.27	incl. in rate	incl. in rate	$925.40
Laborer	Active	1.00	2.5	8	20.00	L	$45.80	incl. in rate	incl. in rate	$916.00
Hydraulic Excavator (2.5cy)	Active	1.00	2.5	8	20.00	E	$203.63	incl. in rate	incl. in rate	$4,072.60
Equipment Operator (medium)	Active	1.00	2.5	8	20.00	L	$66.28	incl. in rate	incl. in rate	$1,325.60
Vibratory Hammer & Extractor	Active	1.00	2.5	8	20.00	E	$94.34	incl. in rate	incl. in rate	$1,886.80
				Labor Hours	60				TOTAL LABOR	$3,167.00
				Equipment Hours	40				TOTAL EQUIPMENT	$5,959.40

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$158.35	$158.35
					TOTAL MATERIAL	$158.35

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$3,167.00	Labor Burden @	49.7%	$0.00		$3,167.00
Material Cost	$158.35	Material Tax @	7.8%	$12.27		$170.62
Equipment Cost	$5,959.40	Equipment Tax @	0.0%	$0.00		$5,959.40
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$9,285			$12	DIRECT COST SUBTOTALS	$9,297

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$9,297.02		$1,394.55
Installing Contractors Profit@	8.0%				$9,297.02		$743.76
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$2,138.32
General Contractors Insurance @	1.0%		on		$11,435.34		$114
Bond @	1.0%		on		$11,435.34		$114
Contingency @	0.0%		on		$11,664.04		$0
						TOTAL COST for pay item	$11,664

Additional Pay Item Notes :

Assumed 150 lenght of public water supply wells, wells domestic water, drilled, 4" to 6" diameter, removed in the same time with the regular excavation.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.029		Project	: IRONGATE		
Description	: Remove and Dispose of Intake Structure					
Quantity	: 72,000.00 LBS					
Daily Production	: 20,000.00 LBS per 8 hour shift		Project #	: 0		
Work Days	: 3.6 Days		Estimator	: Mihaela Tomulesı		
				LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $0.90 per LBS		Probable Low Cost Parameter	23000	$54,964	$0.76
Total Cost	: $64,663		Probable High Cost Parameter	16000	$77,596	$1.08

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.6	8	28.80	L	$46.27	$0.00		$1,332.58
Electrician	Active	1.00	3.6	8	28.80	L	$45.23	$0.00		$1,302.62
Steelworker	Active	6.00	3.6	8	172.80	L	$65.52	$0.00		$11,321.86
Hydraulic Excavator (6.0cy)	Active	1.00	3.6	8	28.80	E	$322.48	$322.48		$9,287.42
Truck Driver (heavy)	Active	1.00	3.6	8	28.80	L	$57.59	$0.00		$1,658.59
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	3.6	8	28.80	E	$111.64	$111.64		$3,215.23
Hydraulic Crane (120tn)	Active	1.00	3.6	8	28.80	E	$239.06	$239.06		$6,884.93
Welder	Active	2.00	3.6	8	57.60	L	$7.84	$0.00		$451.44
Gas Welding Machine	Active	2.00	3.6	8	57.60	E	$2.88	$2.88		$165.71
Equipment Operator (medium)	Active	2.00	3.6	8	57.60	L	$66.28	$0.00		$3,817.73
Equipment Operator (crane)	Active	1.00	3.6	8	28.80	L	$68.41	$0.00		$1,970.21
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	3.6	8	28.80	E	$62.72	$62.72		$1,806.34
				Labor Hours	403.2				TOTAL LABOR	$21,855.02
				Equipment Hours	172.8				TOTAL EQUIPMENT	$21,359.63

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, electrodes, wrenches, hard hats etc)	1.00	LS	1.000	1.00	$3,278.25	$3,278.25
					TOTAL MATERIAL	$3,278.25

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (25%)	9.00	ton	1.000	9.00	$595.00	$5,355.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	36.00	mile	1.000	36.00	$7.25	$261.00
					TOTAL SUBCONTRACTS	$5,616.00

SUMMARY OF COSTS

Labor Cost	$21,855.02	Labor Burden @	49.7%	$0.00		$21,855.02
Material Cost	$3,278.25	Material Tax @	7.8%	$254.06		$3,532.32
Equipment Cost	$21,359.63	Equipment Tax @	0.0%	$0.00		$21,359.63
Subcontractors	$5,616.00					$5,616.00
DIRECT COST SUBTOTALS	$52,109			$254	DIRECT COST SUBTOTALS	$52,363

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$46,746.98	$7,012.05
Installing Contractors Profit@	8.0%				$46,746.98	$3,739.76
GC Markup on Subs @	5.0%				$5,616.00	$280.80
					TOTAL MARKUP COSTS	$11,032.60
General Contractors Insurance @	1.0%			on	$63,395.58	$634
Bond @	1.0%			on	$63,395.58	$634
Contingency @	0.0%			on	$64,663.49	$0
					TOTAL COST for pay item	$64,663

Additional Pay Item Notes :

The removal trash rack and trash rake is done by one 9-men crew (1 foreman, 6 steelworkers, 1 welder, 1 electrician and 2 equipment operators). Based on the current production rate and the fact that we dispose big pieces of steel we use 1 trucks per day. Assumed hazardous waste cleanup 25% of total weight disposal.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.030	**Project**	: IRONGATE
Description	: Remove and Dispose of Sluice and Diversion Tunnel Gate		
Quantity	: 28,000.00 LBS		
Daily Production	: 18,000.00 LBS per 8 hour shift	**Project #**	: 2
Work Days	: 1.6 Days	**Estimator**	: Mihaela Tomulesı
Unit Price	: $1.09 per LBS		
Total Cost	: $30,649		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	20700	$26,052	$0.93
Probable High Cost Parameter	14400	$36,779	$1.31

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.6	8	12.80	L	$46.27	$0.00		$592.26
Laborer	Active	4.00	1.6	8	51.20	L	$45.80	$0.00		$2,344.96
Crawler Crane (270tn)	Active	2.00	1.6	8	25.60	E	$399.50	$446.84		$10,227.20
Equipment Operator (medium)	Active	2.00	1.6	8	25.60	L	$66.28	$0.00		$1,696.77
Welder	Active	2.00	1.6	8	25.60	L	$7.84	$0.00		$200.64
Gas Welding Machine	Active	2.00	1.6	8	25.60	E	$2.88	$2.88		$73.65
Electrician	Active	1.00	1.6	8	12.80	L	$45.23	$0.00		$578.94
Steelworker	Active	2.00	1.6	8	25.60	L	$65.52	$0.00		$1,677.31
Truck, Flatbed (4x4, 10,000 gvw)	Active	4.00	1.6	8	51.20	E	$31.90	$31.90		$1,633.28
Truck Driver (heavy)	Active	4.00	1.6	8	51.20	L	$57.59	$0.00		$2,948.61

Labor Hours	**204.8**	**TOTAL LABOR**	**$10,039.49**
Equipment Hours	**102.4**	**TOTAL EQUIPMENT**	**$11,934.13**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,003.95	$1,003.95
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	1,500.00	LF	1.000	1,500.00	$0.85	$1,275.00
					TOTAL MATERIAL	**$2,278.95**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$10,039.49	Labor Burden @	49.7%	$0.00		$10,039.49
Material Cost	$2,278.95	Material Tax @	7.8%	$176.62		$2,455.57
Equipment Cost	$11,934.13	Equipment Tax @	0.0%	$0.00		$11,934.13
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$24,253**			**$177**	**DIRECT COST SUBTOTALS**	**$24,429**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$24,429.19	$3,664.38
Installing Contractors Profit@	8.0%				$24,429.19	$1,954.33
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$5,618.71**
General Contractors Insurance @	1.0%		on		$30,047.90	$300
Bond @	1.0%		on		$30,047.90	$300
Contingency @	0.0%		on		$30,648.86	$0
					TOTAL COST for pay item	**$30,649**

Additional Pay Item Notes :

Production based on crew 1 Forman, 2 Steelworkers and 1 Welder to cut and attach hooks to the gate for disposal, 4 Laborers to rigging wire rope slings, 1 Electrician to provide power for tools, 1 Truck for 2 gates. Assuming 1 day of work.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.031		Project	: IRONGATE		
Description	:	Remove and Dispose of Hoist Stem - 6" Dia. Sch 160' x150'					
Quantity	:	7,500.00 LBS					
Daily Production	:	12,500.00 LBS per	8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	0.6	Days	Estimator	: Mihaela Tomulesı	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.01 per LBS		Probable Low Cost Parameter	14375	$6,441	$0.86
Total Cost	:	$7,578		Probable High Cost Parameter	10000	$9,093	$1.21

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	0.6	8	4.80	L	$46.27	$0.00		$222.10
Electrician	Active	1.00	0.6	8	4.80	L	$45.23	$0.00		$217.10
Steelworker	Active	3.00	0.6	8	14.40	L	$65.52	$0.00		$943.49
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.6	8	4.80	E	$221.50	$221.50		$1,063.20
Truck Driver (heavy)	Active	2.00	0.6	8	9.60	L	$57.59	$0.00		$552.86
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	0.6	8	9.60	E	$31.90	$31.90		$306.24
Hydraulic Crane (120tn)	Active	1.00	0.6	8	4.80	E	$239.06	$239.06		$1,147.49
Welder	Active	2.00	0.6	8	9.60	L	$7.84	$0.00		$75.24
Gas Welding Machine	Active	2.00	0.6	8	9.60	E	$2.88	$2.88		$27.62
Equipment Operator (medium)	Active	1.00	0.6	8	4.80	L	$66.28	$0.00		$318.14
Equipment Operator (crane)	Active	1.00	0.6	8	4.80	L	$68.41	$0.00		$328.37
Laborer	Active	3.00	0.6	8	14.40	L	$45.80	$0.00		$659.52
				Labor Hours	67.2				TOTAL LABOR	$3,316.82
				Equipment Hours	28.8				TOTAL EQUIPMENT	$2,544.55

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$165.84	$165.84
					TOTAL MATERIAL	$165.84

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$3,316.82	Labor Burden @	49.7%	$0.00		$3,316.82
Material Cost	$165.84	Material Tax @	7.8%	$12.85		$178.69
Equipment Cost	$2,544.55	Equipment Tax @	0.0%	$0.00		$2,544.55
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$6,027			$13	DIRECT COST SUBTOTALS	$6,040

	Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%			$6,040.06		$906.01
Installing Contractors Profit@	8.0%			$6,040.06		$483.21
GC Markup on Subs @	5.0%			$0.00		$0.00
					TOTAL MARKUP COSTS	$1,389.21
General Contractors Insurance @	1.0%		on	$7,429.28		$74
Bond @	1.0%		on	$7,429.28		$74
Contingency @	0.0%		on	$7,577.87		$0
					TOTAL COST for pay item	$7,578

Additional Pay Item Notes :

The removal hoist stem 150 LF is done by one 9-men crew (1 foreman, 3 steelworkers, 1 welder, 3 laborer,1 electrician and 2 equipment operators). Based on the fact that we dispose big pieces of steel we use 2 trucks per day. Assumed is not taking around 1/2 day of work.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.032	**Project**	: Iron Gate			
Description	:	Remove and Dispose of Air Vent Pipe - 8" Dia. Sch 40 x160'					
Quantity	:	4,650.00 LBS					
Daily Production	:	2,325.00 LBS per 8 hour shift	**Project #**	: 4			
Work Days	:	2.0 Days	**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost**	**Unit Price Per LBS**
Unit Price	:	$2.12 per LBS	**Probable Low Cost Parameter**		2673.75	$8,377	$1.80
Total Cost	:	$9,855	**Probable High Cost Parameter**		1860	$11,826	$2.54

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (light)	Active	1.00	2.0	8	16.00	L	$56.29	incl. in rate	incl. in rate	$900.64
Laborer	Active	1.00	2.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Equipment Operator (light)	Active	1.00	2.0	8	16.00	L	$64.90	incl. in rate	incl. in rate	$1,038.40
Loader, FE Rubber Tire (3.5cy)	Active	1.00	2.0	8	16.00	E	$64.23	incl. in rate	incl. in rate	$1,027.68
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Steelworker	Active	1.00	2.0	8	16.00	L	$65.52	incl. in rate	incl. in rate	$1,048.32
				Labor Hours	**64**				**TOTAL LABOR**	**$3,720.16**
				Equipment Hours	**32**				**TOTAL EQUIPMENT**	**$2,813.92**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$281.39	$281.39
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$281.39**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Forklift crew, all-terrain forklift, 45' lift, 35' reach, 9000 lb. capacity, weekly use	0.20	week	1.000	0.20	$5,961.23	$1,192.25
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$1,192.25**

SUMMARY OF COSTS

Labor Cost	$3,720.16	Labor Burden @		49.7%	$0.00		$3,720.16
Material Cost	$281.39	Material Tax @		7.8%	$21.81		$303.20
Equipment Cost	$2,813.92	Equipment Tax @		0.0%	$0.00		$2,813.92
Subcontractors	$1,192.25						$1,192.25
DIRECT COST SUBTOTALS	**$8,008**				**$22**	**DIRECT COST SUBTOTALS**	**$8,030**
		Crew	**Material**	**Subs**	**Cost Basis**		
Installing Contractors Overhead@	15.0%				$6,837.28		$1,025.59
Installing Contractors Profit@	8.0%				$6,837.28		$546.98
GC Markup on Subs @	5.0%				$1,192.25		$59.61
						TOTAL MARKUP COSTS	**$1,632.19**
General Contractors Insurance @	1.0%			on	$9,661.71		$97
Bond @	1.0%			on	$9,661.71		$97
Contingency @	0.0%			on	$9,854.95		$0
						TOTAL COST for pay item	**$9,855**

Additional Pay Item Notes :

Assumed we need forklift because of work in the tunnel near sluice gate, based on RS Means, Utility removal, pipe, sewer/water, 8" diameter, remove, excludes excavation, B12Z Crew is formed of 2 laborers loading 1 truck with the crane for disposal based on daily production.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.034	Project	: Iron Gate
Description	: Remove and Dispose of Air Vent Pipe - 12" Dia. Sch 40 x560'		
Quantity	: 30,250.00 LBS		
Daily Production	: 2,500.00 LBS per 8 hour shift	Project #	: 4
Work Days	: 12.1 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $2.26 per LBS		
Total Cost	: $68,353		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	2875	$58,100	$1.92
Probable High Cost Parameter	2000	$82,024	$2.71

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (light)	Active	1.00	1.0	8	8.00	L	$56.29	incl. in rate	incl. in rate	$450.32
Laborer	Active	2.00	12.1	8	193.60	L	$45.80	incl. in rate	incl. in rate	$8,866.88
Equipment Operator (medium)	Active	1.00	12.1	8	96.80	L	$66.28	incl. in rate	incl. in rate	$6,415.90
Loader, FE Rubber Tire (5.25cy)	Active	1.00	12.1	8	96.80	E	$75.42	incl. in rate	incl. in rate	$7,300.66
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Steelworker	Active	2.00	12.1	8	193.60	L	$65.52	incl. in rate	incl. in rate	$12,684.67
Labor Foreman	Active	1.00	12.1	8	96.80	L	$48.27	incl. in rate	incl. in rate	$4,672.54
				Labor Hours	588.8				TOTAL LABOR	$33,090.31
				Equipment Hours	104.8				TOTAL EQUIPMENT	$8,193.78

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$819.38	$819.38
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$819.38

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Forklift crew, all-terrain forklift, 45' lift, 35' reach, 9000 lb. capacity, weekly use	2.42	week	1.000	2.42	$5,961.23	$14,426.18
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	$14,426.18

SUMMARY OF COSTS

Labor Cost	$33,090.31	Labor Burden @	49.7%	$0.00	$33,090.31
Material Cost	$819.38	Material Tax @	7.8%	$63.50	$882.88
Equipment Cost	$8,193.78	Equipment Tax @	0.0%	$0.00	$8,193.78
Subcontractors	$14,426.18				$14,426.18
DIRECT COST SUBTOTALS	$56,530			$64	DIRECT COST SUBTOTALS $56,593

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$42,166.97	$6,325.05
Installing Contractors Profit@	8.0%				$42,166.97	$3,373.36
GC Markup on Subs @	5.0%				$14,426.18	$721.31
					TOTAL MARKUP COSTS	$10,419.71
General Contractors Insurance @	1.0%		on		$67,012.86	$670
Bond @	1.0%		on		$67,012.86	$670
Contingency @	0.0%		on		$68,353.11	$0
					TOTAL COST for pay item	$68,353

Additional Pay Item Notes :

Assumed we need forklift because of work in the tunnel from gate to outlet works, based on RS Means, Utility removal, pipe, sewer/water, 12" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B6 .

PAY ITEM INFORMATION

PAY ITEM NUMBER :	4.038	Project : IRON GATE				
Description :	Remove and Dispose of Power Cable and 4" Conduit from Penstock Structure					
Quantity :	800.00 LF					
Daily Production :	125.00 LF per 8 hour shift	Project # : 4				
Work Days :	6.4 Days	Estimator : Mihaela Tomulescu		LF per	Total Cost	Unit Price Per LF
Unit Price :	$49.86 per LF	Probable Low Cost Parameter		143.75	$33,904	$42
Total Cost :	$39,887	Probable High Cost Parameter		106.25	$45,870	$57

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	6.4	8	51.20	L	$47.23	incl. in rate	incl. in rate	$2,418.18
Electrician	Active	4.00	6.4	8	204.80	L	$45.23	incl. in rate	incl. in rate	$9,263.10
Laborer	Active	2.00	6.4	8	102.40	L	$45.80	incl. in rate	incl. in rate	$4,689.92
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	6.4	8	102.40	E	$111.64	incl. in rate	incl. in rate	$11,431.94
Truck Driver (heavy)	Active	1.00	6.4	8	51.20	L	$57.59	incl. in rate	incl. in rate	$2,948.61
				Labor Hours	409.6				TOTAL LABOR	$19,319.81
				Equipment Hours	102.4				TOTAL EQUIPMENT	$11,431.94

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$965.99	$965.99
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$965.99

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$19,319.81	Labor Burden @	49.7%	$0.00		$19,319.81
Material Cost	$965.99	Material Tax @	7.8%	$74.86		$1,040.85
Equipment Cost	$11,431.94	Equipment Tax @	0.0%	$0.00		$11,431.94
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$31,718			$75	DIRECT COST SUBTOTALS	$31,793

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$31,792.60		$4,768.89
Installing Contractors Profit@	8.0%				$31,792.60		$2,543.41
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$7,312.30
General Contractors Insurance @	1.0%			on	$39,104.90		$391
Bond @	1.0%			on	$39,104.90		$391
Contingency @	0.0%			on	$39,886.99		$0
						TOTAL COST for pay item	**$39,887**

Additional Pay Item Notes :

Based on RS Means:26050510- Armored cable, (BX), #8, 3 wire, average 50' runs, electrical demolition, remove we use crew Elec2 and 26050510 -Conduit, rigid galvanized steel, 4" to 6" diameter, electrical demolition, remove conduit to 10' high, including fittings & hangers

PAY ITEM COST DETAIL WORKSHEET — **4.039 Remove Powerhouse Concrete down to spring-line of turbine**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.039	**Project**	: COPCO 2			
Description	:	Remove Powerhouse Concrete down to spring-line of turbine					
Quantity	:	5,200.00 cy					
Daily Production	:	50.00 cy per 8 hour shift	**Project #**	: 3			
Work Days	:	104.0 Days	**Estimator**	: Felipe Poletto	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	:	$402.36 per cy	**Probable Low Cost Parameter**		**55**	**$1,883,040**	**$362.12**
Total Cost	:	$2,092,267	**Probable High Cost Parameter**		**42.5**	**$2,406,107**	**$462.71**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	104.0	8	832.00	L	$48.27	incl. in rate	incl. in rate	$40,160.64
Laborer	Active	3.00	104.0	8	2,496.00	L	$45.80	incl. in rate	incl. in rate	$114,316.80
Carpenters	Active	2.00	104.0	8	1,664.00	L	$72.60	incl. in rate	incl. in rate	$120,806.40
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	104.0	8	1,664.00	E	$70.35	incl. in rate	incl. in rate	$117,062.40
Equipment Operator (medium)	Active	1.00	104.0	8	832.00	L	$66.28	incl. in rate	incl. in rate	$55,144.96
Truck Driver (heavy)	Active	1.00	104.0	8	832.00	L	$57.59	incl. in rate	incl. in rate	$47,914.88
Hydraulic Excavator (5.0cy)	Active	4.00	104.0	8	3,328.00	E	$274.63	incl. in rate	incl. in rate	$913,968.64
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	2.00	104.0	8	1,664.00	E	$62.72	incl. in rate	incl. in rate	$104,366.08
Truck, Pickup (4x4, 3/4tn)	Active	3.00	104.0	8	2,496.00	E	$16.94	incl. in rate	incl. in rate	$42,282.24
0	Active	1.00	104.0	8	832.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	3.00	104.0	8	2,496.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	104.0	8	832.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			104.0	8	0.00					$0.00
			104.0	8	0.00					$0.00
			104.0	8	0.00					$0.00
			104.0	8	0.00					$0.00
			104.0	8	0.00					$0.00
				Labor Hours	**6,656**				**TOTAL LABOR**	**$378,343.68**
				Equipment Hours	**9,152**				**TOTAL EQUIPMENT**	**$1,177,679.36**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$18,917.18	$18,917.18
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$18,917.18**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$378,343.68	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$378,343.68
Material Cost	$18,917.18	Material Tax @	7.75%	$1,466.08		$20,383.27
Equipment Cost	$1,177,679.36	Equipment Tax @	7.75%	$91,270.15		$1,268,949.51
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$1,574,940**			**$92,736**	**DIRECT COST SUBTOTALS**	**$1,667,676**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,667,676.46	$250,151.47
Installing Contractors Profit@	8.0%				$1,667,676.46	$133,414.12
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$383,565.58**
General Contractors Insurance @	1.0%			on	$2,051,242.04	$20,512
Bond @	1.0%			on	$2,051,242.04	$20,512
Contingency @	0.0%			on	$2,092,266.88	$0
					TOTAL COST for pay item	**$2,092,267**

Additional Pay Item Notes :

Production is based on 2 trucks hauling 3 loads per day on average, 2 excavators with breakers will demolish concrete and 2 excavators will load trucks with demolished material, Carpenters and laborers will support equipment on the ground level, Foreman with truck will oversee operation.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.040	Project	: Iron Gate
Description	: Remove and Dispose of Turbine Unit		
Quantity	: 344,058.00 LBS		
Daily Production	: 30,000.00 LBS per 8 hour shift	Project #	: 4
Work Days	: 11.5 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $0.95 per LBS		
Total Cost	: $327,583		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	34500	$278,446	$1
Probable High Cost Parameter	25500	$376,721	$1

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	11.5	8	92.00	L	$48.27	incl. in rate	incl. in rate	$4,440.84
Ironworkers	Active	5.00	11.5	8	460.00	L	$63.95	incl. in rate	incl. in rate	$29,417.00
Crawler Crane (270tn)	Active	2.00	11.5	8	184.00	E	$399.50	incl. in rate	incl. in rate	$73,508.00
Equipment Operator (medium)	Active	2.00	11.5	8	184.00	L	$66.28	incl. in rate	incl. in rate	$12,195.52
Welder	Active	4.00	11.5	8	368.00	L	$7.84	incl. in rate	incl. in rate	$2,884.20
Gas Welding Machine	Active	4.00	11.5	8	368.00	E	$2.88	incl. in rate	incl. in rate	$1,058.73
Electrician	Active	2.00	11.5	8	184.00	L	$45.23	incl. in rate	incl. in rate	$8,322.32
Electrician Foreman	Active	1.00	11.5	8	92.00	L	$47.23	incl. in rate	incl. in rate	$4,345.16
Truck, Off-Road, Articulated Rear, 20cy	Active	4.00	11.5	8	368.00	E	$111.64	incl. in rate	incl. in rate	$41,083.52
Loader, FE Rubber Tire (8.6cy)	Active	2.00	11.5	8	184.00	E	$221.50	incl. in rate	incl. in rate	$40,756.00
Millwright	Active	5.00	11.5	8	460.00	L	$69.46	incl. in rate	incl. in rate	$31,951.60
Equipment Operator (oiler)	Active	1.00	11.5	8	92.00	L	$62.94	incl. in rate	incl. in rate	$5,790.48
				Labor Hours	1932				TOTAL LABOR	$99,347.12
				Equipment Hours	1104				TOTAL EQUIPMENT	$156,406.25

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$4,967.36	$4,967.36
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$4,967.36

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$99,347.12	Labor Burden @	49.7%	$0.00	$99,347.12
Material Cost	$4,967.36	Material Tax @	7.8%	$384.97	$5,352.33
Equipment Cost	$156,406.25	Equipment Tax @	0.0%	$0.00	$156,406.25
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$260,721			$385	DIRECT COST SUBTOTALS $261,106

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$261,105.70	$39,165.85
Installing Contractors Profit@	8.0%				$261,105.70	$20,888.46
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$60,054.31
General Contractors Insurance @	1.0%		on		$321,160.01	$3,212
Bond @	1.0%		on		$321,160.01	$3,212
Contingency @	0.0%		on		$327,583.21	$0
					TOTAL COST for pay item	$327,583

Additional Pay Item Notes :

Working with a crew formed of 1 El. Forman 2 Electrician starting to disconnect power and take care of the temporary electrical power they need at the site. The crew of 5 Ironworker and 5 Millwright. open the engine side panels, and remove the nacelle access panels. Disconnect the engine thermocouple leads at the terminal board. Before disconnecting any lines all fuel, oil, and hydraulic fluid valves are closed. Plug all lines as they are disconnected to prevent entrance of foreign material. Remove the clamps securing the bleed-air ducts at the firewall. Then, disconnect the electrical connector plugs, engine breather and vent lines, and fuel, oil, and hydraulic lines. Disconnect the engine power lever and propeller control rods or cables. Remove the covers from the lift points, attach the sling, and remove slack from the cables using a suitable hoist. The sling must be adjusted to position. Remove the engine mount bolts. The engine ready to be removed. Move the engine forward, out of the nacelle structure, until it clears the aircraft. Lower the into position on the stand, and secure it prior to removing the engine sling. The crew of 4 Welder are going to cut in pieces the big parts of the runner, turbine, scroll case to be able to load them in the truck using a loader and dispose.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.041	Project	: IRON GATE
Description	:	Remove and Dispose of Draft Tube Bulkheads		
Quantity	:	16,500.00 lbs		
Daily Production	:	25,000.00 lbs per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	:	0.7 Days	Estimator	: Mihaela Tomulescu
Unit Price	:	$0.98 per lbs		
Total Cost	:	$16,235		

	lbs per	Total Cost	Unit Price Per lbs
Probable Low Cost Parameter	28750	$13,800	$0.84
Probable High Cost Parameter	20000	$19,482	$1.18

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.7	8	5.60	L	$48.27	incl. in rate	incl. in rate	$270.31
Ironworkers	Active	4.00	0.7	8	22.40	L	$63.95	incl. in rate	incl. in rate	$1,432.48
Crawler Crane (270tn)	Active	2.00	0.7	8	11.20	E	$399.50	incl. in rate	incl. in rate	$4,474.40
Equipment Operator (crane)	Active	2.00	0.7	8	11.20	L	$68.41	incl. in rate	incl. in rate	$766.19
Welder	Active	2.00	0.7	8	11.20	L	$7.84	incl. in rate	incl. in rate	$87.78
Gas Welding Machine	Active	2.00	0.7	8	11.20	E	$2.88	incl. in rate	incl. in rate	$32.22
Electrician	Active	1.00	0.7	8	5.60	L	$45.23	incl. in rate	incl. in rate	$253.29
Millwright	Active	6.00	0.7	8	33.60	L	$69.46	incl. in rate	incl. in rate	$2,333.86
Truck, Flatbed (4x4, 10,000 gvw)	Active	4.00	0.7	8	22.40	E	$31.90	incl. in rate	incl. in rate	$714.56
Truck Driver (heavy)	Active	4.00	0.7	8	22.40	L	$57.59	incl. in rate	incl. in rate	$1,290.02

Labor Hours	112	TOTAL LABOR	$6,433.92
Equipment Hours	44.8	TOTAL EQUIPMENT	$5,221.18

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$643.39	$643.39
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$643.39

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.83	ton	1.000	0.83	$595.00	$490.88
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	$693.88

SUMMARY OF COSTS

Labor Cost	$6,433.92	Labor Burden @	49.7%	$0.00	$6,433.92
Material Cost	$643.39	Material Tax @	7.8%	$49.86	$693.26
Equipment Cost	$5,221.18	Equipment Tax @	0.0%	$0.00	$5,221.18
Subcontractors	$693.88				$693.88
DIRECT COST SUBTOTALS	$12,992			$50	DIRECT COST SUBTOTALS $13,042

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$12,348.36	$1,852.25
Installing Contractors Profit@	8.0%				$12,348.36	$987.87
GC Markup on Subs @	5.0%				$693.88	$34.69
					TOTAL MARKUP COSTS	$2,874.82

General Contractors Insurance @	1.0%	on	$15,917.05	$159
Bond @	1.0%	on	$15,917.05	$159
Contingency @	0.0%	on	$16,235.39	$0

TOTAL COST for pay item $16,235

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed contains paint with heavy metals 10% of the total lbs., calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.042		Project	: IRON GATE		
Description	: Remove and Dispose of Crane					
Quantity	: 24,000.00 lbs					
Daily Production	: 25,000.00 lbs per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 1.0 Days		Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	: $1.07 per lbs		Probable Low Cost Parameter		28750	$21,776	$0.91
Total Cost	: $25,619		Probable High Cost Parameter		18750	$32,023	$1.33

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	1.0	8	16.00	L	$48.27	incl. in rate	incl. in rate	$772.32
Laborer	Active	8.00	1.0	8	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Crawler Crane (270tn)	Active	2.00	1.0	8	16.00	E	$399.50	incl. in rate	incl. in rate	$6,392.00
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Welder	Active	4.00	1.0	8	32.00	L	$7.84	incl. in rate	incl. in rate	$250.80
Gas Welding Machine	Active	4.00	1.0	8	32.00	E	$2.88	incl. in rate	incl. in rate	$92.06
Electrician	Active	2.00	1.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Millwright	Active	2.00	1.0	8	16.00	L	$69.46	incl. in rate	incl. in rate	$1,111.36
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Equipment Operator (oiler)	Active	1.00	1.0	8	8.00	L	$62.94	incl. in rate	incl. in rate	$503.52
				Labor Hours	176				TOTAL LABOR	$7,814.08
				Equipment Hours	64				TOTAL EQUIPMENT	$9,149.18

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$781.41	$781.41
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$2,481.41

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.20	ton	1.000	1.20	$595.00	$714.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	$917.00

SUMMARY OF COSTS

Labor Cost	$7,814.08	Labor Burden @		49.7%	$0.00		$7,814.08
Material Cost	$2,481.41	Material Tax @		7.8%	$192.31		$2,673.72
Equipment Cost	$9,149.18	Equipment Tax @		0.0%	$0.00		$9,149.18
Subcontractors	$917.00						$917.00
DIRECT COST SUBTOTALS	$20,362				$192	DIRECT COST SUBTOTALS	$20,554
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$19,636.98		$2,945.55
Installing Contractors Profit@	8.0%				$19,636.98		$1,570.96
GC Markup on Subs @	5.0%				$917.00		$45.85
						TOTAL MARKUP COSTS	$4,562.36
General Contractors Insurance @	1.0%		on		$25,116.34		$251
Bond @	1.0%		on		$25,116.34		$251
Contingency @	0.0%		on		$25,618.66		$0
						TOTAL COST for pay item	$25,619

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed contains paint with heavy metals 10% of the total lbs., calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.043	**Project**	: IRON GATE		
Description	:	Remove and Dispose of Gorvernor				
Quantity	:	20,310.00 lbs				
Daily Production	:	25,000.00 lbs per 8 hour shift	**Project #**	: Klamath Dams Removal		
Work Days	:	0.8 Days	**Estimator**	: Mihaela Tomulescu	**lbs per** / **Total Cost**	**Unit Price Per lbs**
Unit Price	:	$1.04 per lbs	**Probable Low Cost Parameter**		28750 / $17,878	$0.88
Total Cost	:	$21,033	**Probable High Cost Parameter**		20000 / $25,240	$1.24

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	0.8	8	12.80	L	$48.27	incl. in rate	incl. in rate	$617.86
Laborer	Active	8.00	0.8	8	51.20	L	$45.80	incl. in rate	incl. in rate	$2,344.96
Crawler Crane (270tn)	Active	2.00	0.8	8	12.80	E	$399.50	incl. in rate	incl. in rate	$5,113.60
Equipment Operator (medium)	Active	2.00	0.8	8	12.80	L	$66.28	incl. in rate	incl. in rate	$848.38
Welder	Active	4.00	0.8	8	25.60	L	$7.84	incl. in rate	incl. in rate	$200.64
Gas Welding Machine	Active	4.00	0.8	8	25.60	E	$2.88	incl. in rate	incl. in rate	$73.65
Electrician	Active	2.00	0.8	8	12.80	L	$45.23	incl. in rate	incl. in rate	$578.94
Millwright	Active	2.00	0.8	8	12.80	L	$69.46	incl. in rate	incl. in rate	$889.09
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.8	8	6.40	E	$111.64	incl. in rate	incl. in rate	$714.50
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.8	8	6.40	E	$221.50	incl. in rate	incl. in rate	$1,417.60
Truck Driver (heavy)	Active	1.00	0.8	8	6.40	L	$57.59	incl. in rate	incl. in rate	$368.58
Equipment Operator (oiler)	Active	1.00	0.8	8	6.40	L	$62.94	incl. in rate	incl. in rate	$402.82
				Labor Hours	**140.8**				**TOTAL LABOR**	**$6,251.26**
				Equipment Hours	**51.2**				**TOTAL EQUIPMENT**	**$7,319.35**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$625.13	$625.13
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$2,325.13**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.02	ton	1.000	1.02	$595.00	$604.22
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$807.22**

SUMMARY OF COSTS

Labor Cost	$6,251.26	Labor Burden @	49.7%	$0.00		$6,251.26
Material Cost	$2,325.13	Material Tax @	7.8%	$180.20		$2,505.32
Equipment Cost	$7,319.35	Equipment Tax @	0.0%	$0.00		$7,319.35
Subcontractors	$807.22					$807.22
DIRECT COST SUBTOTALS	**$16,703**			**$180**	**DIRECT COST SUBTOTALS**	**$16,883**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$16,075.93	$2,411.39
Installing Contractors Profit@	8.0%				$16,075.93	$1,286.07
GC Markup on Subs @	5.0%				$807.22	$40.36
					TOTAL MARKUP COSTS	**$3,737.83**
General Contractors Insurance @	1.0%		on		$20,620.98	$206
Bond @	1.0%		on		$20,620.98	$206
Contingency @	0.0%		on		$21,033.40	$0
					TOTAL COST for pay item	**$21,033**

Additional Pay Item Notes :

Crews E-19 for metals demolition, E-12 for welding , E-25 for cutting steel and A-3H for equipment disposal. Assumed contains paint with heavy metals 10% of the total lbs., calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.044	Project	: IRON GATE			
Description	:	Remove and Dispose of Bearing Oil System and Cooling Water System					
Quantity	:	9,182.00 lbs					
Daily Production	:	6,000.00 lbs per 8 hour shift	Project #	: 4			
Work Days	:	1.5 Days	Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$1.06 per lbs	Probable Low Cost Parameter		6900	$8,297	$0.90
Total Cost	:	$9,761	Probable High Cost Parameter		4800	$11,713	$1.28

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.5	8	12.00	L	$48.27	incl. in rate	incl. in rate	$579.24
Laborer	Active	2.00	1.5	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Steelworker	Active	2.00	1.5	8	24.00	L	$65.52	incl. in rate	incl. in rate	$1,572.48
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.5	8	4.00	E	$221.50	incl. in rate	incl. in rate	$886.00
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56
Equipment Operator (light)	Active	1.00	0.5	8	4.00	L	$64.90	incl. in rate	incl. in rate	$259.60
				Labor Hours	68				TOTAL LABOR	$3,740.88
				Equipment Hours	8				TOTAL EQUIPMENT	$1,332.56

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$187.04	$187.04
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$187.04

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	4.59	ton	1.000	4.59	$595.00	$2,731.65
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	$2,934.65

SUMMARY OF COSTS

Labor Cost	$3,740.88	Labor Burden @	49.7%	$0.00		$3,740.88
Material Cost	$187.04	Material Tax @	7.8%	$14.50		$201.54
Equipment Cost	$1,332.56	Equipment Tax @	0.0%	$0.00		$1,332.56
Subcontractors	$2,934.65					$2,934.65
DIRECT COST SUBTOTALS	$8,195			$14	DIRECT COST SUBTOTALS	$8,210

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,274.98		$791.25
Installing Contractors Profit@	8.0%				$5,274.98		$422.00
GC Markup on Subs @	5.0%				$2,934.65		$146.73
						TOTAL MARKUP COSTS	$1,359.98
General Contractors Insurance @	1.0%			on	$9,569.60		$96
Bond @	1.0%			on	$9,569.60		$96
Contingency @	0.0%			on	$9,760.99		$0
						TOTAL COST for pay item	$9,761

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 3375 LF of 1 1/2" oil pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 3 Laborers to load the pipes in the truck.
The cooling and lubrication systems for the Hydroelectric Barge turbine, speed increaser and generator will be a combination of water and oil. These systems will be isolated from the water passages so that no contamination of passing water will occur. The following is a list of hazardous materials, substances, chemicals, and wastes normally found at a hydropower facility that may require disposal actions if not recycled or reused for their intended purpose:

1. Polychlorinated Biphenyls (PCBs)
2. Asbestos
3. Paint/abrasive blast grit (red lead paint)
4. Oil
5. Mercury
6. Antifreeze
7. Halogenated and non-halogenated solvents
8. Greases
9. Pesticides (includes herbicides, insecticides, and wood preservatives)
10. Petroleum contaminated
11. Chlorinated fluorocarbons (CFCs) Freon/Halon
12. Gasoline/diesel (includes product and sludge in tanks)
13. Batteries (includes acid)
14. Water treatment sludge (septic tanks/wastewater treatment)

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.045		Project	: IRON GATE			
Description	:	Remove and Dispose of CO2 Systems						
Quantity	:	2,568.00 lbs						
Daily Production	:	6,000.00 lbs per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	0.4	Days	Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$1.01 per lbs		Probable Low Cost Parameter		6600	$2,343	$0.91
Total Cost	:	$2,604		Probable High Cost Parameter		4800	$3,124	$1.22

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.4	8	3.20	E	$64.23	incl. in rate	incl. in rate	$205.54
Equipment Operator (light)	Active	1.00	0.4	8	3.20	L	$64.90	incl. in rate	incl. in rate	$207.68
Truck Driver (light)	Active	1.00	0.4	8	3.20	L	$56.29	incl. in rate	incl. in rate	$180.13
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.4	8	3.20	E	$111.64	incl. in rate	incl. in rate	$357.25
Gas Welding Machine	Active	1.00	0.4	8	3.20	E	$2.88	incl. in rate	incl. in rate	$9.21
Laborer	Active	3.00	0.4	8	9.60	L	$45.80	incl. in rate	incl. in rate	$439.68
Steelworker	Active	2.00	0.4	8	6.40	L	$65.52	incl. in rate	incl. in rate	$419.33
Labor Foreman	Active	1.00	0.4	8	3.20	L	$48.27	incl. in rate	incl. in rate	$154.46
Welder	Active	1.00	0.4	8	3.20	L	$7.84	incl. in rate	incl. in rate	$25.08
				Labor Hours	28.8				TOTAL LABOR	$1,426.36
				Equipment Hours	9.6				TOTAL EQUIPMENT	$571.99

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$71.32	$71.32
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$71.32

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,426.36	Labor Burden @		49.7%	$0.00		$1,426.36
Material Cost	$71.32	Material Tax @		7.8%	$5.53		$76.85
Equipment Cost	$571.99	Equipment Tax @		0.0%	$0.00		$571.99
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$2,070				$6	DIRECT COST SUBTOTALS	$2,075

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$2,075.20		$311.28
Installing Contractors Profit@	8.0%				$2,075.20		$166.02
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$477.29
General Contractors Insurance @	1.0%			on	$2,552.49		$26
Bond @	1.0%			on	$2,552.49		$26
Contingency @	0.0%			on	$2,603.54		$0
						TOTAL COST for pay item	$2,604

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 945 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers/ 1 Welder to cut the pipes and 3 Laborers to haul the pipes in the truck with the loader.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.046		Project	: IRON GATE		
Description	:	Remove and Dispose of Plant Water and Fire Protection System					
Quantity	:	9,182.00 lbs					
Daily Production	:	6,000.00 lbs per	8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	1.5 Days		Estimator	: Mihaela Tomulescu	lbs per / Total Cost	Unit Price Per lbs
Unit Price	:	$1.05 per lbs		Probable Low Cost Parameter	6600	$8,636	$0.94
Total Cost	:	$9,596		Probable High Cost Parameter	4800	$11,515	$1.25

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.5	8	12.00	L	$48.27	incl. in rate	incl. in rate	$579.24
Laborer	Active	3.00	1.5	8	36.00	L	$45.80	incl. in rate	incl. in rate	$1,648.80
Truck Driver (light)	Active	1.00	1.5	8	12.00	L	$56.29	incl. in rate	incl. in rate	$675.48
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.5	8	12.00	E	$111.64	incl. in rate	incl. in rate	$1,339.68
Steelworker	Active	2.00	1.5	8	24.00	L	$65.52	incl. in rate	incl. in rate	$1,572.48
Loader, FE Rubber Tire (3.5cy)	Active	1.00	1.5	8	12.00	E	$64.23	incl. in rate	incl. in rate	$770.76
Equipment Operator (light)	Active	1.00	1.5	8	12.00	L	$64.90	incl. in rate	incl. in rate	$778.80
				Labor Hours	96				TOTAL LABOR	$5,254.80
				Equipment Hours	24				TOTAL EQUIPMENT	$2,110.44

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$262.74	$262.74
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$262.74

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$5,254.80	Labor Burden @	49.7%	$0.00		$5,254.80
Material Cost	$262.74	Material Tax @	7.8%	$20.36		$283.10
Equipment Cost	$2,110.44	Equipment Tax @	0.0%	$0.00		$2,110.44
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$7,628			$20	DIRECT COST SUBTOTALS	$7,648

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$7,648.34	$1,147.25
Installing Contractors Profit@	8.0%				$7,648.34	$611.87
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,759.12
General Contractors Insurance @	1.0%		on		$9,407.46	$94
Bond @	1.0%		on		$9,407.46	$94
Contingency @	0.0%		on		$9,595.61	$0
					TOTAL COST for pay item	$9,596

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 3375 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 3 Laborers to load the pipes in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.047		Project	: IRON GATE		
Description	:	Remove and Dispose of Oil Sump Pumps					
Quantity	:	2,000.00 lbs					
Daily Production	:	6,000.00 lbs per 8 hour shift		Project #	: 4		
Work Days	:	0.3 Days		Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$1.05 per lbs		Probable Low Cost Parameter		6600	$1,883	$0.94
Total Cost	:	$2,092		Probable High Cost Parameter		4800	$2,510	$1.26

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.3	8	2.40	L	$48.27	incl. in rate	incl. in rate	$115.85
Electrician	Active	1.00	0.3	8	2.40	L	$45.23	incl. in rate	incl. in rate	$108.55
Laborer	Active	2.00	0.3	8	4.80	L	$45.80	incl. in rate	incl. in rate	$219.84
Hydraulic Crane (17tn)	Active	1.00	0.2	8	1.60	E	$81.52	incl. in rate	incl. in rate	$130.43
Truck Driver (heavy)	Active	1.00	0.2	8	1.60	L	$57.59	incl. in rate	incl. in rate	$92.14
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	incl. in rate	incl. in rate	$178.62
Equipment Operator (medium)	Active	1.00	0.2	8	1.60	L	$66.28	incl. in rate	incl. in rate	$106.05
				Labor Hours	12.8				TOTAL LABOR	$642.43
				Equipment Hours	3.2				TOTAL EQUIPMENT	$309.06

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$32.12	$32.12
						$0.00
					TOTAL MATERIAL	$32.12

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (assumed weight)	1.00	ton	1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	$798.00

SUMMARY OF COSTS

Labor Cost	$642.43	Labor Burden @		49.7%	$0.00		$642.43
Material Cost	$32.12	Material Tax @		7.8%	$2.49		$34.61
Equipment Cost	$309.06	Equipment Tax @		0.0%	$0.00		$309.06
Subcontractors	$798.00						$798.00
DIRECT COST SUBTOTALS	$1,782				$2	DIRECT COST SUBTOTALS	$1,784
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$986.10		$147.91
Installing Contractors Profit@	8.0%				$986.10		$78.89
GC Markup on Subs @	5.0%				$798.00		$39.90
						TOTAL MARKUP COSTS	$266.70
General Contractors Insurance @	1.0%			on	$2,050.80		$21
Bond @	1.0%			on	$2,050.80		$21
Contingency @	0.0%			on	$2,091.82		$0
						TOTAL COST for pay item	$2,092

Additional Pay Item Notes :

Used 1 crane to pick up the oil sump pumps, 1 Forman and 2 Laborers to remove the pumps. One electrician to unplug the power and assure the temporary power at the construction site. Assumed hazardous waste since we deal with the oil sump pump.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.048	Project	: IRON GATE		
Description	: Remove and Dispose of Pumps				
Quantity	: 22,000.00 lbs				
Daily Production	: 18,000.00 lbs per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	: 1.2 Days	Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	: $1.09 per lbs	Probable Low Cost Parameter		19800	$21,676	$0.99
Total Cost	: $24,084	Probable High Cost Parameter		14400	$28,901	$1.31

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	1.2	8	19.20	L	$48.27	incl. in rate	incl. in rate	$926.78
Laborer	Active	4.00	1.2	8	38.40	L	$45.80	incl. in rate	incl. in rate	$1,758.72
Crawler Crane (270tn)	Active	2.00	1.2	8	19.20	E	$399.50	incl. in rate	incl. in rate	$7,670.40
Equipment Operator (medium)	Active	2.00	1.2	8	19.20	L	$66.28	incl. in rate	incl. in rate	$1,272.58
Welder	Active	2.00	1.2	8	19.20	L	$7.84	incl. in rate	incl. in rate	$150.48
Gas Welding Machine	Active	2.00	1.2	8	19.20	E	$2.88	incl. in rate	incl. in rate	$55.24
Electrician	Active	1.00	1.2	8	9.60	L	$45.23	incl. in rate	incl. in rate	$434.21
Millwright	Active	2.00	1.2	8	19.20	L	$69.46	incl. in rate	incl. in rate	$1,333.63
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.2	8	9.60	E	$111.64	incl. in rate	incl. in rate	$1,071.74
Equipment Operator (crane)	Active	1.00	1.2	8	9.60	L	$68.41	incl. in rate	incl. in rate	$656.74
Truck Driver (light)	Active	1.00	1.2	8	9.60	L	$56.29	incl. in rate	incl. in rate	$540.38
				Labor Hours	144				TOTAL LABOR	$7,073.52
				Equipment Hours	48				TOTAL EQUIPMENT	$8,797.38

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$707.35	$707.35
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$2,407.35

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.10	ton	1.000	1.10	$595.00	$654.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	$857.50

SUMMARY OF COSTS

Labor Cost	$7,073.52	Labor Burden @	49.7%	$0.00	$7,073.52
Material Cost	$2,407.35	Material Tax @	7.8%	$186.57	$2,593.92
Equipment Cost	$8,797.38	Equipment Tax @	0.0%	$0.00	$8,797.38
Subcontractors	$857.50				$857.50
DIRECT COST SUBTOTALS	$19,136			$187	DIRECT COST SUBTOTALS $19,322

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$18,464.82	$2,769.72
Installing Contractors Profit@	8.0%				$18,464.82	$1,477.19
GC Markup on Subs @	5.0%				$857.50	$42.88
					TOTAL MARKUP COSTS	$4,289.78
General Contractors Insurance @	1.0%			on	$23,612.11	$236
Bond @	1.0%			on	$23,612.11	$236
Contingency @	0.0%			on	$24,084.35	$0
					TOTAL COST for pay item	$24,084

Additional Pay Item Notes :

Used 2 Crew formed of 1 crane to pick up the pumps, 1 Forman, 1 Millwright to cut steel , 1 Welder to cut steel in inaccessible places and 2 Laborers to remove the pumps. 1 electrician to unplug the power and assure the temporary power at the construction site. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.049		**Project**	: IRON GATE		
Description	:	Remove and Dispose of Exposed Piping Around the Plant					
Quantity	:	19,291.00 lbs					
Daily Production	:	14,500.00 lbs per 8 hour shift		**Project #**	: Klamath Dams Removal		
Work Days	:	1.3 Days		**Estimator**	: Mihaela Tomulescu	**lbs per**	**Total Cost** / **Unit Price Per lbs**
Unit Price	:	$1.05 per lbs		**Probable Low Cost Parameter**		**15950**	**$18,257** / **$0.95**
Total Cost	:	$20,285		**Probable High Cost Parameter**		**11600**	**$24,342** / **$1.26**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	1.3	8	20.80	L	$48.27	incl. in rate	incl. in rate	$1,004.02
Laborer	Active	6.00	1.3	8	62.40	L	$45.80	incl. in rate	incl. in rate	$2,857.92
Truck Driver (heavy)	Active	1.00	1.3	8	10.40	L	$57.59	incl. in rate	incl. in rate	$598.94
Equipment Operator (oiler)	Active	1.00	1.3	8	10.40	L	$62.94	incl. in rate	incl. in rate	$654.58
Welder	Active	4.00	1.3	8	41.60	L	$7.84	incl. in rate	incl. in rate	$326.04
Gas Welding Machine	Active	4.00	1.3	8	41.60	E	$2.88	incl. in rate	incl. in rate	$119.68
Electrician	Active	2.00	1.3	8	20.80	L	$45.23	incl. in rate	incl. in rate	$940.78
Steelworker	Active	4.00	1.3	8	41.60	L	$65.52	incl. in rate	incl. in rate	$2,725.63
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.3	8	10.40	E	$111.64	incl. in rate	incl. in rate	$1,161.06
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.3	8	10.40	E	$221.50	incl. in rate	incl. in rate	$2,303.60
				Labor Hours	**208**				**TOTAL LABOR**	**$9,107.90**
				Equipment Hours	**62.4**				**TOTAL EQUIPMENT**	**$3,584.34**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$910.79	$910.79
Selective demolition, torch cutting, steel, 1" thick plate (assumption)	2,000.00	LF	1.000	2,000.00	$0.85	$1,700.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$2,610.79**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.96	ton	1.000	0.96	$595.00	$573.91
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	**$776.91**

SUMMARY OF COSTS

Labor Cost	$9,107.90	Labor Burden @	49.7%	$0.00		$9,107.90
Material Cost	$2,610.79	Material Tax @	7.8%	$202.34		$2,813.13
Equipment Cost	$3,584.34	Equipment Tax @	0.0%	$0.00		$3,584.34
Subcontractors	$776.91					$776.91
DIRECT COST SUBTOTALS	**$16,080**			**$202**	**DIRECT COST SUBTOTALS**	**$16,282**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$15,505.37	$2,325.81
Installing Contractors Profit@	8.0%				$15,505.37	$1,240.43
GC Markup on Subs @	5.0%				$776.91	$38.85
					TOTAL MARKUP COSTS	**$3,605.08**
General Contractors Insurance @	1.0%		on		$19,887.36	$199
Bond @	1.0%		on		$19,887.36	$199
Contingency @	0.0%		on		$20,285.10	$0
					TOTAL COST for pay item	**$20,285**

Additional Pay Item Notes :

Used RS Means : Assumed Pipe, metal pipe, to 1-1/2" diam., selective demolition, 9200 LF of 1 1/2" pipes at 2.72 Lbs. Used 2 Crew formed of 1 Forman, 2 Steelworkers to cut the pipes, 1 Welder to cut steel in inaccessible places , 3 Laborers to haul the pipes in the truck with the loader, 1 electrician to unplug the power and assure the temporary power at the construction site.. Assumed contains paint with heavy metals 10% of the total lbs. calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.050		Project	: IRON GATE		
Description	: Remove and Dispose of Unwatering Piping					
Quantity	: 19,291.00 lbs					
Daily Production	: 18,000.00 lbs per 8 hour shift		Project #	: 4		
Work Days	: 1.1 Days		Estimator	: Mihaela Tomulescu		
				lbs per	Total Cost	Unit Price Per lbs
Unit Price	: $0.88 per lbs		Probable Low Cost Parameter	19800	$15,270	$0.79
Total Cost	: $16,967		Probable High Cost Parameter	15300	$19,512	$1.01

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.1	8	8.80	L	$48.27	incl. in rate	incl. in rate	$424.78
Electrician	Active	1.00	1.1	8	8.80	L	$45.23	incl. in rate	incl. in rate	$398.02
Steelworker	Active	2.00	1.1	8	17.60	L	$65.52	incl. in rate	incl. in rate	$1,153.15
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.1	8	8.80	E	$221.50	incl. in rate	incl. in rate	$1,949.20
Truck Driver (heavy)	Active	1.00	1.1	8	8.80	L	$57.59	incl. in rate	incl. in rate	$506.79
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.1	8	8.80	E	$111.64	incl. in rate	incl. in rate	$982.43
Laborer	Active	3.00	1.1	8	26.40	L	$45.80	incl. in rate	incl. in rate	$1,209.12
Welder	Active	1.00	1.1	8	8.80	L	$7.84	incl. in rate	incl. in rate	$68.97
Gas Welding Machine	Active	1.00	1.1	8	8.80	E	$2.88	incl. in rate	incl. in rate	$25.32
Equipment Operator (medium)	Active	1.00	1.1	8	8.80	L	$66.28	incl. in rate	incl. in rate	$583.26
				Labor Hours	88				TOTAL LABOR	$4,344.10
				Equipment Hours	26.4				TOTAL EQUIPMENT	$2,956.95

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$217.20	$217.20
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	1,000.00	LF	1.000	1,000.00	$0.85	$850.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$1,067.20

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	9.65	ton	1.000	9.65	$595.00	$5,739.07
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	$5,942.07

SUMMARY OF COSTS

Labor Cost	$4,344.10	Labor Burden @	49.7%	$0.00		$4,344.10
Material Cost	$1,067.20	Material Tax @	7.8%	$82.71		$1,149.91
Equipment Cost	$2,956.95	Equipment Tax @	0.0%	$0.00		$2,956.95
Subcontractors	$5,942.07					$5,942.07
DIRECT COST SUBTOTALS	$14,310			$83	DIRECT COST SUBTOTALS	$14,393

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,450.96		$1,267.64
Installing Contractors Profit@	8.0%				$8,450.96		$676.08
GC Markup on Subs @	5.0%				$5,942.07		$297.10
						TOTAL MARKUP COSTS	$2,240.82
General Contractors Insurance @	1.0%			on	$16,633.86		$166
Bond @	1.0%			on	$16,633.86		$166
Contingency @	0.0%			on	$16,966.54		$0
						TOTAL COST for pay item	$16,967

Additional Pay Item Notes :

Used RS Means : Assumed Pipe, metal pipe, to 1-1/2" diam., selective demolition, 7100 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Crew formed of 1 Forman, 2 Steelworkers to cut the pipes, 1 Welder to cut steel in inaccessible places , 3 Laborers to haul the pipes in the truck with the loader, 1 electrician to unplug the power and to assure the temporary power at the construction site. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.051	Project	: IRON GATE		
Description	:	Remove and Dispose of Drainage Piping				
Quantity	:	9,518.00 lbs				
Daily Production	:	4,450.00 lbs per 8 hour shift	Project #	: 4		
Work Days	:	2.1 Days	Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	:	$1.12 per lbs	Probable Low Cost Parameter		4895	$9,591	$1.01
Total Cost	:	$10,657	Probable High Cost Parameter		3782.5	$12,256	$1.29

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.1	8	16.80	L	$48.27	incl. in rate	incl. in rate	$810.94
Laborer	Active	2.00	2.1	8	33.60	L	$45.80	incl. in rate	incl. in rate	$1,538.88
Steelworker	Active	2.00	2.1	8	33.60	L	$65.52	incl. in rate	incl. in rate	$2,201.47
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Equipment Operator (light)	Active	1.00	1.0	8	8.00	L	$64.90	incl. in rate	incl. in rate	$519.20

Labor Hours	100	TOTAL LABOR	$5,531.21
Equipment Hours	16	TOTAL EQUIPMENT	$2,665.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$276.56	$276.56
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$276.56

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$5,531.21	Labor Burden @	49.7%	$0.00		$5,531.21
Material Cost	$276.56	Material Tax @	7.8%	$21.43		$297.99
Equipment Cost	$2,665.12	Equipment Tax @	0.0%	$0.00		$2,665.12
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$8,473			$21	DIRECT COST SUBTOTALS	$8,494

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,494.32		$1,274.15
Installing Contractors Profit@	8.0%				$8,494.32		$679.55
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$1,953.69
General Contractors Insurance @	1.0%			on	$10,448.02		$104
Bond @	1.0%			on	$10,448.02		$104
Contingency @	0.0%			on	$10,656.98		$0
						TOTAL COST for pay item	$10,657

Additional Pay Item Notes :

2600 LF of 1 " drainage pipes at 3.66 Lbs. Used 1 Loader and 1 Forman, 2 Steelworkers to cut the pipes and 2 Laborers to load the pipes in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.052		Project	: IRON GATE		
Description	: Remove and Dispose of Transformer Oil and Fire Protection Pipes					
Quantity	: 9,182.00 lbs					
Daily Production	: 6,000.00 lbs per 8 hour shift		Project #	: 4		
Work Days	: 1.5 Days		Estimator	: Mihaela Tomulescu	lbs per	Total Cost / Unit Price Per lbs
Unit Price	: $1.00 per lbs		Probable Low Cost Parameter		6300	$8,739 / $0.95
Total Cost	: $9,199		Probable High Cost Parameter		5400	$10,119 / $1.10

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	2.00	1.5	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Truck Driver (light)	Active	1.00	1.0	8	8.00	L	$56.29	incl. in rate	incl. in rate	$450.32
Steelworker	Active	2.00	1.5	8	24.00	L	$65.52	incl. in rate	incl. in rate	$1,572.48
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Pump, Centrifugal, 3"	Active	1.00	1.5	8	12.00	E	$2.76	incl. in rate	incl. in rate	$33.07
Labor Foreman	Active	1.00	1.5	8	12.00	L	$48.27	incl. in rate	incl. in rate	$579.24
				Labor Hours	68				TOTAL LABOR	$3,701.24
				Equipment Hours	20				TOTAL EQUIPMENT	$926.19

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$185.06	$185.06
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$185.06

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit	Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	4.59	ton	1.000	4.59	$595.00	$2,731.65
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
						$0.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	$2,934.65

SUMMARY OF COSTS

Labor Cost	$3,701.24	Labor Burden @	49.7%	$0.00		$3,701.24
Material Cost	$185.06	Material Tax @	7.8%	$14.34		$199.40
Equipment Cost	$926.19	Equipment Tax @	0.0%	$0.00		$926.19
Subcontractors	$2,934.65					$2,934.65
DIRECT COST SUBTOTALS	$7,747			$14	DIRECT COST SUBTOTALS	$7,761

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$4,826.83		$724.02
Installing Contractors Profit@	8.0%				$4,826.83		$386.15
GC Markup on Subs @	5.0%				$2,934.65		$146.73
						TOTAL MARKUP COSTS	$1,256.90
General Contractors Insurance @	1.0%			on	$9,018.38		$90
Bond @	1.0%			on	$9,018.38		$90
Contingency @	0.0%			on	$9,198.75		$0
						TOTAL COST for pay item	$9,199

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 3375 LF of 1 1/2" fire protection pipes at 2.72 Lbs. Used 1 Forman, 2 Steelworkers to cut the pipes and 3 Laborers to load the pipes in the truck. Used a pump for the oil disposal. Each hydropower facility has at least 150,000 gallons to 250,000 gallon of oil currently in use. This oil would have to be properly disposed of in the event of decommissioning. Oil removed from the turbines and other equipment, including transformer oil, would be either a waste oil or used oil, depending on prior use and contaminants found in the oil. Containerized oil containing contaminants such as solvents are commonly encountered at hydropower facilities. Oil sludges are common in tanks. Oil disposal would likely be costly due to the large volumes found at hydropower facilities and the ease of contamination with other regulated hazardous wastes. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.053		Project	: IRONGATE		
Description	: Remove and Dispose of Compressed Air System					
Quantity	: 1,450.00 lbs					
Daily Production	: 6,000.00 lbs per 8 hour shift		Project #	: 4		
Work Days	: 0.242 Days		Estimator	: Mihaela Tomulescu	lbs per	Total Cost	Unit Price Per lbs
Unit Price	: $0.91 per lbs		Probable Low Cost Parameter		6600	$1,182	$0.81
Total Cost	: $1,313		Probable High Cost Parameter		5100	$1,510	$1.04

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Loader, FE Rubber Tire (5.25cy)	Active	1.00	0.242	8	1.93	E	$75.42	incl. in rate	incl. in rate	$145.81
Laborer	Active	1.00	0.242	8	1.93	L	$45.80	incl. in rate	incl. in rate	$88.55
Steelworker	Active	1.00	0.242	8	1.93	L	$65.52	incl. in rate	incl. in rate	$126.67
Equipment Operator (light)	Active	1.00	0.242	8	1.93	L	$64.90	incl. in rate	incl. in rate	$125.47
				Labor Hours	5.8				TOTAL LABOR	$340.69
				Equipment Hours	1.933333333				TOTAL EQUIPMENT	$145.81

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price			Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$17.03			$17.03
								$0.00
								$0.00
								$0.00
								$0.00
								$0.00
							TOTAL MATERIAL	$17.03

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price			Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.73	ton	1.000	0.73	$595.00			$431.38
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25			$203.00
								$0.00
								$0.00
							TOTAL SUBCONTRACTS	$634.38

SUMMARY OF COSTS

Labor Cost	$340.69	Labor Burden @		49.7%	$0.00		$340.69
Material Cost	$17.03	Material Tax @		7.8%	$1.32		$18.35
Equipment Cost	$145.81	Equipment Tax @		0.0%	$0.00		$145.81
Subcontractors	$634.38						$634.38
DIRECT COST SUBTOTALS	$1,138				$1	DIRECT COST SUBTOTALS	$1,139
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$504.86		$75.73
Installing Contractors Profit@	8.0%				$504.86		$40.39
GC Markup on Subs @	5.0%				$634.38		$31.72
						TOTAL MARKUP COSTS	$147.84
General Contractors Insurance @	1.0%		on		$1,287.07		$13
Bond @	1.0%		on		$1,287.07		$13
Contingency @	0.0%		on		$1,312.81		$0
						TOTAL COST for pay item	$1,313

Additional Pay Item Notes :

Used RS Means : Pipe, metal pipe, to 1-1/2" diam., selective demolition, 535 LF of 1 1/2" pipes at 2.72 Lbs. Used 1 Steelworkers to cut the pipes and 1 Laborers for hauling. Assumed hazardous waste 100% of the total lbs, calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.053a	**Project**	: IRON GATE			
Description	:	Remove & Dispose - Petroleum Products from Mechanical Equip.					
Quantity	:	1,100.00 GAL					
Daily Production	:	550.00 GAL per 8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	:	2.0 Days	**Estimator**	: Mihaela Tomulescu	**GAL per**	**Total Cost**	**Unit Price Per GAL**
Unit Price	:	$10.05 per GAL	**Probable Low Cost Parameter**		**577.5**	**$10,504**	**$10**
Total Cost	:	$11,057	**Probable High Cost Parameter**		**495**	**$12,163**	**$11**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.0	8	16.00	L	$48.27	incl. in rate	incl. in rate	$772.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Laborer	Active	5.00	2.0	8	80.00	L	$45.80	incl. in rate	incl. in rate	$3,664.00
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
				Labor Hours	**128**				**TOTAL LABOR**	**$6,081.44**
				Equipment Hours	**0**				**TOTAL EQUIPMENT**	**$0.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	0.00	LS	1.000	0.00	$0.00	$0.00
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, liquid pickup, vacuum truck, stainless steel tank, 5000 gallons, minimum charge, 4 hours, 2 compartment	16.00	hour	1.000	$200.00	$3,200.00
				TOTAL SUBCONTRACTS	**$3,200.00**

SUMMARY OF COSTS

Labor Cost	$6,081.44	Labor Burden @	49.7%	$0.00	$6,081.44
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00	$0.00
Subcontractors	$3,200.00				$3,200.00
DIRECT COST SUBTOTALS	**$9,281**			**$0**	**DIRECT COST SUBTOTALS** **$9,281**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,081.44	$912.22
Installing Contractors Profit@	8.0%				$6,081.44	$486.52
GC Markup on Subs @	5.0%				$3,200.00	$160.00
					TOTAL MARKUP COSTS	**$1,558.73**
General Contractors Insurance @	1.0%		on		$10,840.17	$108
Bond @	1.0%		on		$10,840.17	$108
Contingency @	0.0%		on		$11,056.97	$0
					TOTAL COST for pay item	**$11,057**

Additional Pay Item Notes :

Petroleum-based products, ranging from fuel oil and hydraulic fluid to lubricating greases and oils, are found throughout every type of power generating plant or system. Lubrication supports bearings and moving parts in all sorts of equipment: pumps, conveyors, feeders, scrubbers, cranes, turbines, and more. A good oil/water separation system will result in a flow of concentrated waste oil to a collection area and a flow of oil-free water ready for secondary processing or discharge. Once an oil layer has been separated from free water, it must be removed for recycling or disposal. Many plants use one or more of these oil removal methods, but each has costly limitations:

1. Absorbent materials. Absorbent mats or materials are frequently used to dam up and absorb excess oils and greases resulting from accidents or the routine operation of machinery. These materials are very effective for preventing the spread of a source leak and very efficient in terms of oil pickup. Yet, their use on large volumes of waste oil results in multiple, recurring costs that can make them impractical as an everyday solution:

- the costs of the materials themselves
- the labor costs for ordering, stocking, application, and removal
- the costs of used-media collection, disposal, or re-processing/recycling.

2. Manually operated "slotted pipes." Many separators feature a "slotted pipe," a pipe located near the top of the vessel that has a horizontal opening. Oil is removed by turning the horizontal opening downward until it meets the floating oil layer, which drains through the pipe to a collection receptacle. These pipes work well on thick layers of oil, but cannot drain off a sheen of oil without draining off a large amount of water as well.

AECOM assumed the best is Vacuum truck removal method .Used a crew formed of 1 Forman, 5 Laborers to takeout the petroleum waste, 1 Electrician to unplug the power and to assure the temporary power at the construction site. Vacuum-equipped tank trucks are used to remove waste oil from collection points at plants so that it can be transported to recycling or disposal locations. If the waste oil has been thoroughly separated, highly concentrated, and stored in an appropriate receptacle, this service can be used very efficiently. However, vacuum disposal units are often used to pump oil layers directly off of water. This results in the intake of a significant amount free water along with the waste oil – and a significantly higher cost.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.054	Project	: Iron Gate	
Description	:	Remove and Dispose of AC Generator, Outdoor Horizontal			
Quantity	:	1.00 EA			
Daily Production	:	0.10 EA per 8 hour shift	Project #	: 4	
Work Days	:	10.0 Days	Estimator	: Mihaela Tomulescu	
Unit Price	:	$91,158.88 per EA			
Total Cost	:	$91,159			

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	0.11	$82,043	$82,043
Probable High Cost Parameter	0.085	$104,833	$104,833

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Hydraulic Crane (120tn)	Active	2.00	2.5	8	40.00	E	$239.06	incl. in rate	incl. in rate	$9,562.40
Electrician	Active	3.00	10.0	8	240.00	L	$45.23	incl. in rate	incl. in rate	$10,855.20
Equipment Operator (oiler)	Active	2.00	10.0	8	160.00	L	$62.94	incl. in rate	incl. in rate	$10,070.40
Equipment Operator (crane)	Active	2.00	2.5	8	40.00	L	$68.41	incl. in rate	incl. in rate	$2,736.40
Laborer	Active	5.00	10.0	8	400.00	L	$45.80	incl. in rate	incl. in rate	$18,320.00
Loader, FE Rubber Tire (5.25cy)	Active	2.00	10.0	8	160.00	E	$75.42	incl. in rate	incl. in rate	$12,067.20
Electrician Foreman	Active	1.00	10.0	8	80.00	L	$47.23	incl. in rate	incl. in rate	$3,778.40
Welder	Active	1.00	10.0	8	80.00	L	$7.84	incl. in rate	incl. in rate	$627.00
Gas Welding Machine	Active	1.00	10.0	8	80.00	E	$2.88	incl. in rate	incl. in rate	$230.16
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	2.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40
				Labor Hours	1016				TOTAL LABOR	$47,308.84
				Equipment Hours	296				TOTAL EQUIPMENT	$22,370.16

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$2,365.44	$2,365.44
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$2,365.44

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$100.00	$100.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum (assumed qty)	56.00	mile	1.000	56.00	$7.25	$406.00
						$0.00
					TOTAL SUBCONTRACTS	$506.00

SUMMARY OF COSTS

Labor Cost	$47,308.84	Labor Burden @	49.7%	$0.00	$47,308.84
Material Cost	$2,365.44	Material Tax @	7.8%	$183.32	$2,548.76
Equipment Cost	$22,370.16	Equipment Tax @	0.0%	$0.00	$22,370.16
Subcontractors	$506.00				$506.00
DIRECT COST SUBTOTALS	$72,550			$183	DIRECT COST SUBTOTALS $72,734

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$72,227.76	$10,834.16
Installing Contractors Profit@	8.0%				$72,227.76	$5,778.22
GC Markup on Subs @	5.0%				$506.00	$25.30
					TOTAL MARKUP COSTS	$16,637.69
General Contractors Insurance @	1.0%		on		$89,371.45	$894
Bond @	1.0%		on		$89,371.45	$894
Contingency @	0.0%		on		$91,158.88	$0
					TOTAL COST for pay item	$91,159

Additional Pay Item Notes :

The cooling and lubrication systems for the generator will be a combination of water and oil. These systems will be isolated from the water passages so that no contamination of passing water will occur. Used RS Means, a R13 Crew formed of 1 Forman, 3 Electricians, 1 Oiler, 0 .25 Equipment Crane. 5 Steelworkers to cut adjacent appurtenances and 1 Welder to cut pipes. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling (back and forth).

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.055		Project	: IRON GATE		
Description	: Remove and Dispose of Excitation equipment for 18.975 MVA Generator					
Quantity	: 1.00 EA					
Daily Production	: 1.00 EA per 8 hour shift		Project #	: 4		
Work Days	: 1.0 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $2,384.74 per EA		Probable Low Cost Parameter		1.1	$2,146	$2,146
Total Cost	: $2,385		Probable High Cost Parameter		0.85	$2,742	$2,742

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Laborer	Active	1.00	1.0	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56
Truck Driver (heavy)	Active	1.00	0.5	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
				Labor Hours	28				TOTAL LABOR	$1,336.44
				Equipment Hours	4				TOTAL EQUIPMENT	$446.56

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$66.82	$66.82
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	50.00	LF	1.000	50.00	$0.85	$42.50
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$109.32

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,336.44	Labor Burden @	49.7%	$0.00		$1,336.44
Material Cost	$109.32	Material Tax @	7.8%	$8.47		$117.79
Equipment Cost	$446.56	Equipment Tax @	0.0%	$0.00		$446.56
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$1,892			$8	DIRECT COST SUBTOTALS	$1,901

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,900.79		$285.12
Installing Contractors Profit@	8.0%				$1,900.79		$152.06
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$437.18
General Contractors Insurance @	1.0%			on	$2,337.98		$23
Bond @	1.0%			on	$2,337.98		$23
Contingency @	0.0%			on	$2,384.74		$0
						TOTAL COST for pay item	$2,385

Additional Pay Item Notes :

Used 1 Forman, 1 Electrician to remove the electrical equipment and 1 laborer to haul.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.056		Project	: IRON GATE		
Description	: Remove and Dispose of Surge protection equip. for 18.975 MVA Generator					
Quantity	: 1.00 EA					
Daily Production	: 1.00 EA per 4 hour shift		Project #	: 4		
Work Days	: 1.0 Days		Estimator	: Mihaela Tomulescu		
				EA per	Total Cost	Unit Price Per EA
Unit Price	: $1,891.05 per EA		Probable Low Cost Parameter	1.1	$1,702	$1,702
Total Cost	: $1,891		Probable High Cost Parameter	0.85	$2,175	$2,175

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	4	4.00	L	$47.23	incl. in rate	incl. in rate	$188.92
Electrician	Active	1.00	1.0	4	4.00	L	$45.23	incl. in rate	incl. in rate	$180.92
Laborer	Active	1.00	1.0	4	4.00	L	$45.80	incl. in rate	incl. in rate	$183.20
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.5	4	2.00	E	$221.50	incl. in rate	incl. in rate	$443.00
Truck Driver (heavy)	Active	1.00	0.5	4	2.00	L	$57.59	incl. in rate	incl. in rate	$115.18
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.5	4	2.00	E	$111.64	incl. in rate	incl. in rate	$223.28
Equipment Operator (light)	Active	1.00	0.5	4	2.00	L	$64.90	incl. in rate	incl. in rate	$129.80
				Labor Hours	16				TOTAL LABOR	$798.02
				Equipment Hours	4				TOTAL EQUIPMENT	$666.28

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$39.90	$39.90
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$39.90

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$798.02	Labor Burden @		49.7%	$0.00		$798.02
Material Cost	$39.90	Material Tax @		7.8%	$3.09		$42.99
Equipment Cost	$666.28	Equipment Tax @		0.0%	$0.00		$666.28
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$1,504				$3	DIRECT COST SUBTOTALS	$1,507

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,507.29		$226.09
Installing Contractors Profit@	8.0%				$1,507.29		$120.58
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$346.68
General Contractors Insurance @	1.0%			on	$1,853.97		$19
Bond @	1.0%			on	$1,853.97		$19
Contingency @	0.0%			on	$1,891.05		$0
						TOTAL COST for pay item	$1,891

Additional Pay Item Notes :

Used 1 Forman, 1 Electrician to remove the electrical equipment and 1 laborer to haul.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.057		Project	: IRON GATE		
Description	:	Remove and Dispose of Neutral grounding equip. for 18.975 MVA Generator					
Quantity	:	1.00 EA					
Daily Production	:	1.00 EA per	8 hour shift	Project #	: 4		
Work Days	:	1.0	Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$3,980.33	per EA	Probable Low Cost Parameter		1.1	$3,582	$3,582
Total Cost	:	$3,980		Probable High Cost Parameter		0.85	$4,577	$4,577

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Ironworkers	Active	1.00	1.0	8	8.00	L	$63.95	incl. in rate	incl. in rate	$511.60
Laborer	Active	1.00	1.0	8	8.00	L	$45.80	incl. in rate	incl. in rate	$366.40
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Gas Welding Machine	Active	1.00	1.0	8	8.00	E	$2.88	incl. in rate	incl. in rate	$23.02
Welder	Active	1.00	1.0	8	8.00	L	$7.84	incl. in rate	incl. in rate	$62.70
				Labor Hours	48				TOTAL LABOR	$2,141.10
				Equipment Hours	16				TOTAL EQUIPMENT	$916.14

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$107.06	$107.06
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$107.06

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,141.10	Labor Burden @		49.7%	$0.00	$2,141.10
Material Cost	$107.06	Material Tax @		7.8%	$8.30	$115.35
Equipment Cost	$916.14	Equipment Tax @		0.0%	$0.00	$916.14
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$3,164				$8	DIRECT COST SUBTOTALS $3,173

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,172.59	$475.89
Installing Contractors Profit@	8.0%				$3,172.59	$253.81
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$729.70
General Contractors Insurance @	1.0%		on		$3,902.28	$39
Bond @	1.0%		on		$3,902.28	$39
Contingency @	0.0%		on		$3,980.33	$0
					TOTAL COST for pay item	$3,980

Additional Pay Item Notes :

Used 1 Forman, 1 Electrician, 1 Ironworker and 1 welder to cut rods, to remove the electrical equipment and 1 laborer to haul in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.058	Project	: IRON GATE		
Description	: Remove and Dispose of Station Service Switchgear, 600 volt - (5 sections)				
Quantity	: 1.00 EA				
Daily Production	: 1.00 EA per 8 hour shift	Project #	: 4		
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $7,378.96 per EA	Probable Low Cost Parameter		1.1	$6,641	$6,641
Total Cost	: $7,379	Probable High Cost Parameter		0.85	$8,486	$8,486

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	3.00	1.0	8	24.00	L	$45.23	incl. in rate	incl. in rate	$1,085.52
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Hydraulic Crane (35tn)	Active	1.00	1.0	8	8.00	E	$116.30	incl. in rate	incl. in rate	$930.40
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
				Labor Hours	64				TOTAL LABOR	$3,204.16
				Equipment Hours	16				TOTAL EQUIPMENT	$1,823.52

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$160.21	$160.21
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$160.21

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price		Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum (assumed qty)	1.00	ton		1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum (assumed qty)	28.00	mile		1.000	28.00	$7.25	$203.00
						TOTAL SUBCONTRACTS	$798.00

SUMMARY OF COSTS

Labor Cost	$3,204.16	Labor Burden @	49.7%	$0.00	$3,204.16
Material Cost	$160.21	Material Tax @	7.8%	$12.42	$172.62
Equipment Cost	$1,823.52	Equipment Tax @	0.0%	$0.00	$1,823.52
Subcontractors	$798.00				$798.00
DIRECT COST SUBTOTALS	$5,986			$12	DIRECT COST SUBTOTALS $5,998

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,200.30	$780.05
Installing Contractors Profit@	8.0%				$5,200.30	$416.02
GC Markup on Subs @	5.0%				$798.00	$39.90
					TOTAL MARKUP COSTS	$1,235.97
General Contractors Insurance @	1.0%			on	$7,234.27	$72
Bond @	1.0%			on	$7,234.27	$72
Contingency @	0.0%			on	$7,378.96	$0
					TOTAL COST for pay item	$7,379

Additional Pay Item Notes :

Used 1 Forman, 3 Electrician, 2 laborer to haul with the crane in the truck. Assumed containing hazardous waste that will be disposed at 28 miles away from the construction site. In normal circumstances, decontaminated residual components could be accepted at landfill sites but Polychlorinated biphenyl, otherwise known as PCB, is a synthetic chemical that is widely used for industrial and commercial use as dielectric fluid in transformers and capacitors because of its high resistance to decomposition, low electrical conductivity, low flammability and high heat capacity. Transformer repair, reconditioning and retro-filling facilities are the major industry sectors that contributes to the spread of PCB contamination. Types of PCB Wastes:
PCB wastes are discarded materials that contain PCB or have been contaminated with PCBs and that are without any commercial, industrial, or economic use. For the purpose of this Code of Practice, PCBs wastes are classified as follows: Liquid PCB wastes
o PCB-based dielectric fluids removed from transformers and other equipment
o PCB-based heat transfer and hydraulic fluids Metallic solid wastes
o PCB equipment such as capacitors, transformers, switchgears, circuit breakers, heat transfer systems, etc.
o Contaminated components removed from electrical equipment such as windings; PCB-contaminated containers and equipment such as metal drums, tanks, pumps, metal filters, etc. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.059		Project	: IRON GATE		
Description	: Remove and Dispose of Unit and plant control switchboard					
Quantity	: 1.00 EA					
Daily Production	: 0.20 EA per 8 hour shift		Project #	: 4		
Work Days	: 5.0 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $23,948.92 per EA		Probable Low Cost Parameter		0.22	$21,554	$21,554
Total Cost	: $23,949		Probable High Cost Parameter		0.17	$27,541	$27,541

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	5.0	8	40.00	L	$47.23	incl. in rate	incl. in rate	$1,889.20
Electrician	Active	6.00	5.0	8	240.00	L	$45.23	incl. in rate	incl. in rate	$10,855.20
Loader, FE Rubber Tire (3.5cy)	Active	1.00	2.0	8	16.00	E	$64.23	incl. in rate	incl. in rate	$1,027.68
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Equipment Operator (light)	Active	1.00	2.0	8	16.00	L	$64.90	incl. in rate	incl. in rate	$1,038.40
				Labor Hours	312				TOTAL LABOR	$14,704.24
				Equipment Hours	32				TOTAL EQUIPMENT	$2,813.92

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$735.21	$735.21
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$735.21

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.00	ton	1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
						$0.00
						$0.00
					TOTAL SUBCONTRACTS	$798.00

SUMMARY OF COSTS

Labor Cost	$14,704.24	Labor Burden @	49.7%	$0.00		$14,704.24
Material Cost	$735.21	Material Tax @	7.8%	$56.98		$792.19
Equipment Cost	$2,813.92	Equipment Tax @	0.0%	$0.00		$2,813.92
Subcontractors	$798.00					$798.00
DIRECT COST SUBTOTALS	$19,051			$57	DIRECT COST SUBTOTALS	$19,108

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$19,108.35	$2,866.25
Installing Contractors Profit@	8.0%				$18,310.35	$1,464.83
GC Markup on Subs @	5.0%				$798.00	$39.90
					TOTAL MARKUP COSTS	$4,370.98
General Contractors Insurance @	1.0%			on	$23,479.33	$235
Bond @	1.0%			on	$23,479.33	$235
Contingency @	0.0%			on	$23,948.92	$0
					TOTAL COST for pay item	$23,949

Additional Pay Item Notes :

Used 1 Forman, 6 Electrician including hauling with the loader in the truck. Assumed containing hazardous waste that will be disposed at 200 miles away from the construction site. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.060		Project	: IRONGATE		
Description	:	Remove and Dispose of Battery System - assume 60 batteries, charger					
Quantity	:	1.00 EA					
Daily Production	:	0.33 EA per	8 hour shift	Project #	: 2		
Work Days	:	3.0	Days	Estimator	: Mihaela Tomulesı	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$15,350.22	per EA	Probable Low Cost Parameter	0.363	$13,815	$13,815.20
Total Cost	:	$15,350		Probable High Cost Parameter	0.2805	$17,653	$17,652.76

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	3.0	8	24.00	L	$48.27	$0.00		$1,158.48
Electrician	Active	1.00	3.0	8	24.00	L	$45.23	$0.00		$1,085.52
Equipment Operator (light)	Active	1.00	3.0	8	24.00	L	$64.90	$0.00		$1,557.60
Loader, FE Rubber Tire (3.5cy)	Active	1.00	3.0	8	24.00	E	$64.23	$64.23		$1,541.52
Truck Driver (light)	Active	1.00	3.0	8	24.00	L	$56.29	$0.00		$1,350.96
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	3.0	8	24.00	E	$111.64	$111.64		$2,679.36
Laborer	Active	2.00	3.0	8	48.00	L	$45.80	$0.00		$2,198.40
Welder	Active	1.00	3.0	8	24.00	L	$7.84	$0.00		$188.10
Gas Welding Machine	Active	1.00	3.0	8	24.00	E	$2.88	$2.88		$69.05
				Labor Hours	168				TOTAL LABOR	$7,539.06
				Equipment Hours	72				TOTAL EQUIPMENT	$4,289.93

MATERIAL COSTS

Description	Item Quantity	Order Unit	onversion ctor / Waste		Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS		1.000	1.00	$376.95	$376.95
						TOTAL MATERIAL	$376.95

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$7,539.06	Labor Burden @	49.7%	$0.00		$7,539.06
Material Cost	$376.95	Material Tax @	7.8%	$29.21		$406.17
Equipment Cost	$4,289.93	Equipment Tax @	0.0%	$0.00		$4,289.93
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$12,206			$29	DIRECT COST SUBTOTALS	$12,235

			Cost Basis		
Installing Contractors Overhead@	15.0%		$12,235.15		$1,835.27
Installing Contractors Profit@	8.0%		$12,235.15		$978.81
GC Markup on Subs @	5.0%		$0.00		$0.00
				TOTAL MARKUP COSTS	$2,814.09
General Contractors Insurance @	1.0%	on	$15,049.24		$150
Bond @	1.0%	on	$15,049.24		$150
Contingency @	0.0%	on	$15,350.22		$0
				TOTAL COST for pay item	$15,350

Additional Pay Item Notes :

Assuming 3 days of work disposing around 60 batteries, racks and supports. Using Crews E-19 for metals demolition, E-12 and E-25 for cutting steel and A-3H for equipment disposal, B-34A for hauling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.061	Project	: IRON GATE		
Description	:	Remove and Dispose of Raceways, Bus, Conduit and Cable				
Quantity	:	1.00 EA				
Daily Production	:	0.20 EA per 8 hour shift	Project #	: 4		
Work Days	:	5.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$18,352.70 per EA	Probable Low Cost Parameter		0.22	$16,517	$16,517
Total Cost	:	$18,353	Probable High Cost Parameter		0.17	$21,106	$21,106

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	5.0	8	40.00	L	$47.23	incl. in rate	incl. in rate	$1,889.20
Electrician	Active	2.00	5.0	8	80.00	L	$45.23	incl. in rate	incl. in rate	$3,618.40
Laborer	Active	1.00	5.0	8	40.00	L	$45.80	incl. in rate	incl. in rate	$1,832.00
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	5.0	8	40.00	E	$111.64	incl. in rate	incl. in rate	$4,465.60
Truck Driver (heavy)	Active	1.00	5.0	8	40.00	L	$57.59	incl. in rate	incl. in rate	$2,303.60
				Labor Hours	200				TOTAL LABOR	$9,643.20
				Equipment Hours	40				TOTAL EQUIPMENT	$4,465.60

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$482.16	$482.16
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$482.16

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$9,643.20	Labor Burden @		49.7%	$0.00		$9,643.20
Material Cost	$482.16	Material Tax @		7.8%	$37.37		$519.53
Equipment Cost	$4,465.60	Equipment Tax @		0.0%	$0.00		$4,465.60
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$14,591				$37	DIRECT COST SUBTOTALS	$14,628
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$14,628.33		$2,194.25
Installing Contractors Profit@	8.0%				$14,628.33		$1,170.27
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$3,364.52
General Contractors Insurance @	1.0%			on	$17,992.84		$180
Bond @	1.0%			on	$17,992.84		$180
Contingency @	0.0%			on	$18,352.70		$0
						TOTAL COST for pay item	$18,353

Additional Pay Item Notes :

Used 1 Forman, 2 Electrician, 1 Laborer hauling with the loader in the truck.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.062	Project	: IRON GATE
Description	: Remove and Dispose of Unit and plant control switchboard		
Quantity	: 1.00 EA		
Daily Production	: 0.65 EA per 8 hour shift	Project #	: 4
Work Days	: 1.5 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $5,642.84 per EA		
Total Cost	: $5,643		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	0.715	$5,079	$5,079
Probable High Cost Parameter	0.5525	$6,489	$6,489

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.5	8	12.00	L	$47.23	incl. in rate	incl. in rate	$566.76
Electrician	Active	1.00	1.5	8	12.00	L	$45.23	incl. in rate	incl. in rate	$542.76
Laborer	Active	1.00	1.5	8	12.00	L	$45.80	incl. in rate	incl. in rate	$549.60
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.5	8	12.00	E	$111.64	incl. in rate	incl. in rate	$1,339.68
Truck Driver (heavy)	Active	1.00	1.5	8	12.00	L	$57.59	incl. in rate	incl. in rate	$691.08
				Labor Hours	48				TOTAL LABOR	$2,350.20
				Equipment Hours	12				TOTAL EQUIPMENT	$1,339.68

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$117.51	$117.51
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$117.51

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.00	ton	1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	$798.00

SUMMARY OF COSTS

Labor Cost	$2,350.20	Labor Burden @	49.7%	$0.00	$2,350.20
Material Cost	$117.51	Material Tax @	7.8%	$9.11	$126.62
Equipment Cost	$1,339.68	Equipment Tax @	0.0%	$0.00	$1,339.68
Subcontractors	$798.00				$798.00
DIRECT COST SUBTOTALS	$4,605			$9	DIRECT COST SUBTOTALS $4,614

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,816.50	$572.47
Installing Contractors Profit@	8.0%				$3,816.50	$305.32
GC Markup on Subs @	5.0%				$798.00	$39.90
					TOTAL MARKUP COSTS	$917.69
General Contractors Insurance @	1.0%		on		$5,532.19	$55
Bond @	1.0%		on		$5,532.19	$55
Contingency @	0.0%		on		$5,642.84	$0

TOTAL COST for pay item $5,643

Additional Pay Item Notes :

Used 1 Forman, 6 Electrician including hauling with the loader in the truck. Assumed containing hazardous waste that will be disposed at 200 miles away from the construction site. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.063		Project	: IRON GATE		
Description	: Remove and Dispose of Unit and plant control switchboard					
Quantity	: 1.00 EA					
Daily Production	: 0.65 EA per 8 hour shift		Project #	: 4		
Work Days	: 1.5 Days		Estimator	: Mihaela Tomulescu		
				EA per	Total Cost	Unit Price Per EA
Unit Price	: $9,142.79 per EA		Probable Low Cost Parameter	0.715	$8,229	$8,229
Total Cost	: $9,143		Probable High Cost Parameter	0.5525	$10,514	$10,514

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.5	8	12.00	L	$47.23	incl. in rate	incl. in rate	$566.76
Electrician	Active	3.00	1.5	8	36.00	L	$45.23	incl. in rate	incl. in rate	$1,628.28
Laborer	Active	2.00	1.5	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Truck, Pickup (4x4, 3/4tn)	Active	1.00	1.5	8	12.00	E	$16.94	incl. in rate	incl. in rate	$203.28
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.5	8	12.00	E	$111.64	incl. in rate	incl. in rate	$1,339.68
Loader, FE Rubber Tire (3.5cy)	Active	1.00	1.5	8	12.00	E	$64.23	incl. in rate	incl. in rate	$770.76
Equipment Operator (light)	Active	1.00	1.5	8	12.00	L	$64.90	incl. in rate	incl. in rate	$778.80
				Labor Hours	84				TOTAL LABOR	$4,073.04
				Equipment Hours	36				TOTAL EQUIPMENT	$2,313.72

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$203.65	$203.65
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$203.65

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.00	ton	1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	$798.00

SUMMARY OF COSTS

Labor Cost	$4,073.04	Labor Burden @	49.7%	$0.00		$4,073.04
Material Cost	$203.65	Material Tax @	7.8%	$15.78		$219.44
Equipment Cost	$2,313.72	Equipment Tax @	0.0%	$0.00		$2,313.72
Subcontractors	$798.00					$798.00
DIRECT COST SUBTOTALS	$7,388			$16	DIRECT COST SUBTOTALS	$7,404

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,606.20	$990.93
Installing Contractors Profit@	8.0%				$6,606.20	$528.50
GC Markup on Subs @	5.0%				$798.00	$39.90
					TOTAL MARKUP COSTS	$1,559.32
General Contractors Insurance @	1.0%		on		$8,963.52	$90
Bond @	1.0%		on		$8,963.52	$90
Contingency @	0.0%		on		$9,142.79	$0

TOTAL COST for pay item $9,143

Additional Pay Item Notes :

Used 1 Forman, 3 Electrician, 2 laborer to haul with the loader in the truck. Assumed containing hazardous waste that will be disposed at 200 miles away from the construction site. In normal circumstances, decontaminated residual components could be accepted at landfill sites but Polychlorinated biphenyl, otherwise known as PCB, is a synthetic chemical that is widely used for industrial and commercial use as dielectric fluid in transformers and capacitors because of its high resistance to decomposition, low electrical conductivity, low flammability and high heat capacity. Transformer repair, reconditioning and retro-filling facilities are the major industry sectors that contributes to the spread of PCB contamination. Types of PCB Wastes:
PCB wastes are discarded materials that contain PCB or have been contaminated with PCBs and that are without any commercial, industrial, or economic use. For the purpose of this Code of Practice, PCBs wastes are classified as follows: Liquid PCB wastes
o PCB-based dielectric fluids removed from transformers and other equipment
o PCB-based heat transfer and hydraulic fluids Metallic solid wastes
o PCB equipment such as capacitors, transformers, switchgears, circuit breakers, heat transfer systems, etc.
o Contaminated components removed from electrical equipment such as windings; PCB-contaminated containers and equipment such as metal drums, tanks, pumps, metal filters, etc. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.064		Project	: IRON GATE		
Description	:	Remove and Dispose of Unit and plant control switchboard					
Quantity	:	1.00 EA					
Daily Production	:	1.00 EA per 8 hour shift		Project #	: 4		
Work Days	:	0.5 Days		Estimator	: Mihaela Tomulescu		
					EA per	Total Cost	Unit Price Per EA
Unit Price	:	$489.00 per EA		Probable Low Cost Parameter	1.1	$440	$440
Total Cost	:	$489		Probable High Cost Parameter	0.85	$562	$562

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.5	8	4.00	L	$47.23	incl. in rate	incl. in rate	$188.92
Electrician	Active	1.00	0.5	8	4.00	L	$45.23	incl. in rate	incl. in rate	$180.92
Labor Hours					8				TOTAL LABOR	$369.84
Equipment Hours					0				TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$18.49	$18.49
Selective demolition, torch cutting, steel, 1" thick plate (assumed qty)	0.00	LF	1.000	0.00	$0.85	$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$18.49

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$369.84	Labor Burden @		49.7%	$0.00		$369.84
Material Cost	$18.49	Material Tax @		7.8%	$1.43		$19.93
Equipment Cost	$0.00	Equipment Tax @		0.0%	$0.00		$0.00
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$388				$1	DIRECT COST SUBTOTALS	$390

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$389.77		$58.46
Installing Contractors Profit@	8.0%				$389.77		$31.18
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$89.65
General Contractors Insurance @	1.0%		on		$479.41		$5
Bond @	1.0%		on		$479.41		$5
Contingency @	0.0%		on		$489.00		$0
						TOTAL COST for pay item	$489

Additional Pay Item Notes :

Crew formed of 1 Forman and 1 Electrician.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.066	Project	: IRONGATE			
Description	:	Remove and Dispose of Transformer (3 phase, 300 kVA, 6600/480V est.)					
Quantity	:	1.00 EA					
Daily Production	:	1.00 EA per 8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	1.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$10,482.18 per EA	Probable Low Cost Parameter		1.1	$9,434	$9,434
Total Cost	:	$10,482	Probable High Cost Parameter		0.85	$12,055	$12,055

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	2.00	1.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Hydraulic Crane (50tn)	Active	1.00	1.0	8	8.00	E	$134.32	incl. in rate	incl. in rate	$1,074.56
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Vibratory Hammer & Extractor	Active	1.00	1.0	8	8.00	E	$94.34	incl. in rate	incl. in rate	$754.72
Truck, Utility, with Man-Basket	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Truck Driver (heavy)	Active	2.00	1.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Equipment Operator (light)	Active	2.00	1.0	8	16.00	L	$64.90	incl. in rate	incl. in rate	$1,038.40
				Labor Hours	64				TOTAL LABOR	$3,608.64
				Equipment Hours	40				TOTAL EQUIPMENT	$3,870.72

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$180.43	$180.43
					TOTAL MATERIAL	$180.43

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.00	ton	1.000	1.00	$595.00	$595.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	$798.00

SUMMARY OF COSTS

Labor Cost	$3,608.64	Labor Burden @	49.7%	$0.00		$3,608.64
Material Cost	$180.43	Material Tax @	7.8%	$13.98		$194.42
Equipment Cost	$3,870.72	Equipment Tax @	0.0%	$0.00		$3,870.72
Subcontractors	$798.00					$798.00
DIRECT COST SUBTOTALS	$8,458			$14	DIRECT COST SUBTOTALS	$8,472

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$7,673.78	$1,151.07
Installing Contractors Profit@	8.0%				$7,673.78	$613.90
GC Markup on Subs @	5.0%				$798.00	$39.90
					TOTAL MARKUP COSTS	$1,804.87
General Contractors Insurance @	1.0%		on		$10,276.64	$103
Bond @	1.0%		on		$10,276.64	$103
Contingency @	0.0%		on		$10,482.18	$0
					TOTAL COST for pay item	$10,482

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1 Crane to load the transformer in the truck for disposal. In normal circumstances, decontaminated residual components could be accepted at landfill sites. Transformers of known PCB content over 50 ppm must be handled and disposed of in a manner that adheres to a strict code of Federal regulations (4O CFR Part 761).Transformers and other oil filled equipment that are known to be less than 50 ppm PCB are not regulated. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.067		Project	: Iron Gate		
Description	: Remove and Dispose of Step-up Transformer, outdoor, oil-filled, 3-phase, 18.947 kVA, 6.600/69.000 volt					
Quantity	: 1.00 EA					
Daily Production	: 0.25 EA per 8 hour shift		Project #	: 4		
Work Days	: 4.0 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $85,541.22 per EA		Probable Low Cost Parameter		0.275	$76,987	$76,987
Total Cost	: $85,541		Probable High Cost Parameter		0.2125	$98,372	$98,372

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	2.00	4.0	8	64.00	L	$47.23	incl. in rate	incl. in rate	$3,022.72
Electrician	Active	2.00	4.0	8	64.00	L	$45.23	incl. in rate	incl. in rate	$2,894.72
Laborer	Active	4.00	4.0	8	128.00	L	$45.80	incl. in rate	incl. in rate	$5,862.40
Hydraulic Excavator (6.0cy)	Active	1.00	4.0	8	32.00	E	$322.48	incl. in rate	incl. in rate	$10,319.36
Truck Driver (heavy)	Active	1.00	4.0	8	32.00	L	$57.59	incl. in rate	incl. in rate	$1,842.88
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	4.0	8	32.00	E	$31.90	incl. in rate	incl. in rate	$1,020.80
Crawler Crane (130tn)	Active	2.00	4.0	8	64.00	E	$258.66	incl. in rate	incl. in rate	$16,554.24
Truck, Utility, with Man-Basket	Active	2.00	4.0	8	64.00	E	$31.90	incl. in rate	incl. in rate	$2,041.60
Equipment Operator (crane)	Active	2.00	4.0	8	64.00	L	$68.41	incl. in rate	incl. in rate	$4,378.24
Equipment Operator (medium)	Active	1.00	4.0	8	32.00	L	$66.28	incl. in rate	incl. in rate	$2,120.96
				Labor Hours	384				TOTAL LABOR	$20,121.92
				Equipment Hours	192				TOTAL EQUIPMENT	$29,936.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,006.10	$1,006.10
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$1,006.10

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Disposal fee	1	EA	1.000	1.00	$1,000.00	$1,000.00
Remove oil from oil-filled step-up transformer (allowance for oil containers, filters, etc)	1	EA	1.000	1.00	$13,000.00	$13,000.00
Forklift crew, all-terrain forklift, 45' lift, 35' reach, 9000 lb. capacity, weekly use	1	week	1.000	1.00	$5,961.23	$5,961.23
					TOTAL SUBCONTRACTS	$19,961.23

SUMMARY OF COSTS

Labor Cost	$20,121.92	Labor Burden @	49.7%	$0.00	$20,121.92
Material Cost	$1,006.10	Material Tax @	7.8%	$77.97	$1,084.07
Equipment Cost	$29,936.00	Equipment Tax @	0.0%	$0.00	$29,936.00
Subcontractors	$19,961.23				$19,961.23
DIRECT COST SUBTOTALS	$71,025			$78	DIRECT COST SUBTOTALS $71,103

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$51,141.99	$7,671.30
Installing Contractors Profit@	8.0%				$51,141.99	$4,091.36
GC Markup on Subs @	5.0%				$19,961.23	$998.06
					TOTAL MARKUP COSTS	$12,760.72
General Contractors Insurance @	1.0%			on	$83,863.94	$839
Bond @	1.0%			on	$83,863.94	$839
Contingency @	0.0%			on	$85,541.22	$0
					TOTAL COST for pay item	$85,541

Additional Pay Item Notes :

Weight and dimensions of the transformers have particular importance so transport vehicles must be adequate. A considerable proportion of the weight is due to the oil, so the direct consequence is that the big transformers have to be transported empty. During transport the transformers are filled either by dry air or nitrogen. Because of transportation, the auxiliaries have to be removed . For this reason the collaboration with all the people involved in the project is essential. AECOM best assumption - 2 crew R3 formed of 1 Forman, 1 Electricians, 1 utility man-bucket truck to work on the electrical line, 1 crane for disposal of each transformer in the truck and 2 laborers to remove the auxiliaries and the pad (1 excavator).

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.068	Project	: IRONGATE			
Description	:	Remove and Dispose of Lattice steel structure, with 69-kV disconnect switches and insulators					
Quantity	:	1.00 EA					
Daily Production	:	1.00 EA per 8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	1.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$6,973.83 per EA	Probable Low Cost Parameter		1.1	$6,276	$6,276.45
Total Cost	:	$6,974	Probable High Cost Parameter		0.85	$8,020	$8,019.91

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	$0.00		$370.16
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Hydraulic Crane (35tn)	Active	1.00	1.0	8	8.00	E	$116.30	$116.30		$930.40
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Steelworker	Active	1.00	1.0	8	8.00	L	$65.52	$0.00		$524.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	$111.64		$893.12
Truck Driver (light)	Active	1.00	1.0	8	8.00	L	$56.29	$0.00		$450.32
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	$0.00		$732.80
Gas Welding Machine	Active	1.00	1.0	8	8.00	E	$2.88	$2.88		$23.02
Welder	Active	1.00	1.0	8	8.00	L	$7.84	$0.00		$62.70
				Labor Hours	64				TOTAL LABOR	$3,049.26
				Equipment Hours	24				TOTAL EQUIPMENT	$1,846.54

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$152.46	$152.46
					TOTAL MATERIAL	$152.46

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Rent aerial lift, articulating boom, to 80' high, 500 lb. capacity, diesel - Rent per day (RS Means 01543340)	1.00	days	1.000	1.00	$584.00	$584.00
					TOTAL SUBCONTRACTS	$584.00

SUMMARY OF COSTS

Labor Cost	$3,049.26	Labor Burden @		49.7%	$0.00		$3,049.26
Material Cost	$152.46	Material Tax @		7.8%	$11.82		$164.28
Equipment Cost	$1,846.54	Equipment Tax @		0.0%	$0.00		$1,846.54
Subcontractors	$584.00						$584.00
DIRECT COST SUBTOTALS	$5,632				$12	DIRECT COST SUBTOTALS	$5,644
			TRUE	FALSE	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,060.07		$759.01
Installing Contractors Profit@	8.0%				$5,060.07		$404.81
GC Markup on Subs @	5.0%				$584.00		$29.20
						TOTAL MARKUP COSTS	$1,193.02
General Contractors Insurance @	1.0%		on		$6,837.09		$68
Bond @	1.0%		on		$6,837.09		$68
Contingency @	0.0%		on		$6,973.83		$0
						TOTAL COST for pay item	$6,974

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician disconnect switches and insulators, 2 steelworkers to cut in pieces the structure, 2 laborer to help loading and hauling lattice steel members. It will require the use of steel haul trucks; carry alls, boom cranes. the structure will be dismantle on a basis of top to bottom, thus avoiding any form of collapse or toppling over.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.069	Project	: IRONGATE	
Description	:	Remove and Dispose of Generator Switchgear, outdoor, 7.2kV includes unit breaker (5 sections)			
Quantity	:	1.00 EA			
Daily Production	:	0.50 EA per 8 hour shift	Project #	: Klamath Dams Removal	
Work Days	:	2.0 Days	Estimator	: Mihaela Tomulesc	
Unit Price	:	$24,487.62 per EA			
Total Cost	:	$24,488			

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	0.55	$22,039	$22,038.86
Probable High Cost Parameter	0.425	$28,161	$28,160.77

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	2.0	8	32.00	L	$46.27	$0.00		$1,480.64
Electrician	Active	6.00	2.0	8	96.00	L	$45.23	$0.00		$4,342.08
Hydraulic Crane (50tn)	Active	1.00	2.0	8	16.00	E	$134.32	$134.32		$2,149.12
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	$0.00		$1,094.56
Laborer	Active	4.00	2.0	8	64.00	L	$45.80	$0.00		$2,931.20
Steelworker	Active	2.00	2.0	8	32.00	L	$65.52	$0.00		$2,096.64
				Labor Hours	240				TOTAL LABOR	$11,945.12
				Equipment Hours	16				TOTAL EQUIPMENT	$2,149.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$597.26	$597.26
					TOTAL MATERIAL	$597.26

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit	Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	6.00	ton	1.000	6.00	$595.00	$3,570.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	280.00	mile	1.000	280.00	$7.25	$2,030.00
					TOTAL SUBCONTRACTS	$5,600.00

SUMMARY OF COSTS

Labor Cost	$11,945.12	Labor Burden @	49.7%	$0.00	$11,945.12
Material Cost	$597.26	Material Tax @	7.8%	$46.29	$643.54
Equipment Cost	$2,149.12	Equipment Tax @	0.0%	$0.00	$2,149.12
Subcontractors	$5,600.00				$5,600.00
DIRECT COST SUBTOTALS	$20,291			$46	DIRECT COST SUBTOTALS $20,338

		TRUE	FALSE	Cost Basis	
Installing Contractors Overhead@	15.0%			$14,737.78	$2,210.67
Installing Contractors Profit@	8.0%			$14,737.78	$1,179.02
GC Markup on Subs @	5.0%			$5,600.00	$280.00
				TOTAL MARKUP COSTS	$3,669.69
General Contractors Insurance @	1.0%	on		$24,007.47	$240
Bond @	1.0%	on		$24,007.47	$240
Contingency @	0.0%	on		$24,487.62	$0
				TOTAL COST for pay item	$24,488

Additional Pay Item Notes :

Used 2 Crews (2 sections each weight around 2400 LBS per crew) formed of 1 Forman, 3 Electrician, 2 laborer to haul with the crane in the truck considering one way for each section. Assumed containing hazardous waste that will be disposed (12000 LBS) at 28 miles away from the construction site to Yreka Transfer Recycling .

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.070		**Project**	: IRONGATE		
Description	:	Remove and Dispose of Single Phase Pole Transformers (25 kVA est.)					
Quantity	:	3.00 EA					
Daily Production	:	3.00 EA per	8 hour shift	**Project #**	: Klamath Dams Removal		
Work Days	:	1.0	Days	**Estimator**	: Mihaela Tomulesc	**EA per**	**Total Cost** / **Unit Price Per EA**
Unit Price	:	$2,514.24 per EA		**Probable Low Cost Parameter**		**3.3**	**$6,788** / **$2,262.82**
Total Cost	:	$7,543		**Probable High Cost Parameter**		**2.55**	**$8,674** / **$2,891.38**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	3.00	1.0	8	24.00	L	$47.23	incl. in rate	incl. in rate	$1,133.52
Electrician	Active	3.00	1.0	8	24.00	L	$45.23	incl. in rate	incl. in rate	$1,085.52
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Hydraulic Crane (17tn)	Active	1.00	1.0	8	8.00	E	$81.52	incl. in rate	incl. in rate	$652.16
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Truck, Utility, with Man-Basket	Active	3.00	1.0	8	24.00	E	$31.90	incl. in rate	incl. in rate	$765.60
				Labor Hours	**64**				**TOTAL LABOR**	**$3,227.04**
				Equipment Hours	**40**				**TOTAL EQUIPMENT**	**$2,310.88**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$161.35	$161.35
					TOTAL MATERIAL	**$161.35**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit	Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.25	ton	1.000	0.25	$595.00	$148.75
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	**$351.75**

SUMMARY OF COSTS

Labor Cost	$3,227.04	Labor Burden @	49.7%	$0.00	$3,227.04
Material Cost	$161.35	Material Tax @	7.8%	$12.50	$173.86
Equipment Cost	$2,310.88	Equipment Tax @	0.0%	$0.00	$2,310.88
Subcontractors	$351.75				$351.75
DIRECT COST SUBTOTALS	**$6,051**			**$13**	**DIRECT COST SUBTOTALS** **$6,064**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,711.78	$856.77
Installing Contractors Profit@	8.0%				$5,711.78	$456.94
GC Markup on Subs @	5.0%				$351.75	$17.59
					TOTAL MARKUP COSTS	**$1,331.30**

General Contractors Insurance @	1.0%	on	$7,394.82	$74
Bond @	1.0%	on	$7,394.82	$74
Contingency @	0.0%	on	$7,542.72	$0
			TOTAL COST for pay item	**$7,543**

Additional Pay Item Notes :

Production is based off of RSMs using 3 Crew formed of 1 Forman, 1 Electrician,1 Articulated boom for each transformers. In normal circumstances, decontaminated residual components could be accepted at landfill sites. Transformers of known PCB content over 50 ppm must be handled and disposed of in a manner that adheres to a strict code of Federal regulations.Transformers and other oil filled equipment that are known to be less than 50 ppm PCB are not regulated. Calculated 28 miles from Iron Gate Dam to Yreka Transfer Recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.071	Project	: Iron Gate		
Description	:	Remove Concrete in Penstock Intake Structure				
Quantity	:	460.00 cy				
Daily Production	:	50.00 cy per 8 hour shift	Project #	: 4		
Work Days	:	9.2 Days	Estimator	: Felipe Poletto		
				cy per	Total Cost	Unit Price Per cy
Unit Price	:	$302.54 per cy	Probable Low Cost Parameter	57.5	$118,294	$257.16
Total Cost	:	$139,169	Probable High Cost Parameter	42.5	$160,044	$347.92

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	9.2	8	147.20	L	$48.27	incl. in rate	incl. in rate	$7,105.34
Laborer	Active	8.00	9.2	8	588.80	L	$45.80	incl. in rate	incl. in rate	$26,967.04
Equipment Operator (medium)	Active	2.00	9.2	8	147.20	L	$66.28	incl. in rate	incl. in rate	$9,756.42
Truck Driver (heavy)	Active	1.00	9.2	8	73.60	L	$57.59	incl. in rate	incl. in rate	$4,238.62
Air Compressor 900 cfm	Active	1.00	9.2	8	73.60	E	$38.87	incl. in rate	incl. in rate	$2,860.75
Air Compressor 600 cfm	Active	1.00	9.2	8	73.60	E	$21.74	incl. in rate	incl. in rate	$1,599.98
Air Tool, Chipping Hammer	Active	4.00	9.2	8	294.40	E	$1.64	incl. in rate	incl. in rate	$482.53
Generator, Small Generator, 10 - 15 kW	Active	2.00	9.2	8	147.20	E	$7.04	incl. in rate	incl. in rate	$1,036.29
Hydraulic Excavator (2.5cy)	Active	2.00	9.2	8	147.20	E	$203.63	incl. in rate	incl. in rate	$29,974.34
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	9.2	8	73.60	E	$62.72	incl. in rate	incl. in rate	$4,616.19
Hydraulic Thumbs/Shear Attachment	Active	1.00	9.2	8	73.60	E	$16.39	incl. in rate	incl. in rate	$1,206.30
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	9.2	8	73.60	E	$111.64	incl. in rate	incl. in rate	$8,216.70
			9.2	8	0.00					$0.00
			9.2	8	0.00					$0.00
			9.2	8	0.00					$0.00
			9.2	8	0.00					$0.00
			9.2	8	0.00					$0.00
				Labor Hours	957				TOTAL LABOR	$48,067.42
				Equipment Hours	957				TOTAL EQUIPMENT	$49,993.09

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$2,403.37	$2,403.37
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	$2,403.37

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	3	EA	Cost per Mob	$2,500.00	$7,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$7,500.00

SUMMARY OF COSTS

Labor Cost	$48,067.42	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$48,067.42
Material Cost	$2,403.37	Material Tax @	7.75%	$186.26		$2,589.63
Equipment Cost	$49,993.09	Equipment Tax @	7.75%	$3,874.46		$53,867.56
Subcontractors	$7,500.00					$7,500.00
DIRECT COST SUBTOTALS	$107,964			$4,061	DIRECT COST SUBTOTALS	$112,025

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$104,524.61	$15,678.69
Installing Contractors Profit@	8.0%				$104,524.61	$8,361.97
GC Markup on Subs @	5.0%				$7,500.00	$375.00
					TOTAL MARKUP COSTS	$24,415.66
General Contractors Insurance @	1.0%			on	$136,440.28	$1,364
Bond @	1.0%			on	$136,440.28	$1,364
Contingency @	0.0%			on	$139,169.08	$0
					TOTAL COST for pay item	$139,169

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposal site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET **4.072 Remove Concrete in Penstock Encasement**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.072	Project	: Iron Gate			
Description	:	Remove Concrete in Penstock Encasement					
Quantity	:	710.00 cy					
Daily Production	:	50.00 cy per 8 hour shift	Project #	: 4			
Work Days	:	14.2 Days	Estimator	: Felipe Poletto	cy per	Total Cost	Unit Price Per cy
Unit Price	:	$300.16 per cy	Probable Low Cost Parameter		55	$191,805	$270.15
Total Cost	:	$213,116	Probable High Cost Parameter		42.5	$245,084	$345.19

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	14.2	8	227.20	L	$48.27	incl. in rate	incl. in rate	$10,966.94
Laborer	Active	8.00	14.2	8	908.80	L	$45.80	incl. in rate	incl. in rate	$41,623.04
Equipment Operator (medium)	Active	2.00	14.2	8	227.20	L	$66.28	incl. in rate	incl. in rate	$15,058.82
Truck Driver (heavy)	Active	1.00	14.2	8	113.60	L	$57.59	incl. in rate	incl. in rate	$6,542.22
Air Compressor 900 cfm	Active	1.00	14.2	8	113.60	E	$38.87	incl. in rate	incl. in rate	$4,415.51
Air Compressor 600 cfm	Active	1.00	14.2	8	113.60	E	$21.74	incl. in rate	incl. in rate	$2,469.54
Air Tool, Chipping Hammer	Active	4.00	14.2	8	454.40	E	$1.64	incl. in rate	incl. in rate	$744.78
Generator, Small Generator, 10 - 15 kW	Active	2.00	14.2	8	227.20	E	$7.04	incl. in rate	incl. in rate	$1,599.49
Hydraulic Excavator (2.5cy)	Active	2.00	14.2	8	227.20	E	$203.63	incl. in rate	incl. in rate	$46,264.74
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	14.2	8	113.60	E	$62.72	incl. in rate	incl. in rate	$7,124.99
Hydraulic Thumbs/Shear Attachment	Active	1.00	14.2	8	113.60	E	$16.39	incl. in rate	incl. in rate	$1,861.90
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	14.2	8	113.60	E	$111.64	incl. in rate	incl. in rate	$12,682.30
			14.2	8	0.00					$0.00
			14.2	8	0.00					$0.00
			14.2	8	0.00					$0.00
			14.2	8	0.00					$0.00
			14.2	8	0.00					$0.00
				Labor Hours	1,477				TOTAL LABOR	$74,191.02
				Equipment Hours	1,477				TOTAL EQUIPMENT	$77,163.25

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$3,709.55	$3,709.55
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	$3,709.55

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	4	EA	Cost per Mob	$2,500.00	$10,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$10,000.00

SUMMARY OF COSTS

Labor Cost	$74,191.02	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$74,191.02
Material Cost	$3,709.55	Material Tax @	7.75%	$287.49		$3,997.04
Equipment Cost	$77,163.25	Equipment Tax @	7.75%	$5,980.15		$83,143.40
Subcontractors	$10,000.00					$10,000.00
DIRECT COST SUBTOTALS	$165,064			$6,268	DIRECT COST SUBTOTALS	$171,331

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$161,331.47	$24,199.72
Installing Contractors Profit@	8.0%				$161,331.47	$12,906.52
GC Markup on Subs @	5.0%				$10,000.00	$500.00
					TOTAL MARKUP COSTS	$37,606.24
General Contractors Insurance @	1.0%			on	$208,937.71	$2,089
Bond @	1.0%			on	$208,937.71	$2,089
Contingency @	0.0%			on	$213,116.46	$0
					TOTAL COST for pay item	**$213,116**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposal site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM COST DETAIL WORKSHEET **4.073 Remove Concrete in 3 Penstock Anchors and 7 Penstock Supports**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.073	**Project** : Iron Gate				
Description	: Remove Concrete in 3 Penstock Anchors and 7 Penstock Supports					
Quantity	: 3,110.00 cy					
Daily Production	: 50.00 cy per 8 hour shift	**Project #** : 4				
Work Days	: 62.2 Days	**Estimator** : Felipe Poletto		**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	: $298.85 per cy	**Probable Low Cost Parameter**		**57.5**	**$790,022**	**$254.03**
Total Cost	: $929,437	**Probable High Cost Parameter**		**42.5**	**$1,068,853**	**$343.68**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	62.2	8	995.20	L	$48.27	incl. in rate	incl. in rate	$48,038.30
Laborer	Active	8.00	62.2	8	3,980.80	L	$45.80	incl. in rate	incl. in rate	$182,320.64
Equipment Operator (medium)	Active	2.00	62.2	8	995.20	L	$66.28	incl. in rate	incl. in rate	$65,961.86
Truck Driver (heavy)	Active	1.00	62.2	8	497.60	L	$57.59	incl. in rate	incl. in rate	$28,656.78
Air Compressor 900 cfm	Active	1.00	62.2	8	497.60	E	$38.87	incl. in rate	incl. in rate	$19,341.17
Air Compressor 600 cfm	Active	1.00	62.2	8	497.60	E	$21.74	incl. in rate	incl. in rate	$10,817.29
Air Tool, Chipping Hammer	Active	4.00	62.2	8	1,990.40	E	$1.64	incl. in rate	incl. in rate	$3,262.33
Generator, Small Generator, 10 - 15 kW	Active	2.00	62.2	8	995.20	E	$7.04	incl. in rate	incl. in rate	$7,006.21
Hydraulic Excavator (2.5cy)	Active	2.00	62.2	8	995.20	E	$203.63	incl. in rate	incl. in rate	$202,652.58
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	62.2	8	497.60	E	$62.72	incl. in rate	incl. in rate	$31,209.47
Hydraulic Thumbs/Shear Attachment	Active	1.00	62.2	8	497.60	E	$16.39	incl. in rate	incl. in rate	$8,155.66
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	62.2	8	497.60	E	$111.64	incl. in rate	incl. in rate	$55,552.06
			62.2	8	0.00					$0.00
			62.2	8	0.00					$0.00
			62.2	8	0.00					$0.00
			62.2	8	0.00					$0.00
			62.2	8	0.00					$0.00
				Labor Hours	**6,469**				**TOTAL LABOR**	**$324,977.58**
				Equipment Hours	**6,469**				**TOTAL EQUIPMENT**	**$337,996.78**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$16,248.88	$16,248.88
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	**$16,248.88**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	16	EA	**Cost per Mob**	$2,500.00	$40,000.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$40,000.00**

SUMMARY OF COSTS

Labor Cost	$324,977.58	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$324,977.58
Material Cost	$16,248.88	Material Tax @	7.75%	$1,259.29		$17,508.17
Equipment Cost	$337,996.78	Equipment Tax @	7.75%	$26,194.75		$364,191.53
Subcontractors	$40,000.00					$40,000.00
DIRECT COST SUBTOTALS	**$719,223**			**$27,454**	**DIRECT COST SUBTOTALS**	**$746,677**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$706,677.28	$106,001.59
Installing Contractors Profit@	8.0%				$706,677.28	$56,534.18
GC Markup on Subs @	5.0%				$40,000.00	$2,000.00
					TOTAL MARKUP COSTS	**$164,535.77**
General Contractors Insurance @	1.0%		on		$911,213.06	$9,112
Bond @	1.0%		on		$911,213.06	$9,112
Contingency @	0.0%		on		$929,437.32	$0
					TOTAL COST for pay item	**$929,437**

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposal site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.075		Project : Iron Gate			
Description	:	Remove Concrete in Intake Structure Footbridge Abutment					
Quantity	:	5.00	cy				
Daily Production	:	50.00	cy per 8 hour shift	Project # : 4			
Work Days	:	0.1	Days	Estimator : Felipe Poletto	cy per	Total Cost	Unit Price Per cy
Unit Price	:	$820.58	per cy	Probable Low Cost Parameter	57.5	$3,487	$697.49
Total Cost	:	$4,103		Probable High Cost Parameter	42.5	$4,718	$943.67

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	0.1	8	1.60	L	$48.27	incl. in rate	incl. in rate	$77.23
Laborer	Active	8.00	0.1	8	6.40	L	$45.80	incl. in rate	incl. in rate	$293.12
Equipment Operator (medium)	Active	2.00	0.1	8	1.60	L	$66.28	incl. in rate	incl. in rate	$106.05
Truck Driver (heavy)	Active	1.00	0.1	8	0.80	L	$57.59	incl. in rate	incl. in rate	$46.07
Air Compressor 900 cfm	Active	1.00	0.1	8	0.80	E	$38.87	incl. in rate	incl. in rate	$31.10
Air Compressor 600 cfm	Active	1.00	0.1	8	0.80	E	$21.74	incl. in rate	incl. in rate	$17.39
Air Tool, Chipping Hammer	Active	4.00	0.1	8	3.20	E	$1.64	incl. in rate	incl. in rate	$5.24
Generator, Small Generator, 10 - 15 kW	Active	2.00	0.1	8	1.60	E	$7.04	incl. in rate	incl. in rate	$11.26
Hydraulic Excavator (2.5cy)	Active	2.00	0.1	8	1.60	E	$203.63	incl. in rate	incl. in rate	$325.81
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	0.1	8	0.80	E	$62.72	incl. in rate	incl. in rate	$50.18
Hydraulic Thumbs/Shear Attachment	Active	1.00	0.1	8	0.80	E	$16.39	incl. in rate	incl. in rate	$13.11
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.1	8	0.80	E	$111.64	incl. in rate	incl. in rate	$89.31
			0.1	8	0.00					$0.00
			0.1	8	0.00					$0.00
			0.1	8	0.00					$0.00
			0.1	8	0.00					$0.00
			0.1	8	0.00					$0.00
				Labor Hours	10				TOTAL LABOR	$522.47
				Equipment Hours	10				TOTAL EQUIPMENT	$543.40

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$26.12	$26.12
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	$26.12

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	1	EA	Cost per Mob	$2,500.00	$2,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$2,500.00

SUMMARY OF COSTS

Labor Cost	$522.47	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$522.47
Material Cost	$26.12	Material Tax @	7.75%	$2.02		$28.15
Equipment Cost	$543.40	Equipment Tax @	7.75%	$42.11		$585.52
Subcontractors	$2,500.00					$2,500.00
DIRECT COST SUBTOTALS	$3,592			$44	DIRECT COST SUBTOTALS	$3,636

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$1,136.14	$170.42
Installing Contractors Profit@	8.0%				$1,136.14	$90.89
GC Markup on Subs @	5.0%				$2,500.00	$125.00
					TOTAL MARKUP COSTS	$386.31
General Contractors Insurance @	1.0%			on	$4,022.45	$40
Bond @	1.0%			on	$4,022.45	$40
Contingency @	0.0%			on	$4,102.90	$0
					TOTAL COST for pay item	$4,103

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposal site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.074	Project	: IRONGATE		
Description	:	Remove Steel Footbridge to Intake Structure				
Quantity	:	11,000.00 LBS				
Daily Production	:	10,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	1.1 Days	Estimator	: Mihaela Tomulesı	LBS per	Total Cost / Unit Price Per LBS
Unit Price	:	$1.11 per LBS	Probable Low Cost Parameter		11500	$10,337 / $0.94
Total Cost	:	$12,161	Probable High Cost Parameter		8500	$13,986 / $1.27

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.1	8	8.80	L	$46.27	incl. in rate	incl. in rate	$407.18
Electrician	Active	1.00	1.1	8	8.80	L	$45.23	incl. in rate	incl. in rate	$398.02
Hydraulic Crane (50tn)	Active	1.00	1.1	8	8.80	E	$134.32	incl. in rate	incl. in rate	$1,182.02
Equipment Operator (crane)	Active	1.00	1.1	8	8.80	L	$68.41	incl. in rate	incl. in rate	$602.01
Vibratory Hammer & Extractor	Active	1.00	1.1	8	8.80	E	$94.34	incl. in rate	incl. in rate	$830.19
Laborer	Active	2.00	1.1	8	17.60	L	$45.80	incl. in rate	incl. in rate	$806.08
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.1	8	17.60	E	$111.64	incl. in rate	incl. in rate	$1,964.86
Truck Driver (heavy)	Active	2.00	1.1	8	17.60	L	$57.59	incl. in rate	incl. in rate	$1,013.58
Equipment Operator (light)	Active	1.00	1.1	8	8.80	L	$64.90	incl. in rate	incl. in rate	$571.12
Steelworker	Active	2.00	1.1	8	17.60	L	$65.52	incl. in rate	incl. in rate	$1,153.15
				Labor Hours	88				TOTAL LABOR	$4,951.14
				Equipment Hours	35.2				TOTAL EQUIPMENT	$3,977.07

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$247.56	$247.56
					TOTAL MATERIAL	$247.56

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Rent aerial lift, articulating boom, to 80' high, 500 lb. capacity, diesel - Rent per day (RS Means 01543340)	1.00	days	1.000	1.00	$584.00	$584.00
					TOTAL SUBCONTRACTS	$584.00

SUMMARY OF COSTS

Labor Cost	$4,951.14	Labor Burden @	49.7%	$0.00		$4,951.14
Material Cost	$247.56	Material Tax @	7.8%	$19.19		$266.74
Equipment Cost	$3,977.07	Equipment Tax @	0.0%	$0.00		$3,977.07
Subcontractors	$584.00					$584.00
DIRECT COST SUBTOTALS	$9,760			$19	DIRECT COST SUBTOTALS	$9,779

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$9,194.96		$1,379.24
Installing Contractors Profit@	8.0%				$9,194.96		$735.60
GC Markup on Subs @	5.0%				$584.00		$29.20
						TOTAL MARKUP COSTS	$2,144.04
General Contractors Insurance @	1.0%			on	$11,923.00		$119
Bond @	1.0%			on	$11,923.00		$119
Contingency @	0.0%			on	$12,161.46		$0
						TOTAL COST for pay item	$12,161

Additional Pay Item Notes :

The bridge steel grid, excess steel members and similar materials shall be removed from each span prior to removing the main supporting beams, girders or trusses over land. Assumed crew is formed of 1 Forman, 1 Electrician (tempoary power for tools), 2 steelworkers to cut steel and 2 Laborers (Load, Haul, help with the crane rops, etc).

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.076	Project	: Iron Gate		
Description	: Remove and Dispose of Intake Structure				
Quantity	: 131,630.00 LBS				
Daily Production	: 25,000.00 LBS per 8 hour shift	Project #	: 4		
Work Days	: 5.3 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $1.04 per LBS	Probable Low Cost Parameter		28750	$115,941	$0.88
Total Cost	: $136,401	Probable High Cost Parameter		21250	$156,862	$1.19

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Barge, Bargeman, Deckhand, Fireman, Oiler	Active	1.00	5.3	8	42.40	L	$60.96	incl. in rate	incl. in rate	$2,584.70
Carpenter Foreman (out)	Active	1.00	5.3	8	42.40	L	$46.40	incl. in rate	incl. in rate	$1,967.36
Carpenters, Journeyman	Active	6.00	5.3	8	254.40	L	$65.37	incl. in rate	incl. in rate	$16,630.13
Hydraulic Excavator (6.0cy)	Active	2.00	5.3	8	84.80	E	$322.48	incl. in rate	incl. in rate	$27,346.30
Hydraulic Crane (120tn)	Active	1.00	5.3	8	42.40	E	$239.06	incl. in rate	incl. in rate	$10,136.14
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	5.3	8	42.40	E	$62.72	incl. in rate	incl. in rate	$2,659.33
Truck Driver (heavy)	Active	2.00	5.3	8	84.80	L	$57.59	incl. in rate	incl. in rate	$4,883.63
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	5.3	8	84.80	E	$70.35	incl. in rate	incl. in rate	$5,965.68
				Labor Hours	424				TOTAL LABOR	$26,065.82
				Equipment Hours	254.4				TOTAL EQUIPMENT	$46,107.46

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Permeable Floating Turbidity Barrier	600.00	lf	1.000	600.00	$38.00	$22,800.00
Floating Marker Buoy	7.00	ea	1.000	7.00	$32.00	$224.00
Anchor Systems	13.00	ea	1.000	13.00	$215.00	$2,795.00
Tow Bridles	2.00	ea	1.000	2.00	$50.00	$100.00
Pile Template	1.00	ls	1.000	1.00	$8,000.00	$8,000.00
					TOTAL MATERIAL	$33,919.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$26,065.82	Labor Burden @	49.7%	$0.00		$26,065.82
Material Cost	$33,919.00	Material Tax @	7.8%	$2,628.72		$36,547.72
Equipment Cost	$46,107.46	Equipment Tax @	0.0%	$0.00		$46,107.46
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$106,092			$2,629	DIRECT COST SUBTOTALS	$108,721

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$108,721.00	$16,308.15
Installing Contractors Profit@	8.0%				$108,721.00	$8,697.68
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$25,005.83
General Contractors Insurance @	1.0%		on		$133,726.83	$1,337
Bond @	1.0%		on		$133,726.83	$1,337
Contingency @	0.0%		on		$136,401.37	$0
					TOTAL COST for pay item	$136,401

Additional Pay Item Notes :

AECOM best estimate - the crew is formed of 1 Forman, 6 journeyman working with 2 excavators, 1 hydraulic breaker and 1 crane. Using 2 trucks per day for disposal based on daily production.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.081	**Project**	: Iron Gate		
Description	:	Remove and Dispose of Penstock Vent - 46" Dia, 0.25" Thick x 60'				
Quantity	:	7,440.00 LBS				
Daily Production	:	7,440.00 LBS per 8 hour shift	**Project #**	: 4		
Work Days	:	1.0 Days	**Estimator**	: Mihaela Tomulescu	**LBS per**	**Total Cost** / **Unit Price Per LBS**
Unit Price	:	$2.08 per LBS	**Probable Low Cost Parameter**		**8556**	**$13,146** / **$1.77**
Total Cost	:	$15,466	**Probable High Cost Parameter**		**6324**	**$17,786** / **$2.39**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Steelworker	Active	5.00	1.0	8	40.00	L	$65.52	incl. in rate	incl. in rate	$2,620.80
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Crawler Crane (130tn)	Active	1.00	1.0	8	8.00	E	$258.66	incl. in rate	incl. in rate	$2,069.28
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Hydraulic Excavator (5.0cy)	Active	1.00	1.0	8	8.00	E	$274.63	incl. in rate	incl. in rate	$2,197.04
Welder	Active	1.00	1.0	8	8.00	L	$7.84	incl. in rate	incl. in rate	$62.70
Gas Welding Machine	Active	1.00	1.0	8	8.00	E	$2.88	incl. in rate	incl. in rate	$23.02
Carpenters, Journeyman	Active	5.00	1.0	8	40.00	L	$65.37	incl. in rate	incl. in rate	$2,614.80
Carpenter Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.40	incl. in rate	incl. in rate	$371.20
				Labor Hours	**112**				**TOTAL LABOR**	**$6,586.94**
				Equipment Hours	**32**				**TOTAL EQUIPMENT**	**$5,182.46**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$518.25	$518.25
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	**$518.25**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$6,586.94	Labor Burden @	49.7%	$0.00		$6,586.94
Material Cost	$518.25	Material Tax @	7.8%	$40.16		$558.41
Equipment Cost	$5,182.46	Equipment Tax @	0.0%	$0.00		$5,182.46
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$12,288**			**$40**	**DIRECT COST SUBTOTALS**	**$12,328**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$12,327.81	$1,849.17
Installing Contractors Profit@	8.0%				$12,327.81	$986.22
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$2,835.40**
General Contractors Insurance @	1.0%			on	$15,163.20	$152
Bond @	1.0%			on	$15,163.20	$152
Contingency @	0.0%			on	$15,466.46	$0
					TOTAL COST for pay item	**$15,466**

Additional Pay Item Notes :

AECOM best estimate - the crew is formed of 1 Forman,5 steelworkers and 1 Welder cutting the steel bends, 1 hydraulic breaker and 1 crane. 5 journeymen loading 1 trucks per day for disposal based on daily production.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.082	Project	: Iron Gate		
Description	:	Remove and Dispose of Penstock - 12" Dia, 0.25" Thick x 698'				
Quantity	:	294,428.00 LBS				
Daily Production	:	10,500.00 LBS per 8 hour shift	Project #	: 4		
Work Days	:	28.0 Days	Estimator	: Mihaela Tomulescu		
				LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.47 per LBS	Probable Low Cost Parameter	12075	$368,102	$1.25
Total Cost	:	$433,061	Probable High Cost Parameter	8925	$498,020	$1.69

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	28.0	8	224.00	L	$46.27	incl. in rate	incl. in rate	$10,364.48
Steelworker	Active	5.00	28.0	8	1,120.00	L	$65.52	incl. in rate	incl. in rate	$73,382.40
Equipment Operator (crane)	Active	1.00	28.0	8	224.00	L	$68.41	incl. in rate	incl. in rate	$15,323.84
Crawler Crane (130tn)	Active	1.00	28.0	8	224.00	E	$258.66	incl. in rate	incl. in rate	$57,939.84
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	28.0	8	224.00	E	$111.64	incl. in rate	incl. in rate	$25,007.36
Hydraulic Excavator (5.0cy)	Active	1.00	28.0	8	224.00	E	$274.63	incl. in rate	incl. in rate	$61,517.12
Welder	Active	1.00	28.0	8	224.00	L	$7.84	incl. in rate	incl. in rate	$1,755.60
Gas Welding Machine	Active	1.00	28.0	8	224.00	E	$2.88	incl. in rate	incl. in rate	$644.45
Carpenters, Journeyman	Active	5.00	28.0	8	1,120.00	L	$65.37	incl. in rate	incl. in rate	$73,214.40
Carpenter Foreman (out)	Active	1.00	28.0	8	224.00	L	$46.40	incl. in rate	incl. in rate	$10,393.60
				Labor Hours	3136				TOTAL LABOR	$184,434.32
				Equipment Hours	896				TOTAL EQUIPMENT	$145,108.77

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$14,510.88	$14,510.88
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$14,510.88

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$184,434.32	Labor Burden @	49.7%	$0.00		$184,434.32
Material Cost	$14,510.88	Material Tax @	7.8%	$1,124.59		$15,635.47
Equipment Cost	$145,108.77	Equipment Tax @	0.0%	$0.00		$145,108.77
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$344,054			$1,125	DIRECT COST SUBTOTALS	$345,179

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$345,178.55	$51,776.78
Installing Contractors Profit@	8.0%				$345,178.55	$27,614.28
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$79,391.07
General Contractors Insurance @	1.0%			on	$424,569.62	$4,246
Bond @	1.0%			on	$424,569.62	$4,246
Contingency @	0.0%			on	$433,061.02	$0
					TOTAL COST for pay item	$433,061

Additional Pay Item Notes :

AECOM best estimate - the crew is formed of 1 Forman,5 steelworkers and 1 Welder cutting the steel bends, 1 hydraulic breaker and 1 crane. 5 journeymen loading 1 trucks per day for disposal based on daily production.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.083	Project	: IRONGATE
Description	:	Remove and Dispose of Bypass Outlet - 96" Dia, 0.25" Thick x 50'		
Quantity	:	12,800.00 LBS		
Daily Production	:	43,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	:	0.3 Days	Estimator	: Mihaela Tomulesc
Unit Price	:	$0.90 per LBS		
Total Cost	:	$11,547		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	49450	$9,815	$0.77
Probable High Cost Parameter	36550	$13,279	$1.04

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	3.00	0.3	8	7.20	L	$48.27	$0.00		$347.54
Steelworker	Active	12.00	0.3	8	28.80	L	$65.52	$0.00		$1,886.98
Crawler Crane (270tn)	Active	2.00	0.3	8	4.80	E	$399.50	$446.84		$1,917.60
Equipment Operator (crane)	Active	2.00	0.3	8	4.80	L	$68.41	$0.00		$328.37
Welder	Active	3.00	0.3	8	7.20	L	$7.84	$0.00		$56.43
Gas Welding Machine	Active	3.00	0.3	8	7.20	E	$2.88	$2.88		$20.71
Electrician	Active	1.00	0.3	8	2.40	L	$45.23	$0.00		$108.55
Carpenters, Journeyman	Active	12.00	0.3	8	28.80	L	$65.37	$0.00		$1,882.66
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.3	8	2.40	E	$111.64	$111.64		$267.94
Loader, FE Rubber Tire (8.6cy)	Active	2.00	0.3	8	4.80	E	$221.50	$221.50		$1,063.20
Truck Driver (heavy)	Active	1.00	0.3	8	2.40	L	$57.59	$0.00		$138.22
	Active	2.00	0.3	8	4.80	E	$36.58	$36.58		$175.58
				Labor Hours	81.6				TOTAL LABOR	$4,748.74
				Equipment Hours	24				TOTAL EQUIPMENT	$3,445.03

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$474.87	$474.87
					TOTAL MATERIAL	$474.87

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.64	ton	1.000	0.64	$595.00	$380.80
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	$583.80

SUMMARY OF COSTS

Labor Cost	$4,748.74	Labor Burden @	49.7%	$0.00	$4,748.74
Material Cost	$474.87	Material Tax @	7.8%	$36.80	$511.68
Equipment Cost	$3,445.03	Equipment Tax @	0.0%	$0.00	$3,445.03
Subcontractors	$583.80				$583.80
DIRECT COST SUBTOTALS	$9,252			$37	DIRECT COST SUBTOTALS $9,289

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$8,705.45	$1,305.82
Installing Contractors Profit@	8.0%				$8,705.45	$696.44
GC Markup on Subs @	5.0%				$583.80	$29.19
					TOTAL MARKUP COSTS	$2,031.44
General Contractors Insurance @	1.0%			on	$11,320.70	$113
Bond @	1.0%			on	$11,320.70	$113
Contingency @	0.0%			on	$11,547.11	$0
					TOTAL COST for pay item	$11,547

Additional Pay Item Notes :

Assumed the process of removing and disposing of Bypass Outlet - 96" Dia, 0.25" Thick x 50' (weight: 256 LBS/LF)is done in around 1/2 day by 3 crew formed of 1 forman, 4 jouneymen, 4 steelworkers ;6 equipment operators 1 for each excavator, crane and loader. We dispose pipes with 1 trucks per day for each crew. Assumed contains paint with heavy metals 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, excavator and welding machine.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.084		Project	: IRONGATE		
Description	:	Remove and Dispose of Outlet Valve on bypass outlet - 66" Dia.					
Quantity	:	18,000.00	LBS				
Daily Production	:	9,000.00	LBS per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	2.0	Days	Estimator	: Mihaela Tomulesı	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.62	per LBS	Probable Low Cost Parameter	10350	$24,814	$1.38
Total Cost	:	$29,193		Probable High Cost Parameter	7650	$33,572	$1.87

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	2.0	8	16.00	L	$48.27	$0.00		$772.32
Steelworker	Active	2.00	2.0	8	32.00	L	$65.52	$0.00		$2,096.64
Crawler Crane (270tn)	Active	1.00	2.0	8	16.00	E	$399.50	$446.84		$6,392.00
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	$0.00		$1,094.56
Welder	Active	1.00	2.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	1.00	2.0	8	16.00	E	$2.88	$2.88		$46.03
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	$0.00		$723.68
Carpenters, Journeyman	Active	2.00	2.0	8	32.00	L	$65.37	$0.00		$2,091.84
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.0	8	16.00	E	$111.64	$111.64		$1,786.24
Hydraulic Excavator (6.0cy)	Active	1.00	2.0	8	16.00	E	$322.48	$322.48		$5,159.68
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	$0.00		$921.44
	Active	1.00	2.0	8	16.00	E	$36.58	$36.58		$585.28

Labor Hours	144	TOTAL LABOR	$7,825.88
Equipment Hours	80	TOTAL EQUIPMENT	$13,969.23

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$782.59	$782.59
					TOTAL MATERIAL	$782.59

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit	Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.90	ton	1.000	0.90	$595.00	$535.50
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	$738.50

SUMMARY OF COSTS

Labor Cost	$7,825.88	Labor Burden @	49.7%	$0.00	$7,825.88
Material Cost	$782.59	Material Tax @	7.8%	$60.65	$843.24
Equipment Cost	$13,969.23	Equipment Tax @	0.0%	$0.00	$13,969.23
Subcontractors	$738.50				$738.50
DIRECT COST SUBTOTALS	$23,316			$61	DIRECT COST SUBTOTALS $23,377

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$22,638.35	$3,395.75
Installing Contractors Profit@	8.0%				$22,638.35	$1,811.07
GC Markup on Subs @	5.0%				$738.50	$36.93
					TOTAL MARKUP COSTS	$5,243.75
General Contractors Insurance @	1.0%			on	$28,620.60	$286
Bond @	1.0%			on	$28,620.60	$286
Contingency @	0.0%			on	$29,193.01	$0
					TOTAL COST for pay item	$29,193

Additional Pay Item Notes :

Assumed the process of removing and disposing of Outlet Valve on bypass outlet - 66" Dia. is done in around 1/2 day by crew formed of 1 forman, 2 jouneymen, 2 steelworkers ; 2 equipment operators for excavator, crane. We dispose Outlet Valve with 1 truck. Assumed contains paint with heavy metals 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, excavator and welding machine.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.087		Project	: IRON GATE			
Description	: Remove and Dispose Power Cable and Conduit						
Quantity	: 1.00 EA						
Daily Production	: 0.14 EA per 8 hour shift		Project #	: 4			
Work Days	: 7.1 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $91,734.75 per EA		Probable Low Cost Parameter		0.161	$77,975	$77,975
Total Cost	: $91,735		Probable High Cost Parameter		0.119	$105,495	$105,495

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	2.00	7.1	8	113.60	L	$47.23	incl. in rate	incl. in rate	$5,365.33
Electrician	Active	8.00	7.1	8	454.40	L	$45.23	incl. in rate	incl. in rate	$20,552.51
Laborer	Active	6.00	7.1	8	340.80	L	$45.80	incl. in rate	incl. in rate	$15,608.64
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	7.1	8	56.80	E	$111.64	incl. in rate	incl. in rate	$6,341.15
Truck Driver (heavy)	Active	1.00	7.1	8	56.80	L	$57.59	incl. in rate	incl. in rate	$3,271.11
Equipment Operator (medium)	Active	1.00	7.1	8	56.80	L	$66.28	incl. in rate	incl. in rate	$3,764.70
Hydraulic Excavator (5.0cy)	Active	1.00	7.1	8	56.80	E	$274.63	incl. in rate	incl. in rate	$15,598.98
				Labor Hours	1022.4				TOTAL LABOR	$48,562.30
				Equipment Hours	113.6				TOTAL EQUIPMENT	$21,940.14

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$2,428.11	$2,428.11
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$2,428.11

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$48,562.30	Labor Burden @		49.7%	$0.00		$48,562.30
Material Cost	$2,428.11	Material Tax @		7.8%	$188.18		$2,616.29
Equipment Cost	$21,940.14	Equipment Tax @		0.0%	$0.00		$21,940.14
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$72,931				$188	DIRECT COST SUBTOTALS	$73,119
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$73,118.73		$10,967.81
Installing Contractors Profit@	8.0%				$73,118.73		$5,849.50
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$16,817.31
General Contractors Insurance @	1.0%		on		$89,936.03		$899
Bond @	1.0%		on		$89,936.03		$899
Contingency @	0.0%		on		$91,734.75		$0
						TOTAL COST for pay item	$91,735

Additional Pay Item Notes :

Based on RS Means:26050510- 1. Armored cable, (BX), #8, 3 wire, average 50' runs, electrical demolition, remove we use crew Elec2 (9000 LF); 2. Conduit, rigid galvanized steel, 4" to 6" diameter, electrical demolition, remove conduit to 10' high, including fittings & hangers (1800 LF); 3. Conduit, rigid galvanized steel, 2-1/2" to 3-1/2" diameter, electrical demolition, remove conduit to 10 high, including fittings & hangers (1200 LF)

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.097		Project	: Iron Gate		
Description	: Clear and Grub Disposal Area					
Quantity	: 29.00 AC					
Daily Production	: 1.25 AC per 10 hour shift		Project #	: 4		
Work Days	: 23.2 Days		Estimator	: Eric Jones	AC per	Total Cost	Unit Price Per AC
Unit Price	: $6,292.60 per AC		Probable Low Cost Parameter		1.4375	$155,113	$5,348.71
Total Cost	: $182,485		Probable High Cost Parameter		1.0625	$209,858	$7,236.49

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	23.2	10	232.00	L	$46.27	incl. in rate	incl. in rate	$10,734.64
Equipment Operator (medium)	Active	2.00	23.2	10	464.00	L	$66.28	incl. in rate	incl. in rate	$30,753.92
Laborer	Active	4.00	23.2	10	928.00	L	$45.80	incl. in rate	incl. in rate	$42,502.40
Loader, FE Rubber Tire (5.25cy)	Active	1.00	23.2	10	232.00	E	$75.42	incl. in rate	incl. in rate	$17,497.44
0		2.00	23.2	10	464.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		2.00	23.2	10	464.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		2.00	23.2	10	464.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		2.00	23.2	10	464.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		4.00	23.2	10	928.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	23.2	10	232.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	23.2	10	232.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	23.2	10	232.00	0	$0.00	incl. in rate	incl. in rate	$0.00
Brush Chipper	Active	1.00	23.2	10	232.00	E	$50.55	incl. in rate	incl. in rate	$11,727.60
Crawler Loader 3CY Bucket	Active	1.00	23.2	10	232.00	E	$160.13	incl. in rate	incl. in rate	$37,150.16
Chain Saw, Gas, 36" Long	Active	2.00	23.2	10	464.00	E	$5.63	incl. in rate	incl. in rate	$2,612.32
			23.2	10	0.00					$0.00
			23.2	10	0.00					$0.00
				Labor Hours	1624				TOTAL LABOR	$83,990.96
				Equipment Hours	1160				TOTAL EQUIPMENT	$68,987.52

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		gal	1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$83,990.96	Labor Burden @	0.0%				$83,990.96
Material Cost	$0.00	Material Tax @	7.75%	$0.00			$0.00
Equipment Cost	$68,987.52	Equipment Tax @	7.75%	$5,346.53			$74,334.05
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$152,978			$5,347		DIRECT COST SUBTOTALS	$158,325

		Crew	Material	Subs	Cost Basis		
Installi	5.0%				$158,325.01		$7,916.25
Installi	8.0%				$158,325.01		$12,666.00
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$20,582.25
General Contractors Insurance @	1.0%		on		$178,907.26		$1,789
Bond @	1.0%		on		$178,907.26		$1,789
Contingency @	0.0%		on		$182,485.41		$0
						TOTAL COST for pay item	$182,485

Additional Pay Item Notes :

Crew is based off clear and grub crew B7 off of RSM means. Production for the crew in 1.25 ac per day to clear and process the trees/ shrubs on site. Production was adjust to .75 acres per day, Equipment is B7 off of RSMs no adjustment was made.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.099		Project	: IRONGATE		
Description	: Clear and Grub, 40' width for 1 mile - Prepare Haul Road - 1.25 mi					
Quantity	: 5.00 AC					
Daily Production	: 0.69 AC per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 7.3 Days		Estimator	: Mihaela Tomulescu		
				AC per	Total Cost	Unit Price Per AC
Unit Price	: $5,479.92 per AC		Probable Low Cost Parameter	0.7935	$23,290	$4,658
Total Cost	: $27,400		Probable High Cost Parameter	0.5865	$31,510	$6,302

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	7.3	8	58.00	L	$46.27	incl. in rate	incl. in rate	$2,683.66
Equipment Operator (medium)	Active	1.00	7.3	8	58.00	L	$66.28	incl. in rate	incl. in rate	$3,844.24
Laborer	Active	4.00	7.3	8	232.00	L	$45.80	incl. in rate	incl. in rate	$10,625.60
Grader. 180hp, 13' blade	Active	1.00	7.3	8	58.00	E	$80.79	incl. in rate	incl. in rate	$4,685.82
				Labor Hours	348				TOTAL LABOR	$17,153.50
				Equipment Hours	58				TOTAL EQUIPMENT	$4,685.82

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$17,153.50	Labor Burden @	49.7%	$0.00		$17,153.50
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$4,685.82	Equipment Tax @	0.0%	$0.00		$4,685.82
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$21,839			$0	DIRECT COST SUBTOTALS	$21,839

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$21,839.32	$3,275.90
Installing Contractors Profit@	8.0%				$21,839.32	$1,747.15
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$5,023.04
General Contractors Insurance @	1.0%			on	$26,862.36	$269
Bond @	1.0%			on	$26,862.36	$269
Contingency @	0.0%			on	$27,399.61	$0
					TOTAL COST for pay item	$27,400

Additional Pay Item Notes :

Crew is based off clear and grub crew B7 off of RSM means. Production for the crew in .69 ac per day to clear and process the trees/ strubs on site.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.101	Project	: IRONGATE
Description	: Remove Building No. 2		
Quantity	: 800.00 SF		
Daily Production	: 150.00 SF per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 5.3 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $73.00 per SF		
Total Cost	: $58,404		

	SF per	Total Cost	Unit Price Per SF
Probable Low Cost Parameter	165	$52,563	$66
Probable High Cost Parameter	127.5	$67,164	$84

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	5.3	8	42.64	L	$46.27	incl. in rate	incl. in rate	$1,972.95
Equipment Operator (medium)	Active	2.00	5.3	8	85.28	L	$66.28	incl. in rate	incl. in rate	$5,652.36
Laborer	Active	3.00	5.3	8	127.92	L	$45.80	incl. in rate	incl. in rate	$5,858.74
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	5.3	8	42.64	E	$111.64	incl. in rate	incl. in rate	$4,760.33
Truck Driver (heavy)	Active	1.00	5.3	8	42.64	L	$57.59	incl. in rate	incl. in rate	$2,455.64
Hydraulic Impact Breaker Attachment (2k-3k ft-lb)	Active	1.00	5.3	8	42.64	E	$30.85	incl. in rate	incl. in rate	$1,315.44
Hydraulic Excavator (2.5cy)	Active	2.00	5.3	8	85.28	E	$203.63	incl. in rate	incl. in rate	$17,365.57

Labor Hours	298.48	TOTAL LABOR	$15,939.68
Equipment Hours	170.56	TOTAL EQUIPMENT	$23,441.34

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Harzardous waste disposal	1	LS		$8,400.00	$8,400.00
				TOTAL SUBCONTRACTS	$8,400.00

SUMMARY OF COSTS

Labor Cost	$15,939.68	Labor Burden @	49.7%	$0.00	$15,939.68
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$23,441.34	Equipment Tax @	0.0%	$0.00	$23,441.34
Subcontractors	$8,400.00				$8,400.00
DIRECT COST SUBTOTALS	$47,781			$0	DIRECT COST SUBTOTALS $47,781

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$39,381.02	$5,907.15
Installing Contractors Profit@	8.0%				$39,381.02	$3,150.48
GC Markup on Subs @	5.0%				$8,400.00	$420.00
					TOTAL MARKUP COSTS	$9,477.64
General Contractors Insurance @	1.0%		on		$57,258.66	$573
Bond @	1.0%		on		$57,258.66	$573
Contingency @	0.0%		on		$58,403.83	$0
					TOTAL COST for pay item	$58,404

Additional Pay Item Notes :

The price of removing a building is based on several factors including the size of the space, structural additions on the property, required permits and waste material clearing. A complete demo of a house and its foundation or basement can cost much as $25,000.
The cost of removal can vary based on the area lived in and the typical wages in the region. Some estimates put a price tag of $18,000 on bulldozing a 1,500 square-foot house, while others show that the average estimate is around $4-$15 per square foot.
Hazardous waste can greatly impact the cost of clearing debris. Many older homes contain asbestos, and there are special fees and considerations associated with its removal and disposal. The national average cost to eliminate asbestos is about $200-$700 per hour. We take in consideration this aspect in our estimate assuming 3 Laborers working 3 days, 8 hours per day @$350

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.102	**Project**	: IRONGATE		
Description	:	Remove Building No. 3				
Quantity	:	1,088.00 SF				
Daily Production	:	150.00 SF per 8 hour shift	**Project #**	: Klamath Dams Removal		
Work Days	:	7.3 Days	**Estimator**	: Mihaela Tomulescu	**SF per**	**Total Cost**
Unit Price	:	$75.55 per SF	**Probable Low Cost Parameter**		**165**	**$73,979**
Total Cost	:	$82,199	**Probable High Cost Parameter**		**127.5**	**$94,529**

	Unit Price Per SF
Probable Low Cost Parameter	**$68**
Probable High Cost Parameter	**$87**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	7.3	8	58.00	L	$46.27	incl. in rate	incl. in rate	$2,683.66
Equipment Operator (medium)	Active	2.00	7.3	8	116.00	L	$66.28	incl. in rate	incl. in rate	$7,688.48
Laborer	Active	3.00	7.3	8	174.00	L	$45.80	incl. in rate	incl. in rate	$7,969.20
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	7.3	8	58.00	E	$111.64	incl. in rate	incl. in rate	$6,475.12
Truck Driver (heavy)	Active	1.00	7.3	8	58.00	L	$57.59	incl. in rate	incl. in rate	$3,340.22
Hydraulic Excavator (2.5cy)	Active	2.00	7.3	8	116.00	E	$203.63	incl. in rate	incl. in rate	$23,621.08
Hydraulic Impact Breaker Attachment (2k-3k ft-lb)	Active	1.00	7.3	8	58.00	E	$30.85	incl. in rate	incl. in rate	$1,789.30
				Labor Hours	**406**				**TOTAL LABOR**	**$21,681.56**
				Equipment Hours	**232**				**TOTAL EQUIPMENT**	**$31,885.50**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Harzardous waste disposal	1	LS		$14,000.00	$14,000.00
				TOTAL SUBCONTRACTS	**$14,000.00**

SUMMARY OF COSTS

Labor Cost	$21,681.56	Labor Burden @	49.7%	$0.00	$21,681.56
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$31,885.50	Equipment Tax @	0.0%	$0.00	$31,885.50
Subcontractors	$14,000.00				$14,000.00
DIRECT COST SUBTOTALS	**$67,567**			**$0**	**DIRECT COST SUBTOTALS** **$67,567**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$53,567.06	$8,035.06
Installing Contractors Profit@	8.0%				$53,567.06	$4,285.36
GC Markup on Subs @	5.0%				$14,000.00	$700.00
					TOTAL MARKUP COSTS	**$13,020.42**
General Contractors Insurance @	1.0%		on		$80,587.48	$806
Bond @	1.0%		on		$80,587.48	$806
Contingency @	0.0%		on		$82,199.23	$0
					TOTAL COST for pay item	**$82,199**

Additional Pay Item Notes :

The price of removing a building is based on several factors including the size of the space, structural additions on the property, required permits and waste material clearing. A complete demo of a house and its foundation or basement can cost much as $25,000.
The cost of removal can vary based on the area lived in and the typical wages in the region. Some estimates put a price tag of $18,000 on bulldozing a 1,500 square-foot house, while others show that the average estimate is around $4-$15 per square foot.
Hazardous waste can greatly impact the cost of clearing debris. Many older homes contain asbestos, and there are special fees and considerations associated with its removal and disposal. The national average cost to eliminate asbestos is about $200-$700 per hour. We take in consideration this aspect in our estimate assuming 3 Laborers working 5 days, 8 hours per day @$350

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.103	Project	: Iron Gate			
Description	: Remove Concrete in Fish Ladder					
Quantity	: 1,240.00 cy					
Daily Production	: 50.00 cy per 8 hour shift	Project #	: 4			
Work Days	: 24.8 Days	Estimator	: Felipe Poletto	cy per	Total Cost	Unit Price Per cy
Unit Price	: $300.19 per cy	Probable Low Cost Parameter		57.5	$316,405	$255.17
Total Cost	: $372,241	Probable High Cost Parameter		42.5	$428,077	$345.22

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	24.8	8	396.80	L	$48.27	incl. in rate	incl. in rate	$19,153.54
Laborer	Active	8.00	24.8	8	1,587.20	L	$45.80	incl. in rate	incl. in rate	$72,693.76
Equipment Operator (medium)	Active	2.00	24.8	8	396.80	L	$66.28	incl. in rate	incl. in rate	$26,299.90
Truck Driver (heavy)	Active	1.00	24.8	8	198.40	L	$57.59	incl. in rate	incl. in rate	$11,425.86
Air Compressor 900 cfm	Active	1.00	24.8	8	198.40	E	$38.87	incl. in rate	incl. in rate	$7,711.59
Air Compressor 600 cfm	Active	1.00	24.8	8	198.40	E	$21.74	incl. in rate	incl. in rate	$4,313.00
Air Tool, Chipping Hammer	Active	4.00	24.8	8	793.60	E	$1.64	incl. in rate	incl. in rate	$1,300.74
Generator, Small Generator, 10 - 15 kW	Active	2.00	24.8	8	396.80	E	$7.04	incl. in rate	incl. in rate	$2,793.47
Hydraulic Excavator (2.5cy)	Active	2.00	24.8	8	396.80	E	$203.63	incl. in rate	incl. in rate	$80,800.38
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	24.8	8	198.40	E	$62.72	incl. in rate	incl. in rate	$12,443.65
Hydraulic Thumbs/Shear Attachment	Active	1.00	24.8	8	198.40	E	$16.39	incl. in rate	incl. in rate	$3,251.78
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	24.8	8	198.40	E	$111.64	incl. in rate	incl. in rate	$22,149.38
			24.8	8	0.00					$0.00
			24.8	8	0.00					$0.00
			24.8	8	0.00					$0.00
			24.8	8	0.00					$0.00
			24.8	8	0.00					$0.00
				Labor Hours	2,579				TOTAL LABOR	$129,573.06
				Equipment Hours	2,579				TOTAL EQUIPMENT	$134,763.99

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables (5% labor)	1.00	LS	1.000	1.00	$6,478.65	$6,478.65
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
			1.000	0.00		$0.00
					TOTAL MATERIAL	$6,478.65

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	7	EA	Cost per Mob	$2,500.00	$17,500.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$17,500.00

SUMMARY OF COSTS

Labor Cost	$129,573.06	Labor Burden @	0.0%	$0.00	Included in hourly labor rate.	$129,573.06
Material Cost	$6,478.65	Material Tax @	7.75%	$502.10		$6,980.75
Equipment Cost	$134,763.99	Equipment Tax @	7.75%	$10,444.21		$145,208.20
Subcontractors	$17,500.00					$17,500.00
DIRECT COST SUBTOTALS	$288,316			$10,946	DIRECT COST SUBTOTALS	$299,262

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$281,762.00	$42,264.30
Installing Contractors Profit@	8.0%				$281,762.00	$22,540.96
GC Markup on Subs @	5.0%				$17,500.00	$875.00
					TOTAL MARKUP COSTS	$65,680.26
General Contractors Insurance @	1.0%		on		$364,942.26	$3,649
Bond @	1.0%		on		$364,942.26	$3,649
Contingency @	0.0%		on		$372,241.11	$0
					TOTAL COST for pay item	$372,241

Additional Pay Item Notes :

The work is done by two 6-men crew (foreman, 4 laborers, and 1 equipment operator). Concrete hauling to disposal site - based on the current production rate, only 5 trips a day would be necessary. Demolition is done using hydraulic chipping hammers and excavator mounted claw. Allowance for saw cutting sub is included at one mobilization a week. Blasting method is not found to be feasible for this work. A check using RS Means was used: reference 03055110 ($224/CY, excludes hauling, sawing, and dumping) - Selective concrete demolition, reinforcing more than 2% cross-sectional area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.104	**Project**	: IRONGATE
Description	: Remove Concrete in Holding Ponds #1 thru #6		
Quantity	: 1,380.00 CY		
Daily Production	: 80.00 CY per 8 hour shift	**Project #**	: Klamath Dams Removal
Work Days	: 17.3 Days	**Estimator**	: Mihaela Tomulescu
Unit Price	: $196.04 per CY		
Total Cost	: $270,529		

	CY per	Total Cost	Unit Price Per CY
Probable Low Cost Parameter	88	$243,476	$176
Probable High Cost Parameter	68	$311,109	$225

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	17.3	8	138.40	L	$46.27	incl. in rate	incl. in rate	$6,403.77
Equipment Operator (medium)	Active	3.00	17.3	8	415.20	L	$66.28	incl. in rate	incl. in rate	$27,519.46
Steelworker	Active	3.00	17.3	8	415.20	L	$65.52	incl. in rate	incl. in rate	$27,203.90
Electrician	Active	1.00	17.3	8	138.40	L	$45.23	incl. in rate	incl. in rate	$6,259.83
Truck Driver (heavy)	Active	2.00	17.3	8	276.80	L	$57.59	incl. in rate	incl. in rate	$15,940.91
Vibratory Hammer & Extractor	Active	2.00	17.3	8	276.80	E	$94.34	incl. in rate	incl. in rate	$26,113.31
Hydraulic Excavator (6.0cy)	Active	1.00	17.3	8	138.40	E	$322.48	incl. in rate	incl. in rate	$44,631.23
Loader, FE Rubber Tire (8.6cy)	Active	1.00	17.3	8	138.40	E	$221.50	incl. in rate	incl. in rate	$30,655.60
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	17.3	8	276.80	E	$111.64	incl. in rate	incl. in rate	$30,901.95
				Labor Hours	**1384**				**TOTAL LABOR**	**$83,327.87**
				Equipment Hours	**830.4**				**TOTAL EQUIPMENT**	**$132,302.10**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$83,327.87	Labor Burden @	49.7%	$0.00	$83,327.87
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$132,302.10	Equipment Tax @	0.0%	$0.00	$132,302.10
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$215,630**			**$0**	**DIRECT COST SUBTOTALS** **$215,630**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$215,629.97	$32,344.50
Installing Contractors Profit@	8.0%				$215,629.97	$17,250.40
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$49,594.89**
General Contractors Insurance @	1.0%		on		$265,224.86	$2,652
Bond @	1.0%		on		$265,224.86	$2,652
Contingency @	0.0%		on		$270,529.36	$0
					TOTAL COST for pay item	**$270,529**

Additional Pay Item Notes :

Based on RS.Means - Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9 and B34B - Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.105		Project	: IRONGATE		
Description	: Remove Concrete in Fish Facility Items					
Quantity	: 1,200.00 CY					
Daily Production	: 160.00 CY per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 7.5 Days		Estimator	: Mihaela Tomulescu	CY per	Total Cost	Unit Price Per CY
Unit Price	: $194.03 per CY		Probable Low Cost Parameter		184	$197,908	$165
Total Cost	: $232,832		Probable High Cost Parameter		136	$267,757	$223

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	7.5	8	120.00	L	$46.27	incl. in rate	incl. in rate	$5,552.40
Equipment Operator (medium)	Active	8.00	7.5	8	480.00	L	$66.28	incl. in rate	incl. in rate	$31,814.40
Steelworker	Active	6.00	7.5	8	360.00	L	$65.52	incl. in rate	incl. in rate	$23,587.20
Electrician	Active	1.00	7.5	8	60.00	L	$45.23	incl. in rate	incl. in rate	$2,713.80
Truck Driver (heavy)	Active	2.00	7.5	8	120.00	L	$57.59	incl. in rate	incl. in rate	$6,910.80
Vibratory Hammer & Extractor	Active	3.00	7.5	8	180.00	E	$94.34	incl. in rate	incl. in rate	$16,981.20
Hydraulic Excavator (6.0cy)	Active	3.00	7.5	8	180.00	E	$322.48	incl. in rate	incl. in rate	$58,046.40
Loader, FE Rubber Tire (8.6cy)	Active	2.00	7.5	8	120.00	E	$221.50	incl. in rate	incl. in rate	$26,580.00
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	7.5	8	120.00	E	$111.64	incl. in rate	incl. in rate	$13,396.80
				Labor Hours	1140				TOTAL LABOR	$70,578.60
				Equipment Hours	600				TOTAL EQUIPMENT	$115,004.40

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$70,578.60	Labor Burden @	49.7%	$0.00		$70,578.60
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$115,004.40	Equipment Tax @	0.0%	$0.00		$115,004.40
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$185,583**			**$0**	**DIRECT COST SUBTOTALS**	**$185,583**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$185,583.00		$27,837.45
Installing Contractors Profit@	8.0%				$185,583.00		$14,846.64
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$42,684.09
General Contractors Insurance @	1.0%			on	$228,267.09		$2,283
Bond @	1.0%			on	$228,267.09		$2,283
Contingency @	0.0%			on	$232,832.43		$0
						TOTAL COST for pay item	**$232,832**

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B"

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.106	Project	: IRONGATE		
Description	: Remove Miscellaneous Metalwork in Fish Facilities				
Quantity	: 12,000.00 LBS				
Daily Production	: 43,000.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	: 0.3 Days	Estimator	: Mihaela Tomulesc	LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $0.95 per LBS	Probable Low Cost Parameter	49450	$9,648	$0.80
Total Cost	: $11,351	Probable High Cost Parameter	34400	$13,621	$1.14

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	3.00	0.3	8	7.20	L	$48.27	$0.00		$347.54
Steelworker	Active	12.00	0.3	8	28.80	L	$65.52	$0.00		$1,886.98
Crawler Crane (270tn)	Active	2.00	0.3	8	4.80	E	$399.50	$446.84		$1,917.60
Equipment Operator (crane)	Active	2.00	0.3	8	4.80	L	$68.41	$0.00		$328.37
Welder	Active	3.00	0.3	8	7.20	L	$7.84	$0.00		$56.43
Gas Welding Machine	Active	3.00	0.3	8	7.20	E	$2.88	$2.88		$20.71
Electrician	Active	1.00	0.3	8	2.40	L	$45.23	$0.00		$108.55
Carpenters, Journeyman	Active	12.00	0.3	8	28.80	L	$65.37	$0.00		$1,882.66
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.3	8	2.40	E	$111.64	$111.64		$267.94
Hydraulic Excavator (6.0cy)	Active	1.00	0.3	8	2.40	E	$322.48	$322.48		$773.95
Truck Driver (heavy)	Active	2.00	0.3	8	4.80	L	$57.59	$0.00		$276.43
	Active	2.00	0.3	8	4.80	E	$36.58	$36.58		$175.58
				Labor Hours	84				TOTAL LABOR	$4,886.96
				Equipment Hours	21.6				TOTAL EQUIPMENT	$3,155.79

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$488.70	$488.70
					TOTAL MATERIAL	$488.70

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit	Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.60	ton	1.000	0.60	$595.00	$357.00
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	$560.00

SUMMARY OF COSTS

Labor Cost	$4,886.96	Labor Burden @	49.7%	$0.00		$4,886.96
Material Cost	$488.70	Material Tax @	7.8%	$37.87		$526.57
Equipment Cost	$3,155.79	Equipment Tax @	0.0%	$0.00		$3,155.79
Subcontractors	$560.00					$560.00
DIRECT COST SUBTOTALS	$9,091			$38	DIRECT COST SUBTOTALS	$9,129

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$8,569.31	$1,285.40
Installing Contractors Profit@	8.0%				$8,569.31	$685.55
GC Markup on Subs @	5.0%				$560.00	$28.00
					TOTAL MARKUP COSTS	$1,998.94
General Contractors Insurance @	1.0%			on	$11,128.26	$111
Bond @	1.0%			on	$11,128.26	$111
Contingency @	0.0%			on	$11,350.82	$0
					TOTAL COST for pay item	$11,351

Additional Pay Item Notes :

Assumed the process of removing and disposing of Miscellaneous Metalwork in Fish Facilities (frames, grating, handrails, laddrs, mechanical sweeps) is done in around 1/2 day by 3 crew formed of 1 forman, 4 jouneymen, 4 steelworkers. We dispose metal with 1 trucks per day for each crew. Assumed contains paint with heavy metals 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary. Demolition is done using one crawler crane, excavator and welding machine.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.107	Project	: IRONGATE			
Description	:	Remoce Concrete Associated with 30" Dia. water supply line					
Quantity	:	80.00 CY					
Daily Production	:	150.00 CY per 8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	0.5 Days	Estimator	: Mihaela Tomulescu	CY per	Total Cost	Unit Price Per CY
Unit Price	:	$194.03 per CY	Probable Low Cost Parameter		172.5	$13,194	$165
Total Cost	:	$15,522	Probable High Cost Parameter		127.5	$17,850	$223

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	0.5	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Equipment Operator (medium)	Active	8.00	0.5	8	32.00	L	$66.28	incl. in rate	incl. in rate	$2,120.96
Steelworker	Active	6.00	0.5	8	24.00	L	$65.52	incl. in rate	incl. in rate	$1,572.48
Electrician	Active	1.00	0.5	8	4.00	L	$45.23	incl. in rate	incl. in rate	$180.92
Truck Driver (heavy)	Active	2.00	0.5	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Vibratory Hammer & Extractor	Active	3.00	0.5	8	12.00	E	$94.34	incl. in rate	incl. in rate	$1,132.08
Hydraulic Excavator (6.0cy)	Active	3.00	0.5	8	12.00	E	$322.48	incl. in rate	incl. in rate	$3,869.76
Loader, FE Rubber Tire (8.6cy)	Active	2.00	0.5	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.5	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
				Labor Hours	76				TOTAL LABOR	$4,705.24
				Equipment Hours	40				TOTAL EQUIPMENT	$7,666.96

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$4,705.24	Labor Burden @		49.7%	$0.00		$4,705.24
Material Cost	$0.00	Material Tax @		7.8%	$0.00		$0.00
Equipment Cost	$7,666.96	Equipment Tax @		0.0%	$0.00		$7,666.96
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$12,372				$0	DIRECT COST SUBTOTALS	$12,372
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$12,372.20		$1,855.83
Installing Contractors Profit@	8.0%				$12,372.20		$989.78
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$2,845.61
General Contractors Insurance @	1.0%			on	$15,217.81		$152
Bond @	1.0%			on	$15,217.81		$152
Contingency @	0.0%			on	$15,522.16		$0
						TOTAL COST for pay item	$15,522

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B"

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.108	**Project**	: IRONGATE		
Description	: Remove Concrete in Aerator Structure				
Quantity	: 65.00 CY				
Daily Production	: 50.00 CY per 8 hour shift	**Project #**	: Klamath Dams Removal		
Work Days	: 1.3 Days	**Estimator**	: Mihaela Tomulescu	**CY per**	**Total Cost** / **Unit Price Per CY**
Unit Price	: $191.23 per CY	**Probable Low Cost Parameter**		**57.5**	**$10,565** / **$163**
Total Cost	: $12,430	**Probable High Cost Parameter**		**42.5**	**$14,294** / **$220**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.3	8	10.40	L	$46.27	incl. in rate	incl. in rate	$481.21
Equipment Operator (medium)	Active	2.00	1.3	8	20.80	L	$66.28	incl. in rate	incl. in rate	$1,378.62
Steelworker	Active	3.00	1.3	8	31.20	L	$65.52	incl. in rate	incl. in rate	$2,044.22
Electrician	Active	1.00	1.3	8	10.40	L	$45.23	incl. in rate	incl. in rate	$470.39
Truck Driver (heavy)	Active	1.00	1.3	8	10.40	L	$57.59	incl. in rate	incl. in rate	$598.94
Vibratory Hammer & Extractor	Active	1.00	1.3	8	10.40	E	$94.34	incl. in rate	incl. in rate	$981.14
Hydraulic Excavator (6.0cy)	Active	1.00	1.3	8	10.40	E	$322.48	incl. in rate	incl. in rate	$3,353.79
Truck Driver (heavy)	Active	1.00	1.3	8	10.40	L	$57.59	incl. in rate	incl. in rate	$598.94

Labor Hours	**93.6**	**TOTAL LABOR**	**$5,572.32**
Equipment Hours	**20.8**	**TOTAL EQUIPMENT**	**$4,334.93**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$5,572.32	Labor Burden @	49.7%	$0.00	$5,572.32
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$4,334.93	Equipment Tax @	0.0%	$0.00	$4,334.93
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$9,907**			**$0**	**DIRECT COST SUBTOTALS** **$9,907**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$9,907.25	$1,486.09
Installing Contractors Profit@	8.0%				$9,907.25	$792.58
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$2,278.67**
General Contractors Insurance @	1.0%			on	$12,185.92	$122
Bond @	1.0%			on	$12,185.92	$122
Contingency @	0.0%			on	$12,429.63	$0
					TOTAL COST for pay item	**$12,430**

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B"

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.111		**Project**	: Iron Gate		
Description	:	Remove Asphalt Pavement					
Quantity	:	3,900.00	SF				
Daily Production	:	1,270.00	SF per 8 hour shift	**Project #**	: 4		
Work Days	:	3.1	Days	**Estimator**	: Eric Jones	**SF per**	**Total Cost** / **Unit Price Per SF**
Unit Price	:	$6.54	per SF	**Probable Low Cost Parameter**		**1460.5**	**$21,665** / **$5.56**
Total Cost	:	$25,489		**Probable High Cost Parameter**		**1079.5**	**$29,312** / **$7.52**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.1	8	24.80	L	$46.27	incl. in rate	incl. in rate	$1,147.50
Laborer	Active	2.00	3.1	8	49.60	L	$45.80	incl. in rate	incl. in rate	$2,271.68
Equipment Operator (light)	Active	1.00	3.1	8	24.80	L	$64.90	incl. in rate	incl. in rate	$1,609.52
Equipment Operator (medium)	Active	1.00	3.1	8	24.80	L	$66.28	incl. in rate	incl. in rate	$1,643.74
Hydraulic Excavator (5.0cy)	Active	1.00	3.1	8	24.80	E	$274.63	incl. in rate	incl. in rate	$6,810.82
Hydraulic Impact Breaker Attachment (5k+ ft-lb)	Active	1.00	3.1	8	24.80	E	$62.72	incl. in rate	incl. in rate	$1,555.46
Loader, FE Rubber Tire (5.25cy)	Active	1.00	3.1	8	24.80	E	$75.42	incl. in rate	incl. in rate	$1,870.42
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	3.1	8	24.80	E	$111.64	incl. in rate	incl. in rate	$2,768.67
Truck Driver (heavy)	Active	1.00	3.1	8	24.80	L	$57.59	incl. in rate	incl. in rate	$1,428.23
		1.00	3.1	8	24.80	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	3.1	8	24.80	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	3.1	8	24.80	0	$0.00	incl. in rate	incl. in rate	$0.00
			3.1	8	0.00					$0.00
			3.1	8	0.00					$0.00
			3.1	8	0.00					$0.00
			3.1	8	0.00					$0.00
			3.1	8	0.00					$0.00
				Labor Hours	**148.8**				**TOTAL LABOR**	**$8,100.67**
				Equipment Hours	**99.2**				**TOTAL EQUIPMENT**	**$13,005.37**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
			1.000	0.00	$18.87	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$8,100.67	Labor Burden @	0.0%			$8,100.67
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$13,005.37	Equipment Tax @	7.75%	$1,007.92		$14,013.28
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$21,106**			**$1,008**	**DIRECT COST SUBTOTALS**	**$22,114**

		Crew	Material	Subs	Cost Basis	
Installi	5.0%				$22,113.96	$1,105.70
Installi	8.0%				$22,113.96	$1,769.12
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$2,874.81**

General Contractors Insurance @	1.0%	on	$24,988.77	$250
Bond @	1.0%	on	$24,988.77	$250
Contingency @	0.0%	on	$25,488.55	$0
			TOTAL COST for pay item	**$25,489**

Additional Pay Item Notes :

Crew is built from B38 RSM which has a production of 53 SY an hour or 424 sy/ 3816 SF a day. Production was adjusted to show reaching 1/3 of the production from RSM's due to working in tight area, working around existing structures, and the haul route location/ turnaround time (which will not be fast). Also added an off-road dump truck and truck driver to haul asphalt waste to disposal area.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.112	Project	: IRONGATE		
Description	: Remove Restroom Building near Aerator Structure				
Quantity	: 340.00 SF				
Daily Production	: 205.00 SF per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	: 1.7 Days	Estimator	: Mihaela Tomulescu	SF per	Total Cost	Unit Price Per SF
Unit Price	: $60.38 per SF	Probable Low Cost Parameter	225.5	$18,475	$54
Total Cost	: $20,528	Probable High Cost Parameter	174.25	$23,607	$69

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.7	8	13.28	L	$46.27	incl. in rate	incl. in rate	$614.47
Equipment Operator (medium)	Active	1.00	1.7	8	13.28	L	$66.28	incl. in rate	incl. in rate	$880.20
Laborer	Active	2.00	1.7	8	26.56	L	$45.80	incl. in rate	incl. in rate	$1,216.45
Electrician	Active	1.00	1.7	8	13.28	L	$45.23	incl. in rate	incl. in rate	$600.65
Truck Driver (heavy)	Active	1.00	1.7	8	13.28	L	$57.59	incl. in rate	incl. in rate	$764.80
Steelworker	Active	2.00	1.7	8	26.56	L	$65.52	incl. in rate	incl. in rate	$1,740.21
Hydraulic Excavator (6.0cy)	Active	1.00	1.7	8	13.28	E	$322.48	incl. in rate	incl. in rate	$4,282.53
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.7	8	13.28	E	$111.64	incl. in rate	incl. in rate	$1,482.58
				Labor Hours	106.24				TOTAL LABOR	$5,816.77
				Equipment Hours	26.56				TOTAL EQUIPMENT	$5,765.11

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Harzardous waste disposal	1	LS		$5,600.00	$5,600.00
				TOTAL SUBCONTRACTS	$5,600.00

SUMMARY OF COSTS

Labor Cost	$5,816.77	Labor Burden @	49.7%	$0.00	$5,816.77
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$5,765.11	Equipment Tax @	0.0%	$0.00	$5,765.11
Subcontractors	$5,600.00				$5,600.00
DIRECT COST SUBTOTALS	$17,182			$0	DIRECT COST SUBTOTALS $17,182

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$11,581.89	$1,737.28
Installing Contractors Profit@	8.0%				$11,581.89	$926.55
GC Markup on Subs @	5.0%				$5,600.00	$280.00
					TOTAL MARKUP COSTS	$2,943.83
General Contractors Insurance @	1.0%			on	$20,125.72	$201
Bond @	1.0%			on	$20,125.72	$201
Contingency @	0.0%			on	$20,528.23	$0
					TOTAL COST for pay item	$20,528

Additional Pay Item Notes :

The price of removing a building is based on several factors including the size of the space, structural additions on the property, required permits and waste material clearing. A complete demo of a house and its foundation or basement can cost much as $25,000.
The cost of removal can vary based on the area lived in and the typical wages in the region. Some estimates put a price tag of $18,000 on bulldozing a 1,500 square-foot house, while others show that the average estimate is around $4-$15 per square foot.
Hazardous waste can greatly impact the cost of clearing debris. Many older homes contain asbestos, and there are special fees and considerations associated with its removal and disposal. The national average cost to eliminate asbestos is about $200-$700 per hour. We take in consideration this aspect in our estimate assuming 3 Laborers working 2 days, 8 hours per day @$350

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.113		Project	: IRONGATE		
Description	: Remove Storage Shed near Aerator Structure					
Quantity	: 90.00 SF					
Daily Production	: 160.00 SF per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 0.6 Days		Estimator	: Mihaela Tomulescu		
				SF per	Total Cost	Unit Price Per SF
Unit Price	: $70.22 per SF		Probable Low Cost Parameter	176	$5,688	$63
Total Cost	: $6,320		Probable High Cost Parameter	136	$7,268	$81

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	0.6	8	4.48	L	$46.27	incl. in rate	incl. in rate	$207.29
Equipment Operator (medium)	Active	1.00	0.6	8	4.48	L	$66.28	incl. in rate	incl. in rate	$296.93
Laborer	Active	2.00	0.6	8	8.96	L	$45.80	incl. in rate	incl. in rate	$410.37
Hydraulic Excavator (5.0cy)	Active	1.00	0.6	8	4.48	E	$274.63	incl. in rate	incl. in rate	$1,230.34
Truck Driver (heavy)	Active	1.00	0.6	8	4.48	L	$57.59	incl. in rate	incl. in rate	$258.00
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.6	8	4.48	E	$111.64	incl. in rate	incl. in rate	$500.15
				Labor Hours	22.4				TOTAL LABOR	$1,172.60
				Equipment Hours	8.96				TOTAL EQUIPMENT	$1,730.49

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
						TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Concrete Saw Cutting	1	EA	Cost per Mob	$2,500.00		$2,500.00
					TOTAL SUBCONTRACTS	$2,500.00

SUMMARY OF COSTS

Labor Cost	$1,172.60	Labor Burden @		49.7%	$0.00		$1,172.60
Material Cost	$0.00	Material Tax @		7.8%	$0.00		$0.00
Equipment Cost	$1,730.49	Equipment Tax @		0.0%	$0.00		$1,730.49
Subcontractors	$2,500.00						$2,500.00
DIRECT COST SUBTOTALS	$5,403				$0	DIRECT COST SUBTOTALS	$5,403
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$2,903.08		$435.46
Installing Contractors Profit@	8.0%				$2,903.08		$232.25
GC Markup on Subs @	5.0%				$2,500.00		$125.00
						TOTAL MARKUP COSTS	$792.71
General Contractors Insurance @	1.0%		on		$6,195.79		$62
Bond @	1.0%		on		$6,195.79		$62
Contingency @	0.0%		on		$6,319.71		$0
						TOTAL COST for pay item	$6,320

Additional Pay Item Notes :

The cost of removal can vary based on the area lived in and the typical wages in the region. We assumed that we need 1 Forman, 2 Laboreres and 1 Excavator to load the rubbish in the truck in 1/2 day.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.114	Project	: IRONGATE
Description	: Remove Toe Drain Pipe		
Quantity	: 260.00 LF		
Daily Production	: 225.00 LF per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 1.2 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $27.00 per LF		
Total Cost	: $7,021		

	LF per	Total Cost	Unit Price Per LF
Probable Low Cost Parameter	258.75	$5,968	$23
Probable High Cost Parameter	191.25	$8,074	$31

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.2	8	9.28	L	$46.27	incl. in rate	incl. in rate	$429.39
Equipment Operator (medium)	Active	1.00	1.2	8	9.28	L	$66.28	incl. in rate	incl. in rate	$615.08
Trencher	Active	2.00	1.2	8	18.56	E	$4.07	incl. in rate	incl. in rate	$75.54
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.2	8	9.28	E	$111.64	incl. in rate	incl. in rate	$1,036.02
Truck Driver (heavy)	Active	1.00	1.2	8	9.28	L	$57.59	incl. in rate	incl. in rate	$534.44
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.2	8	9.28	E	$221.50	incl. in rate	incl. in rate	$2,055.52
Laborer	Active	2.00	1.2	8	18.56	L	$45.80	incl. in rate	incl. in rate	$850.05

Labor Hours	46.4	TOTAL LABOR	$2,428.95
Equipment Hours	37.12	TOTAL EQUIPMENT	$3,167.08

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,428.95	Labor Burden @	49.7%	$0.00	$2,428.95
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$3,167.08	Equipment Tax @	0.0%	$0.00	$3,167.08
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$5,596			$0	DIRECT COST SUBTOTALS $5,596

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,596.03	$839.40
Installing Contractors Profit@	8.0%				$5,596.03	$447.68
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,287.09
General Contractors Insurance @	1.0%			on	$6,883.11	$69
Bond @	1.0%			on	$6,883.11	$69
Contingency @	0.0%			on	$7,020.77	$0
					TOTAL COST for pay item	$7,021

Additional Pay Item Notes :

Based on RS>Means (22050510) crew PLUM2 -"Pipe, metal pipe, 8" to 14" diam., selective demolition".

PAY ITEM COST DETAIL WORKSHEET

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.116	**Project**	: Iron Gate			
Description	: Berm Removal					
Quantity	: 53,000.00 cy					
Daily Production	: 2,500.00 cy per 8 hour shift	**Project #**	: 4			
Work Days	: 21.2 Days	**Estimator**	: Michael Barba	**cy per**	**Total Cost**	**Unit Price Per cy**
Unit Price	: $13.82 per cy	**Probable Low Cost Parameter**		**2750**	**$659,302**	**$12.44**
Total Cost	: $732,558	**Probable High Cost Parameter**		**2125**	**$842,442**	**$15.90**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Dozer (235hp)(CATD7)	Active	2.00	21.2	8	339.20	E	$165.11	incl. in rate	incl. in rate	$56,005.31
Loader, FE Rubber Tire (5.25cy)	Active	2.00	21.2	8	339.20	E	$75.42	incl. in rate	incl. in rate	$25,582.46
Truck, Off-Road, Articulated Rear, 20cy	Active	10.00	21.2	8	1,696.00	E	$111.64	incl. in rate	incl. in rate	$189,341.44
Hydraulic Excavator (5.0cy)	Active	2.00	21.2	8	339.20	E	$274.63	incl. in rate	incl. in rate	$93,154.50
Equipment Operator (medium)	Active	6.00	21.2	8	1,017.60	L	$66.28	incl. in rate	incl. in rate	$67,446.53
Truck Driver (heavy)	Active	10.00	21.2	8	1,696.00	L	$57.59	incl. in rate	incl. in rate	$97,672.64
Laborer	Active	2.00	21.2	8	339.20	L	$45.80	incl. in rate	incl. in rate	$15,535.36
Labor Foreman (out)	Active	1.00	21.2	8	169.60	L	$46.27	incl. in rate	incl. in rate	$7,847.39
Truck, Pickup (4x4, 3/4tn)	Active	1.00	21.2	8	169.60	E	$16.94	incl. in rate	incl. in rate	$2,873.02
		0.00	21.2	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	21.2	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	21.2	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			21.2	8	0.00					$0.00
			21.2	8	0.00					$0.00
			21.2	8	0.00					$0.00
			21.2	8	0.00					$0.00
			21.2	8	0.00					$0.00
				Labor Hours	**3222.4**				**TOTAL LABOR**	**$188,501.92**
				Equipment Hours	**2883.2**				**TOTAL EQUIPMENT**	**$366,956.74**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
	0.00	TN	1.300	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ea	1.000	0.00	$0.00	$0.00
	0.00	ls	1.000	0.00	$0.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$188,501.92	Labor Burden @	49.7%	$0.00		$188,501.92
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$366,956.74	Equipment Tax @	7.75%	$28,439.15		$395,395.88
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$555,459**			**$28,439**	**DIRECT COST SUBTOTALS**	**$583,898**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$583,897.80	$87,584.67
Installing Contractors Profit@	8.0%				$583,897.80	$46,711.82
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$134,296.49**
General Contractors Insurance @	1.0%			on	$718,194.30	$7,182
Bond @	1.0%			on	$718,194.30	$7,182
Contingency @	0.0%			on	$732,558.18	$0
					TOTAL COST for pay item	**$732,558**

Additional Pay Item Notes :

Production is based on using 10 each 20 CY dump trucks hauling 14 load per day on average. Excavators will be used to excavate material and load trucks, loader will be used to load trucks and maintain haul roads, dozers will be used to scrape and stock pile material.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.118	Project	: Iron Gate		
Description	: Remove and Dispose of Pipe Conduit, 30" Dia. x 0.25" Thick x 960'				
Quantity	: 76,640.00 LBS				
Daily Production	: 2,500.00 LBS per 8 hour shift	Project #	: 4		
Work Days	: 30.7 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $1.03 per LBS	Probable Low Cost Parameter		2875	$67,106	$0.88
Total Cost	: $78,948	Probable High Cost Parameter		2000	$94,738	$1.24

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Laborer	Active	2.00	30.7	8	491.20	L	$45.80	incl. in rate	incl. in rate	$22,496.96
Equipment Operator (crane)	Active	1.00	30.7	8	245.60	L	$68.41	incl. in rate	incl. in rate	$16,801.50
Hydraulic Crane (17tn)	Active	1.00	30.7	8	245.60	E	$81.52	incl. in rate	incl. in rate	$20,021.31
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
				Labor Hours	744.8				TOTAL LABOR	$39,759.18
				Equipment Hours	253.6				TOTAL EQUIPMENT	$20,914.43

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$2,091.44	$2,091.44
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$2,091.44

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$39,759.18	Labor Burden @		49.7%	$0.00		$39,759.18
Material Cost	$2,091.44	Material Tax @		7.8%	$162.09		$2,253.53
Equipment Cost	$20,914.43	Equipment Tax @		0.0%	$0.00		$20,914.43
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$62,765				$162	DIRECT COST SUBTOTALS	$62,927
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$62,927.14		$9,439.07
Installing Contractors Profit@	8.0%				$62,927.14		$5,034.17
GC Markup on Subs @	5.0%				$0.00		$0.00
				.		TOTAL MARKUP COSTS	$14,473.24
General Contractors Insurance @	1.0%			on	$77,400.38		$774
Bond @	1.0%			on	$77,400.38		$774
Contingency @	0.0%			on	$78,948.39		$0
						TOTAL COST for pay item	$78,948

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 27" to 36" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B12Z .

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.122	Project	: Iron Gate			
Description	:	Remove and Dispose of Piping- 30-in. Dia. x 0.25 Thikness x 90'					
Quantity	:	7,200.00 LBS					
Daily Production	:	7,200.00 LBS per 8 hour shift	Project #	: 4			
Work Days	:	1.0 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.60 per LBS	Probable Low Cost Parameter		8280	$3,682	$0.51
Total Cost	:	$4,332	Probable High Cost Parameter		5760	$5,198	$0.72

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Hydraulic Crane (17tn)	Active	1.00	1.0	8	8.00	E	$81.52	incl. in rate	incl. in rate	$652.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
				Labor Hours	32				TOTAL LABOR	$1,740.80
				Equipment Hours	16				TOTAL EQUIPMENT	$1,545.28

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$154.53	$154.53
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$154.53

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,740.80	Labor Burden @		49.7%	$0.00		$1,740.80
Material Cost	$154.53	Material Tax @		7.8%	$11.98		$166.50
Equipment Cost	$1,545.28	Equipment Tax @		0.0%	$0.00		$1,545.28
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$3,441				$12	DIRECT COST SUBTOTALS	$3,453
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$3,452.58		$517.89
Installing Contractors Profit@	8.0%				$3,452.58		$276.21
GC Markup on Subs @	5.0%				$0.00		$0.00
				.		TOTAL MARKUP COSTS	$794.09
General Contractors Insurance @	1.0%		on		$4,246.68		$42
Bond @	1.0%		on		$4,246.68		$42
Contingency @	0.0%		on		$4,331.61		$0
						TOTAL COST for pay item	$4,332

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 27" to 36" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B12Z .

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.123	Project	: Iron Gate
Description	:	Remove and Dispose of Piping- 24-in. Dia. x 0.25 Thikness x 248'		
Quantity	:	15,872.00 LBS		
Daily Production	:	7,600.00 LBS per 8 hour shift	Project #	: 4
Work Days	:	2.1 Days	Estimator	: Mihaela Tomulescu
Unit Price	:	$0.50 per LBS		
Total Cost	:	$8,005		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	8740	$6,804	$0.43
Probable High Cost Parameter	6080	$9,606	$0.61

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (heavy)	Active	1.00	1.5	8	12.00	L	$57.59	incl. in rate	incl. in rate	$691.08
Laborer	Active	2.00	2.1	8	33.60	L	$45.80	incl. in rate	incl. in rate	$1,538.88
Equipment Operator (crane)	Active	1.00	2.1	8	16.80	L	$68.41	incl. in rate	incl. in rate	$1,149.29
Hydraulic Crane (17tn)	Active	1.00	2.1	8	16.80	E	$81.52	incl. in rate	incl. in rate	$1,369.54
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.5	8	12.00	E	$111.64	incl. in rate	incl. in rate	$1,339.68

Labor Hours	62.4	TOTAL LABOR	$3,379.25
Equipment Hours	28.8	TOTAL EQUIPMENT	$2,709.22

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$270.92	$270.92
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$270.92

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$3,379.25	Labor Burden @	49.7%	$0.00	$3,379.25
Material Cost	$270.92	Material Tax @	7.8%	$21.00	$291.92
Equipment Cost	$2,709.22	Equipment Tax @	0.0%	$0.00	$2,709.22
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$6,359			$21	DIRECT COST SUBTOTALS $6,380

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,380.38	$957.06
Installing Contractors Profit@	8.0%				$6,380.38	$510.43
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,467.49

General Contractors Insurance @	1.0%	on	$7,847.87	$78
Bond @	1.0%	on	$7,847.87	$78
Contingency @	0.0%	on	$8,004.83	$0
			TOTAL COST for pay item	$8,005

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 21" to 24" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B12Z .

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.124	Project	: Iron Gate			
Description	:	Remove and Dispose of Piping- 20-in. Dia. x 0.25 Thikness x 85'					
Quantity	:	4,505.00 LBS					
Daily Production	:	7,600.00 LBS per 8 hour shift	Project #	: 4			
Work Days	:	0.6 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.58 per LBS	Probable Low Cost Parameter		8740	$2,209	$0.49
Total Cost	:	$2,599	Probable High Cost Parameter		6080	$3,119	$0.69

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (heavy)	Active	1.00	0.6	8	4.80	L	$57.59	incl. in rate	incl. in rate	$276.43
Laborer	Active	2.00	0.6	8	9.60	L	$45.80	incl. in rate	incl. in rate	$439.68
Equipment Operator (crane)	Active	1.00	0.6	8	4.80	L	$68.41	incl. in rate	incl. in rate	$328.37
Hydraulic Crane (17tn)	Active	1.00	0.6	8	4.80	E	$81.52	incl. in rate	incl. in rate	$391.30
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.6	8	4.80	E	$111.64	incl. in rate	incl. in rate	$535.87
				Labor Hours	19.2				TOTAL LABOR	$1,044.48
				Equipment Hours	9.6				TOTAL EQUIPMENT	$927.17

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$92.72	$92.72
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$92.72

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,044.48	Labor Burden @	49.7%	$0.00		$1,044.48
Material Cost	$92.72	Material Tax @	7.8%	$7.19		$99.90
Equipment Cost	$927.17	Equipment Tax @	0.0%	$0.00		$927.17
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$2,064			$7	DIRECT COST SUBTOTALS	$2,072

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,071.55	$310.73
Installing Contractors Profit@	8.0%				$2,071.55	$165.72
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$476.46
General Contractors Insurance @	1.0%			on	$2,548.01	$25
Bond @	1.0%			on	$2,548.01	$25
Contingency @	0.0%			on	$2,598.97	$0
					TOTAL COST for pay item	$2,599

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 21" to 24" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B12Z .

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.125	Project	: Iron Gate		
Description	:	Remove and Dispose of Piping- 18-in. Dia. x 0.25 Thikness x 432'				
Quantity	:	29,088.00 LBS				
Daily Production	:	7,900.00 LBS per 8 hour shift	Project #	: 4		
Work Days	:	3.7 Days	Estimator	: Mihaela Tomulescu		
				LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.38 per LBS	Probable Low Cost Parameter	9085	$9,448	$0.32
Total Cost	:	$11,115	Probable High Cost Parameter	6320	$13,338	$0.46

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Laborer	Active	2.00	3.7	8	59.20	L	$45.80	incl. in rate	incl. in rate	$2,711.36
Equipment Operator (crane)	Active	1.00	3.7	8	29.60	L	$68.41	incl. in rate	incl. in rate	$2,024.94
Hydraulic Crane (17tn)	Active	1.00	3.7	8	29.60	E	$81.52	incl. in rate	incl. in rate	$2,412.99
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
				Labor Hours	96.8				TOTAL LABOR	$5,197.02
				Equipment Hours	37.6				TOTAL EQUIPMENT	$3,306.11

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$330.61	$330.61
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$330.61

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$5,197.02	Labor Burden @		49.7%	$0.00		$5,197.02
Material Cost	$330.61	Material Tax @		7.8%	$25.62		$356.23
Equipment Cost	$3,306.11	Equipment Tax @		0.0%	$0.00		$3,306.11
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$8,834				$26	DIRECT COST SUBTOTALS	$8,859
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,859.36		$1,328.90
Installing Contractors Profit@	8.0%				$8,859.36		$708.75
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$2,037.65
General Contractors Insurance @	1.0%		on		$10,897.01		$109
Bond @	1.0%		on		$10,897.01		$109
Contingency @	0.0%		on		$11,114.96		$0
						TOTAL COST for pay item	$11,115

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 15" to 18" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B12Z .

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.126		Project	: Iron Gate			
Description	:	Remove and Dispose of Piping- 16-in. Dia. x 0.25 Thikness x 166'						
Quantity	:	6,972.00	LBS					
Daily Production	:	7,900.00	LBS per 8 hour shift	Project #	: 4			
Work Days	:	0.9	Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.56	per LBS	Probable Low Cost Parameter		9085	$3,314	$0.48
Total Cost	:	$3,898		Probable High Cost Parameter		6320	$4,678	$0.67

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (heavy)	Active	1.00	0.9	8	7.20	L	$57.59	incl. in rate	incl. in rate	$414.65
Laborer	Active	2.00	0.9	8	14.40	L	$45.80	incl. in rate	incl. in rate	$659.52
Equipment Operator (crane)	Active	1.00	0.9	8	7.20	L	$68.41	incl. in rate	incl. in rate	$492.55
Hydraulic Crane (17tn)	Active	1.00	0.9	8	7.20	E	$81.52	incl. in rate	incl. in rate	$586.94
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.9	8	7.20	E	$111.64	incl. in rate	incl. in rate	$803.81
				Labor Hours	28.8				TOTAL LABOR	$1,566.72
				Equipment Hours	14.4				TOTAL EQUIPMENT	$1,390.75

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$139.08	$139.08
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$139.08

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,566.72	Labor Burden @		49.7%	$0.00		$1,566.72
Material Cost	$139.08	Material Tax @		7.8%	$10.78		$149.85
Equipment Cost	$1,390.75	Equipment Tax @		0.0%	$0.00		$1,390.75
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$3,097				$11	DIRECT COST SUBTOTALS	$3,107
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$3,107.33		$466.10
Installing Contractors Profit@	8.0%				$3,107.33		$248.59
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$714.68
General Contractors Insurance @	1.0%		on		$3,822.01		$38
Bond @	1.0%		on		$3,822.01		$38
Contingency @	0.0%		on		$3,898.45		$0
						TOTAL COST for pay item	$3,898

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 15" to 18" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B12Z .

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.127		Project	: Iron Gate		
Description	:	Remove and Dispose of Piping- 12-in. Dia. x 0.25 Thikness x 64'					
Quantity	:	2,176.00 LBS					
Daily Production	:	9,500.00 LBS per 8 hour shift		Project #	: 4		
Work Days	:	0.2 Days		Estimator	: Mihaela Tomulescu		
					LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.46 per LBS		Probable Low Cost Parameter	10925	$843	$0.39
Total Cost	:	$992		Probable High Cost Parameter	7600	$1,190	$0.55

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (heavy)	Active	1.00	0.2	8	1.83	L	$57.59	incl. in rate	incl. in rate	$105.50
Laborer	Active	2.00	0.2	8	3.66	L	$45.80	incl. in rate	incl. in rate	$167.81
Equipment Operator (crane)	Active	1.00	0.2	8	1.83	L	$68.41	incl. in rate	incl. in rate	$125.33
Hydraulic Crane (17tn)	Active	1.00	0.2	8	1.83	E	$81.52	incl. in rate	incl. in rate	$149.34
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.83	E	$111.64	incl. in rate	incl. in rate	$204.52
				Labor Hours	7.328				TOTAL LABOR	$398.64
				Equipment Hours	3.664				TOTAL EQUIPMENT	$353.87

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$35.39	$35.39
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$35.39

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$398.64	Labor Burden @	49.7%	$0.00		$398.64
Material Cost	$35.39	Material Tax @	7.8%	$2.74		$38.13
Equipment Cost	$353.87	Equipment Tax @	0.0%	$0.00		$353.87
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$788			$3	DIRECT COST SUBTOTALS	$791

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$790.64		$118.60
Installing Contractors Profit@	8.0%				$790.64		$63.25
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$181.85
General Contractors Insurance @	1.0%			on	$972.49		$10
Bond @	1.0%			on	$972.49		$10
Contingency @	0.0%			on	$991.94		$0
						TOTAL COST for pay item	$992

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 12" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B6 .

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.128	Project	: Iron Gate
Description	: Remove and Dispose of Piping- 10-in. Dia. x 0.25 Thikness x 69'		
Quantity	: 1,932.00 LBS		
Daily Production	: 10,000.00 LBS per 8 hour shift	Project #	: 4
Work Days	: 0.2 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $0.45 per LBS		
Total Cost	: $864		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	11500	$734	$0.38
Probable High Cost Parameter	8000	$1,036	$0.54

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (light)	Active	1.00	0.2	8	1.60	L	$56.29	incl. in rate	incl. in rate	$90.06
Laborer	Active	2.00	0.2	8	3.20	L	$45.80	incl. in rate	incl. in rate	$146.56
Equipment Operator (crane)	Active	1.00	0.2	8	1.60	L	$68.41	incl. in rate	incl. in rate	$109.46
Hydraulic Crane (17tn)	Active	1.00	0.2	8	1.60	E	$81.52	incl. in rate	incl. in rate	$130.43
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	incl. in rate	incl. in rate	$178.62
				Labor Hours	6.4				TOTAL LABOR	$346.08
				Equipment Hours	3.2				TOTAL EQUIPMENT	$309.06

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$30.91	$30.91
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$30.91

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$346.08	Labor Burden @	49.7%	$0.00	$346.08
Material Cost	$30.91	Material Tax @	7.8%	$2.40	$33.30
Equipment Cost	$309.06	Equipment Tax @	0.0%	$0.00	$309.06
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$686			$2	DIRECT COST SUBTOTALS $688

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$688.44	$103.27
Installing Contractors Profit@	8.0%				$688.44	$55.07
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$158.34
General Contractors Insurance @	1.0%			on	$846.78	$8
Bond @	1.0%			on	$846.78	$8
Contingency @	0.0%			on	$863.71	$0
					TOTAL COST for pay item	$864

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 10" diameter, remove, excludes excavation & Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH. Using CREW B6 .

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.129	Project	: Iron Gate			
Description	:	Remove and Dispose of Piping- 8-in. Dia. x 0.25 Thikness x 30'					
Quantity	:	3,588.00 LBS					
Daily Production	:	18,000.00 LBS per 8 hour shift	Project #	: 4			
Work Days	:	0.2 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.23 per LBS	Probable Low Cost Parameter		20700	$695	$0.19
Total Cost	:	$818	Probable High Cost Parameter		14400	$982	$0.27

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (light)	Active	1.00	0.2	8	1.60	L	$56.29	incl. in rate	incl. in rate	$90.06
Laborer	Active	2.00	0.2	8	3.20	L	$45.80	incl. in rate	incl. in rate	$146.56
Equipment Operator (light)	Active	1.00	0.2	8	1.60	L	$64.90	incl. in rate	incl. in rate	$103.84
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.2	8	1.60	E	$64.23	incl. in rate	incl. in rate	$102.77
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	incl. in rate	incl. in rate	$178.62
				Labor Hours	6.4				TOTAL LABOR	$340.46
				Equipment Hours	3.2				TOTAL EQUIPMENT	$281.39

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$28.14	$28.14
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$28.14

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$340.46	Labor Burden @		49.7%	$0.00		$340.46
Material Cost	$28.14	Material Tax @		7.8%	$2.18		$30.32
Equipment Cost	$281.39	Equipment Tax @		0.0%	$0.00		$281.39
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$650				$2	DIRECT COST SUBTOTALS	$652
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$652.18		$97.83
Installing Contractors Profit@	8.0%				$652.18		$52.17
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$150.00
General Contractors Insurance @	1.0%		on		$802.18		$8
Bond @	1.0%		on		$802.18		$8
Contingency @	0.0%		on		$818.22		$0
						TOTAL COST for pay item	$818

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 8" diameter, remove, excludes excavation, B12Z Crew is formed of 2 laborers loading 1 truck with the crane for disposal based on daily production.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.130	Project	: Iron Gate			
Description	:	Remove and Dispose of Piping- 3-in. Dia. x STD x 30'					
Quantity	:	1,088.00 LBS					
Daily Production	:	18,000.00 LBS per 8 hour shift	Project #	: 4			
Work Days	:	0.1 Days	Estimator	: Mihaela Tomulescu	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$0.38 per LBS	Probable Low Cost Parameter		20700	$350	$0.32
Total Cost	:	$412	Probable High Cost Parameter		14400	$494	$0.45

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Truck Driver (light)	Active	1.00	0.1	8	0.48	L	$56.29	incl. in rate	incl. in rate	$27.02
Laborer	Active	2.00	0.1	8	0.96	L	$45.80	incl. in rate	incl. in rate	$43.97
Equipment Operator (crane)	Active	1.00	0.1	8	0.48	L	$68.41	incl. in rate	incl. in rate	$32.84
Crawler Crane (130tn)	Active	1.00	0.1	8	0.48	E	$258.66	incl. in rate	incl. in rate	$124.16
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.1	8	0.48	E	$111.64	incl. in rate	incl. in rate	$53.59
Truck Driver (heavy)	Active	1.00	0.1	8	0.48	L	$57.59	incl. in rate	incl. in rate	$27.64
				Labor Hours	2.4				TOTAL LABOR	$131.47
				Equipment Hours	0.96				TOTAL EQUIPMENT	$177.74

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc	1.00	LS	1.000	1.00	$17.77	$17.77
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$17.77

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$131.47	Labor Burden @	49.7%	$0.00		$131.47
Material Cost	$17.77	Material Tax @	7.8%	$1.38		$19.15
Equipment Cost	$177.74	Equipment Tax @	0.0%	$0.00		$177.74
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$327			$1	DIRECT COST SUBTOTALS	$328

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$328.36		$49.25
Installing Contractors Profit@	8.0%				$328.36		$26.27
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$75.52
General Contractors Insurance @	1.0%			on	$403.89		$4
Bond @	1.0%			on	$403.89		$4
Contingency @	0.0%			on	$411.96		$0
						TOTAL COST for pay item	$412

Additional Pay Item Notes :

Based on RS Means, Utility removal, pipe, sewer/water, 3" diameter, remove, excludes excavation, B12Z Crew is formed of 2 laborers loading 1 truck with the crane for disposal based on daily production.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.131		Project	: IRONGATE		
Description	: Remove and Dispose of Gate Valves					
Quantity	: 21,792.00 LBS					
Daily Production	: 10,500.00 LBS per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 2.1 Days		Estimator	: Mihaela Tomulesı		
				LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $0.98 per LBS		Probable Low Cost Parameter	12075	$18,116	$0.83
Total Cost	: $21,312		Probable High Cost Parameter	8400	$25,575	$1.17

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	2.00	2.1	8	33.20	L	$48.27	$0.00		$1,602.56
Steelworker	Active	2.00	2.1	8	33.20	L	$65.52	$0.00		$2,175.26
Crawler Crane (90tn)	Active	1.00	2.1	8	16.60	E	$208.09	$208.09		$3,454.29
Equipment Operator (crane)	Active	1.00	2.1	8	16.60	L	$68.41	$0.00		$1,135.61
Welder	Active	2.00	2.1	8	33.20	L	$7.84	$0.00		$260.21
Gas Welding Machine	Active	2.00	2.1	8	33.20	E	$2.88	$2.88		$95.52
Electrician	Active	2.00	2.1	8	33.20	L	$45.23	$0.00		$1,501.64
Carpenters, Journeyman	Active	2.00	2.1	8	33.20	L	$65.37	$0.00		$2,170.28
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	2.1	8	16.60	E	$111.64	$111.64		$1,853.22
Truck Driver (heavy)	Active	1.00	2.1	8	16.60	L	$57.59	$0.00		$955.99
				Labor Hours	199.2				TOTAL LABOR	$9,801.55
				Equipment Hours	66.4				TOTAL EQUIPMENT	$5,403.03

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$980.16	$980.16
					TOTAL MATERIAL	$980.16

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	1.09	ton	1.000	1.09	$595.00	$648.31
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	$851.31

SUMMARY OF COSTS

Labor Cost	$9,801.55	Labor Burden @	49.7%	$0.00		$9,801.55
Material Cost	$980.16	Material Tax @	7.8%	$75.96		$1,056.12
Equipment Cost	$5,403.03	Equipment Tax @	0.0%	$0.00		$5,403.03
Subcontractors	$851.31					$851.31
DIRECT COST SUBTOTALS	$17,036			$76	DIRECT COST SUBTOTALS	$17,112

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$16,260.70	$2,439.11
Installing Contractors Profit@	8.0%				$16,260.70	$1,300.86
GC Markup on Subs @	5.0%				$851.31	$42.57
					TOTAL MARKUP COSTS	$3,782.53
General Contractors Insurance @	1.0%		on		$20,894.54	$209
Bond @	1.0%		on		$20,894.54	$209
Contingency @	0.0%		on		$21,312.43	$0
					TOTAL COST for pay item	$21,312

Additional Pay Item Notes :

Assumed the process of removing and disposing of 18 Gate Valves between 3" to 24"is done in around 1 day by crews formed of forman, jouneymen, steelworkers. We dispose metal with 1 trucks per day for each crew. Assumed contains paint with heavy metals 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.132		Project	: IRONGATE		
Description	:	Remove and Dispose of Basin #1					
Quantity	:	2,880.00 LBS					
Daily Production	:	2,880.00 LBS per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	:	1.0 Days		Estimator	: Mihaela Tomulese	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$2.89 per LBS		Probable Low Cost Parameter		3312	$7,086	$2.46
Total Cost	:	$8,336		Probable High Cost Parameter		2304	$10,003	$3.47

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	$0.00		$386.16
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	$0.00		$1,048.32
Crawler Crane (90tn)	Active	1.00	1.0	8	8.00	E	$208.09	$208.09		$1,664.72
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Welder	Active	2.00	1.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	$2.88		$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Carpenters, Journeyman	Active	1.00	1.0	8	8.00	L	$65.37	$0.00		$522.96
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	$31.90		$255.20
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
				Labor Hours	72				TOTAL LABOR	$3,452.68
				Equipment Hours	32				TOTAL EQUIPMENT	$1,965.95

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$345.27	$345.27
					TOTAL MATERIAL	$345.27

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Stop log lifter - Rent per day	1.00	day	1.000	1.00	$1,000.00	$1,000.00
					TOTAL SUBCONTRACTS	$1,000.00

SUMMARY OF COSTS

Labor Cost	$3,452.68	Labor Burden @	49.7%	$0.00		$3,452.68
Material Cost	$345.27	Material Tax @	7.8%	$26.76		$372.03
Equipment Cost	$1,965.95	Equipment Tax @	0.0%	$0.00		$1,965.95
Subcontractors	$1,000.00					$1,000.00
DIRECT COST SUBTOTALS	$6,764			$27	DIRECT COST SUBTOTALS	$6,791

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,790.66		$868.60
Installing Contractors Profit@	8.0%				$5,790.66		$463.25
GC Markup on Subs @	5.0%				$1,000.00		$50.00
						TOTAL MARKUP COSTS	$1,381.85
General Contractors Insurance @	1.0%		on		$8,172.51		$82
Bond @	1.0%		on		$8,172.51		$82
Contingency @	0.0%		on		$8,335.96		$0
						TOTAL COST for pay item	**$8,336**

Additional Pay Item Notes :

Assumed the process of removing and disposing of basin#6 (manually operated 18" slide gate and stop logs) is done in around 1 day by crew formed of forman, jouneymen, steelworkers. We dispose metal with 1 trucks per day for each crew. Assumed contains petroleum products 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.133		Project	: IRONGATE		
Description	: Remove and Dispose of Basin #2					
Quantity	: 3,660.00 LBS					
Daily Production	: 3,660.00 LBS per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 1.0 Days		Estimator	: Mihaela Tomulesc	LBS per	Total Cost	Unit Price Per LBS
Unit Price	: $2.28 per LBS		Probable Low Cost Parameter		4209	$7,086	$1.94
Total Cost	: $8,336		Probable High Cost Parameter		2928	$10,003	$2.73

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	$0.00		$386.16
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	$0.00		$1,048.32
Crawler Crane (90tn)	Active	1.00	1.0	8	8.00	E	$208.09	$208.09		$1,664.72
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Welder	Active	2.00	1.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	$2.88		$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Carpenters, Journeyman	Active	1.00	1.0	8	8.00	L	$65.37	$0.00		$522.96
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	$31.90		$255.20
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
				Labor Hours	72				TOTAL LABOR	$3,452.68
				Equipment Hours	32				TOTAL EQUIPMENT	$1,965.95

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$345.27	$345.27
					TOTAL MATERIAL	$345.27

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Stop log lifter - Rent per day	1.00	day	1.000	1.00	$1,000.00	$1,000.00
					TOTAL SUBCONTRACTS	$1,000.00

SUMMARY OF COSTS

Labor Cost	$3,452.68	Labor Burden @	49.7%	$0.00		$3,452.68
Material Cost	$345.27	Material Tax @	7.8%	$26.76		$372.03
Equipment Cost	$1,965.95	Equipment Tax @	0.0%	$0.00		$1,965.95
Subcontractors	$1,000.00					$1,000.00
DIRECT COST SUBTOTALS	$6,764			$27	DIRECT COST SUBTOTALS	$6,791

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,790.66		$868.60
Installing Contractors Profit@	8.0%				$5,790.66		$463.25
GC Markup on Subs @	5.0%				$1,000.00		$50.00
						TOTAL MARKUP COSTS	$1,381.85
General Contractors Insurance @	1.0%		on		$8,172.51		$82
Bond @	1.0%		on		$8,172.51		$82
Contingency @	0.0%		on		$8,335.96		$0
						TOTAL COST for pay item	$8,336

Additional Pay Item Notes :

Assumed the process of removing and disposing of basin#6 (manually operated 18" slide gate and stop logs) is done in around 1 day by crew formed of forman, jouneymen, steelworkers. We dispose metal with 1 trucks per day for each crew. Assumed contains petroleum products 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.134	Project	: IRONGATE			
Description	:	Remove and Dispose of Basin #3					
Quantity	:	2,880.00 LBS					
Daily Production	:	2,880.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	1.0 Days	Estimator	: Mihaela Tomulesc	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$2.89 per LBS	Probable Low Cost Parameter		3312	$7,086	$2.46
Total Cost	:	$8,336	Probable High Cost Parameter		2304	$10,003	$3.47

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	$0.00		$386.16
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	$0.00		$1,048.32
Crawler Crane (90tn)	Active	1.00	1.0	8	8.00	E	$208.09	$208.09		$1,664.72
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Welder	Active	2.00	1.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	$2.88		$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Carpenters, Journeyman	Active	1.00	1.0	8	8.00	L	$65.37	$0.00		$522.96
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	$31.90		$255.20
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
				Labor Hours	72				TOTAL LABOR	$3,452.68
				Equipment Hours	32				TOTAL EQUIPMENT	$1,965.95

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$345.27	$345.27
					TOTAL MATERIAL	$345.27

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Stop log lifter - Rent per day	1.00	day	1.000	1.00	$1,000.00	$1,000.00
					TOTAL SUBCONTRACTS	$1,000.00

SUMMARY OF COSTS

Labor Cost	$3,452.68	Labor Burden @	49.7%	$0.00		$3,452.68
Material Cost	$345.27	Material Tax @	7.8%	$26.76		$372.03
Equipment Cost	$1,965.95	Equipment Tax @	0.0%	$0.00		$1,965.95
Subcontractors	$1,000.00					$1,000.00
DIRECT COST SUBTOTALS	$6,764			$27	DIRECT COST SUBTOTALS	$6,791

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,790.66	$868.60
Installing Contractors Profit@	8.0%				$5,790.66	$463.25
GC Markup on Subs @	5.0%				$1,000.00	$50.00
					TOTAL MARKUP COSTS	$1,381.85
General Contractors Insurance @	1.0%		on		$8,172.51	$82
Bond @	1.0%		on		$8,172.51	$82
Contingency @	0.0%		on		$8,335.96	$0
					TOTAL COST for pay item	$8,336

Additional Pay Item Notes :

Assumed the process of removing and disposing of basin#6 (manually operated 18" slide gate and stop logs) is done in around 1 day by crew formed of forman, jouneymen, steelworkers. We dispose metal with 1 trucks per day for each crew. Assumed contains petroleum products 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary.

PAY ITEM INFORMATION

PAY ITEM NUMBER :	4.135	**Project**	: IRONGATE
Description :	Remove and Dispose of Basin #4		
Quantity :	3,580.00 LBS		
Daily Production :	3,580.00 LBS per 8 hour shift	**Project #**	: Klamath Dams Removal
Work Days :	1.0 Days	**Estimator**	: Mihaela Tomulesc
Unit Price :	$2.33 per LBS		
Total Cost :	$8,336		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	4117	$7,086	$1.98
Probable High Cost Parameter	2864	$10,003	$2.79

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	$0.00		$386.16
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	$0.00		$1,048.32
Crawler Crane (90tn)	Active	1.00	1.0	8	8.00	E	$208.09	$208.09		$1,664.72
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Welder	Active	2.00	1.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	$2.88		$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Carpenters, Journeyman	Active	1.00	1.0	8	8.00	L	$65.37	$0.00		$522.96
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	$31.90		$255.20
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72

Labor Hours	72	**TOTAL LABOR**	**$3,452.68**
Equipment Hours	32	**TOTAL EQUIPMENT**	**$1,965.95**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$345.27	$345.27
					TOTAL MATERIAL	**$345.27**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Stop log lifter - Rent per day	1.00	day	1.000	1.00	$1,000.00	$1,000.00
					TOTAL SUBCONTRACTS	**$1,000.00**

SUMMARY OF COSTS

Labor Cost	$3,452.68	Labor Burden @	49.7%	$0.00	$3,452.68
Material Cost	$345.27	Material Tax @	7.8%	$26.76	$372.03
Equipment Cost	$1,965.95	Equipment Tax @	0.0%	$0.00	$1,965.95
Subcontractors	$1,000.00				$1,000.00
DIRECT COST SUBTOTALS	**$6,764**			**$27**	**DIRECT COST SUBTOTALS** **$6,791**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,790.66	$868.60
Installing Contractors Profit@	8.0%				$5,790.66	$463.25
GC Markup on Subs @	5.0%				$1,000.00	$50.00
					TOTAL MARKUP COSTS	**$1,381.85**
General Contractors Insurance @	1.0%		on		$8,172.51	$82
Bond @	1.0%		on		$8,172.51	$82
Contingency @	0.0%		on		$8,335.96	$0
					TOTAL COST for pay item	**$8,336**

Additional Pay Item Notes :

Assumed the process of removing and disposing of basin#6 (manually operated 18" slide gate and stop logs) is done in around 1 day by crew formed of forman, jouneymen, steelworkers. We dispose metal with 1 trucks per day for each crew. Assumed contains petroleum products 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.136		Project	: IRONGATE		
Description	:	Remove and Dispose of Basin #5					
Quantity	:	1,440.00	LBS				
Daily Production	:	1,440.00	LBS per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	1.0	Days	Estimator	: Mihaela Tomulesc	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$5.79	per LBS	Probable Low Cost Parameter		1656	$7,086	$4.92
Total Cost	:	$8,336		Probable High Cost Parameter		1152	$10,003	$6.95

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	$0.00		$386.16
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	$0.00		$1,048.32
Crawler Crane (90tn)	Active	1.00	1.0	8	8.00	E	$208.09	$208.09		$1,664.72
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Welder	Active	2.00	1.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	$2.88		$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Carpenters, Journeyman	Active	1.00	1.0	8	8.00	L	$65.37	$0.00		$522.96
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	$31.90		$255.20
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
				Labor Hours	72				TOTAL LABOR	$3,452.68
				Equipment Hours	32				TOTAL EQUIPMENT	$1,965.95

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$345.27	$345.27
					TOTAL MATERIAL	$345.27

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company		Unit Price	Contract or Quote Amount
Stop log lifter - Rent per day	1.00	day	1.000	1.00	$1,000.00	$1,000.00
					TOTAL SUBCONTRACTS	$1,000.00

SUMMARY OF COSTS

Labor Cost	$3,452.68	Labor Burden @	49.7%	$0.00	$3,452.68
Material Cost	$345.27	Material Tax @	7.8%	$26.76	$372.03
Equipment Cost	$1,965.95	Equipment Tax @	0.0%	$0.00	$1,965.95
Subcontractors	$1,000.00				$1,000.00
DIRECT COST SUBTOTALS	$6,764			$27	DIRECT COST SUBTOTALS $6,791

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,790.66	$868.60
Installing Contractors Profit@	8.0%				$5,790.66	$463.25
GC Markup on Subs @	5.0%				$1,000.00	$50.00
					TOTAL MARKUP COSTS	$1,381.85
General Contractors Insurance @	1.0%		on		$8,172.51	$82
Bond @	1.0%		on		$8,172.51	$82
Contingency @	0.0%		on		$8,335.96	$0
					TOTAL COST for pay item	$8,336

Additional Pay Item Notes :

Assumed the process of removing and disposing of basin#6 (manually operated 18" slide gate and stop logs) is done in around 1 day by crew formed of forman, jouneymen, steelworkers. We dispose metal with 1 trucks per day for each crew. Assumed contains petroleum products 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.137	Project	: IRONGATE
Description	: Remove and Dispose of Basin #6		
Quantity	: 1,440.00 LBS		
Daily Production	: 1,440.00 LBS per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulesc
Unit Price	: $5.79 per LBS		
Total Cost	: $8,336		

	LBS per	Total Cost	Unit Price Per LBS
Probable Low Cost Parameter	1656	$7,086	$4.92
Probable High Cost Parameter	1152	$10,003	$6.95

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	$0.00		$386.16
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	$0.00		$1,048.32
Crawler Crane (90tn)	Active	1.00	1.0	8	8.00	E	$208.09	$208.09		$1,664.72
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Welder	Active	2.00	1.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	$2.88		$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Carpenters, Journeyman	Active	1.00	1.0	8	8.00	L	$65.37	$0.00		$522.96
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	$31.90		$255.20
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
				Labor Hours	72				TOTAL LABOR	$3,452.68
				Equipment Hours	32				TOTAL EQUIPMENT	$1,965.95

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$345.27	$345.27
					TOTAL MATERIAL	$345.27

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Stop log lifter - Rent per day	1.00	day	1.000	1.00	$1,000.00	$1,000.00
					TOTAL SUBCONTRACTS	$1,000.00

SUMMARY OF COSTS

Labor Cost	$3,452.68	Labor Burden @	49.7%	$0.00	$3,452.68
Material Cost	$345.27	Material Tax @	7.8%	$26.76	$372.03
Equipment Cost	$1,965.95	Equipment Tax @	0.0%	$0.00	$1,965.95
Subcontractors	$1,000.00				$1,000.00
DIRECT COST SUBTOTALS	$6,764			$27	DIRECT COST SUBTOTALS $6,791

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,790.66	$868.60
Installing Contractors Profit@	8.0%				$5,790.66	$463.25
GC Markup on Subs @	5.0%				$1,000.00	$50.00
					TOTAL MARKUP COSTS	$1,381.85
General Contractors Insurance @	1.0%		on		$8,172.51	$82
Bond @	1.0%		on		$8,172.51	$82
Contingency @	0.0%		on		$8,335.96	$0
					TOTAL COST for pay item	$8,336

Additional Pay Item Notes :

Assumed the process of removing and disposing of basin#6 (manually operated 18" slide gate and stop logs) is done in around 1 day by crew formed of forman, jouneymen, steelworkers. We dispose metal with 1 trucks per day for each crew. Assumed contains petroleum products 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling. Based on the current production rate, only 1 trips a day would be necessary.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.138		Project	: IRONGATE		
Description	:	Remove and Dispose of Holding Tank					
Quantity	:	7,400.00	LBS				
Daily Production	:	7,400.00	LBS per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	1.0	Days	Estimator	: Mihaela Tomulesc	LBS per	Total Cost	Unit Price Per LBS
Unit Price	:	$1.53	per LBS	Probable Low Cost Parameter	8510	$9,652	$1.30
Total Cost	:	$11,355		Probable High Cost Parameter	5920	$13,627	$1.84

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	1.0	8	8.00	L	$48.27	$0.00		$386.16
Steelworker	Active	4.00	1.0	8	32.00	L	$65.52	$0.00		$2,096.64
Crawler Crane (90tn)	Active	1.00	1.0	8	8.00	E	$208.09	$208.09		$1,664.72
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	$0.00		$547.28
Welder	Active	2.00	1.0	8	16.00	L	$7.84	$0.00		$125.40
Gas Welding Machine	Active	2.00	1.0	8	16.00	E	$2.88	$2.88		$46.03
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	$0.00		$361.84
Carpenters, Journeyman	Active	4.00	1.0	8	32.00	L	$65.37	$0.00		$2,091.84
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	$31.90		$255.20
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	$0.00		$460.72
				Labor Hours	112				TOTAL LABOR	$6,069.88
				Equipment Hours	32				TOTAL EQUIPMENT	$1,965.95

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$606.99	$606.99
					TOTAL MATERIAL	$606.99

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit	Price	Contract or Quote Amount
Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	0.37	ton	1.000	0.37	$595.00	$220.15
Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	28.00	mile	1.000	28.00	$7.25	$203.00
					TOTAL SUBCONTRACTS	$423.15

SUMMARY OF COSTS

Labor Cost	$6,069.88	Labor Burden @		49.7%	$0.00		$6,069.88
Material Cost	$606.99	Material Tax @		7.8%	$47.04		$654.03
Equipment Cost	$1,965.95	Equipment Tax @		0.0%	$0.00		$1,965.95
Subcontractors	$423.15						$423.15
DIRECT COST SUBTOTALS	$9,066				$47	DIRECT COST SUBTOTALS	$9,113
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,689.86		$1,303.48
Installing Contractors Profit@	8.0%				$8,689.86		$695.19
GC Markup on Subs @	5.0%				$423.15		$21.16
						TOTAL MARKUP COSTS	$2,019.83
General Contractors Insurance @	1.0%			on	$11,132.84		$111
Bond @	1.0%			on	$11,132.84		$111
Contingency @	0.0%			on	$11,355.49		$0
						TOTAL COST for pay item	$11,355

Additional Pay Item Notes :

Assumed the process of removing and disposing of holding tank (2 slide gates 42" x 72" with motor and recirculation pumps) is done in around 1 day by crew formed of forman, jouneymen, steelworkers. Assumed contains petroleum products 10% of the total lbs, 28 miles from Iron Gate to Yreka transfer recycling.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.140	Project	: IRONGATE		
Description	:	Wanaka Springs - Concrete Total				
Quantity	:	28.00 CY				
Daily Production	:	150.00 CY per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	0.2 Days	Estimator	: Mihaela Tomulescu	CY per	Total Cost	Unit Price Per CY
Unit Price	:	$306.28 per CY	Probable Low Cost Parameter		172.5	$7,290	$260
Total Cost	:	$8,576	Probable High Cost Parameter		127.5	$9,862	$352

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	0.2	8	3.04	L	$46.27	incl. in rate	incl. in rate	$140.66
Equipment Operator (medium)	Active	8.00	0.2	8	12.16	L	$66.28	incl. in rate	incl. in rate	$805.96
Steelworker	Active	6.00	0.2	8	9.12	L	$65.52	incl. in rate	incl. in rate	$597.54
Electrician	Active	1.00	0.2	8	1.52	L	$45.23	incl. in rate	incl. in rate	$68.75
Truck Driver (heavy)	Active	2.00	0.2	8	3.04	L	$57.59	incl. in rate	incl. in rate	$175.07
Vibratory Hammer & Extractor	Active	3.00	0.2	8	4.56	E	$94.34	incl. in rate	incl. in rate	$430.19
Hydraulic Excavator (6.0cy)	Active	3.00	0.2	8	4.56	E	$322.48	incl. in rate	incl. in rate	$1,470.51
Loader, FE Rubber Tire (8.6cy)	Active	2.00	0.2	8	3.04	E	$221.50	incl. in rate	incl. in rate	$673.36
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.2	8	3.04	E	$111.64	incl. in rate	incl. in rate	$339.39
				Labor Hours	28.88				TOTAL LABOR	$1,787.99
				Equipment Hours	15.2				TOTAL EQUIPMENT	$2,913.44

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	1	EA	Cost per Mob	$2,500.00	$2,500.00
				TOTAL SUBCONTRACTS	$2,500.00

SUMMARY OF COSTS

Labor Cost	$1,787.99	Labor Burden @		49.7%	$0.00		$1,787.99
Material Cost	$0.00	Material Tax @		7.8%	$0.00		$0.00
Equipment Cost	$2,913.44	Equipment Tax @		0.0%	$0.00		$2,913.44
Subcontractors	$2,500.00						$2,500.00
DIRECT COST SUBTOTALS	$7,201				$0	DIRECT COST SUBTOTALS	$7,201
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$4,701.44		$705.22
Installing Contractors Profit@	8.0%				$4,701.44		$376.11
GC Markup on Subs @	5.0%				$2,500.00		$125.00
						TOTAL MARKUP COSTS	$1,206.33
General Contractors Insurance @	1.0%			on	$8,407.77		$84
Bond @	1.0%			on	$8,407.77		$84
Contingency @	0.0%			on	$8,575.92		$0
						TOTAL COST for pay item	$8,576

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B".

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.144	**Project**	: IRONGATE		
Description	: Wanaka Springs - Regrade				
Quantity	: 2.50 AC				
Daily Production	: 0.69 AC per 8 hour shift	**Project #**	: Klamath Dams Removal		
Work Days	: 3.6 Days	**Estimator**	: Mihaela Tomulescu	**AC per** / **Total Cost**	**Unit Price Per AC**
Unit Price	: $6,798.10 per AC	**Probable Low Cost Parameter**		0.7935 / $14,446	$5,778
Total Cost	: $16,995	**Probable High Cost Parameter**		0.5865 / $19,545	$7,818

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.6	8	28.96	L	$46.27	incl. in rate	incl. in rate	$1,339.98
Equipment Operator (medium)	Active	1.00	3.6	8	28.96	L	$66.28	incl. in rate	incl. in rate	$1,919.47
Laborer	Active	4.00	3.6	8	115.84	L	$45.80	incl. in rate	incl. in rate	$5,305.47
Grader. 180hp, 13' blade	Active	1.00	3.6	8	28.96	E	$80.79	incl. in rate	incl. in rate	$2,339.68
Dozer (235hp)(CATD7)	Active	1.00	2.0	8	16.00	E	$165.11	incl. in rate	incl. in rate	$2,641.76
	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active		0.0	8		E				$0.00
	Active		0.0	8		E				$0.00
	Active		0.0	8		E				$0.00
				Labor Hours	**173.76**				**TOTAL LABOR**	**$8,564.92**
				Equipment Hours	**44.96**				**TOTAL EQUIPMENT**	**$4,981.44**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs	1.000	0.00		$0.00
		lbs	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$8,564.92	Labor Burden @	49.7%	$0.00		$8,564.92
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$4,981.44	Equipment Tax @	0.0%	$0.00		$4,981.44
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$13,546**			**$0**	**DIRECT COST SUBTOTALS**	**$13,546**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$13,546.36	$2,031.95
Installing Contractors Profit@	8.0%				$13,546.36	$1,083.71
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$3,115.66**
General Contractors Insurance @	1.0%		on		$16,662.02	$167
Bond @	1.0%		on		$16,662.02	$167
Contingency @	0.0%		on		$16,995.26	$0
					TOTAL COST for pay item	**$16,995**

Additional Pay Item Notes :

Crew is based off clear and grub crew B7 off of RSM means. Production for the crew in .69 ac per day to clear and process the trees/ strubs on site. Assumed Seeding, mechanical seeding, 215 lb./acre with crew B66. The amount and type of seed are calculated as 215 lbs per acre in total.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.147	Project	: IRONGATE
Description	: Juniper Point - Concrete Total		
Quantity	: 19.00 CY		
Daily Production	: 60.00 CY per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 0.3 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $359.74 per CY		
Total Cost	: $6,835		

	CY per	Total Cost	Unit Price Per CY
Probable Low Cost Parameter	69	$5,810	$306
Probable High Cost Parameter	51	$7,860	$414

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	0.3	8	2.56	L	$46.27	incl. in rate	incl. in rate	$118.45
Equipment Operator (medium)	Active	3.00	0.3	8	7.68	L	$66.28	incl. in rate	incl. in rate	$509.03
Steelworker	Active	3.00	0.3	8	7.68	L	$65.52	incl. in rate	incl. in rate	$503.19
Electrician	Active	1.00	0.3	8	2.56	L	$45.23	incl. in rate	incl. in rate	$115.79
Truck Driver (heavy)	Active	1.00	0.3	8	2.56	L	$57.59	incl. in rate	incl. in rate	$147.43
Vibratory Hammer & Extractor	Active	1.00	0.3	8	2.56	E	$94.34	incl. in rate	incl. in rate	$241.51
Hydraulic Excavator (6.0cy)	Active	1.00	0.3	8	2.56	E	$322.48	incl. in rate	incl. in rate	$825.55
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.3	8	2.56	E	$221.50	incl. in rate	incl. in rate	$567.04
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.3	8	2.56	E	$111.64	incl. in rate	incl. in rate	$285.80

Labor Hours	23.04	TOTAL LABOR	$1,393.89
Equipment Hours	10.24	TOTAL EQUIPMENT	$1,919.90

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	1	EA	Cost per Mob	$2,500.00	$2,500.00
				TOTAL SUBCONTRACTS	$2,500.00

SUMMARY OF COSTS

Labor Cost	$1,393.89	Labor Burden @	49.7%	$0.00	$1,393.89
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$1,919.90	Equipment Tax @	0.0%	$0.00	$1,919.90
Subcontractors	$2,500.00				$2,500.00
DIRECT COST SUBTOTALS	$5,814			$0	DIRECT COST SUBTOTALS $5,814

	Rate	Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,313.79	$497.07
Installing Contractors Profit@	8.0%				$3,313.79	$265.10
GC Markup on Subs @	5.0%				$2,500.00	$125.00
					TOTAL MARKUP COSTS	$887.17
General Contractors Insurance @	1.0%		on		$6,700.96	$67
Bond @	1.0%		on		$6,700.96	$67
Contingency @	0.0%		on		$6,834.98	$0
					TOTAL COST for pay item	$6,835

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B"

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.152	Project	: IRONGATE
Description	: Juniper Point - 50'x5' Composite dock with poly floats		
Quantity	: 250.00 SF		
Daily Production	: 180.00 SF per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 1.4 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $31.34 per SF		
Total Cost	: $7,834		

	SF per	Total Cost	Unit Price Per SF
Probable Low Cost Parameter	198	$7,051	$28
Probable High Cost Parameter	162	$8,618	$34

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.4	8	11.12	L	$46.27	incl. in rate	incl. in rate	$514.52
Carpenters, Journeyman	Active	3.00	1.4	8	33.36	L	$65.37	incl. in rate	incl. in rate	$2,180.74
Hydraulic Crane (17tn)	Active	1.00	1.4	8	11.12	E	$81.52	incl. in rate	incl. in rate	$906.50
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.4	8	11.12	E	$111.64	incl. in rate	incl. in rate	$1,241.44
Truck Driver (heavy)	Active	1.00	1.4	8	11.12	L	$57.59	incl. in rate	incl. in rate	$640.40
Equipment Operator (crane)	Active	1.00	1.4	8	11.12	L	$68.41	incl. in rate	incl. in rate	$760.72
				Labor Hours	66.72				TOTAL LABOR	$4,096.39
				Equipment Hours	22.24				TOTAL EQUIPMENT	$2,147.94

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$4,096.39	Labor Burden @	49.7%	$0.00		$4,096.39
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$2,147.94	Equipment Tax @	0.0%	$0.00		$2,147.94
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$6,244			$0	DIRECT COST SUBTOTALS	$6,244

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$6,244.32		$936.65
Installing Contractors Profit@	8.0%				$6,244.32		$499.55
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$1,436.19
General Contractors Insurance @	1.0%			on	$7,680.52		$77
Bond @	1.0%			on	$7,680.52		$77
Contingency @	0.0%			on	$7,834.13		$0
						TOTAL COST for pay item	$7,834

Additional Pay Item Notes :

Based on RS.Means Crew F3 the Labor and equipment for "Docks, floating, small boat, prefabricated, no shore facilities, excludes pilings, maximum"

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.155	Project	: IRONGATE		
Description	: Juniper Point - Regrade to Natural Contour				
Quantity	: 2.00 AC				
Daily Production	: 0.50 AC per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	: 4.0 Days	Estimator	: Mihaela Tomulescu	AC per	Total Cost	Unit Price Per AC
Unit Price	: $10,546.17 per AC	Probable Low Cost Parameter	0.575	$17,928	$8,964
Total Cost	: $21,092	Probable High Cost Parameter	0.425	$24,256	$12,128

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Equipment Operator (medium)	Active	2.00	4.0	8	64.00	L	$66.28	incl. in rate	incl. in rate	$4,241.92
Laborer	Active	4.00	4.0	8	128.00	L	$45.80	incl. in rate	incl. in rate	$5,862.40
Grader. 180hp, 13' blade	Active	1.00	4.0	8	32.00	E	$80.79	incl. in rate	incl. in rate	$2,585.28
Dozer (235hp)(CATD7)	Active	1.00	2.0	8	16.00	E	$165.11	incl. in rate	incl. in rate	$2,641.76
	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active		0.0		16.00	E				$0.00
	Active		0.0		32.00	E				$0.00
	Active		0.0		16.00	E				$0.00
				Labor Hours	224				TOTAL LABOR	$11,584.96
				Equipment Hours	112				TOTAL EQUIPMENT	$5,227.04

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs	1.000	0.00		$0.00
		lbs	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$11,584.96	Labor Burden @	49.7%	$0.00		$11,584.96
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$5,227.04	Equipment Tax @	0.0%	$0.00		$5,227.04
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$16,812			$0	DIRECT COST SUBTOTALS	$16,812

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$16,812.00	$2,521.80
Installing Contractors Profit@	8.0%				$16,812.00	$1,344.96
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$3,866.76
General Contractors Insurance @	1.0%			on	$20,678.76	$207
Bond @	1.0%			on	$20,678.76	$207
Contingency @	0.0%			on	$21,092.34	$0
					TOTAL COST for pay item	$21,092

Additional Pay Item Notes :

Crew is based off clear and grub crew B7 off of RSM means. Production for the crew in .69 ac per day to clear and process the trees/ strubs on site. Assumed Seeding, mechanical seeding, 215 lb./acre with crew B66.The amount and type of seed are calculated as 215 lbs per acre in total.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.156		Project	: IRONGATE		
Description	: Camp Creek - Concrete Total					
Quantity	: 110.00 CY					
Daily Production	: 110.00 CY per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 1.0 Days		Estimator	: Mihaela Tomulescu	CY per	Total Cost	Unit Price Per CY
Unit Price	: $306.56 per CY		Probable Low Cost Parameter		126.5	$28,664	$261
Total Cost	: $33,722		Probable High Cost Parameter		93.5	$38,780	$353

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	1.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Equipment Operator (medium)	Active	8.00	1.0	8	64.00	L	$66.28	incl. in rate	incl. in rate	$4,241.92
Steelworker	Active	6.00	1.0	8	48.00	L	$65.52	incl. in rate	incl. in rate	$3,144.96
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Truck Driver (heavy)	Active	2.00	1.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Vibratory Hammer & Extractor	Active	3.00	1.0	8	24.00	E	$94.34	incl. in rate	incl. in rate	$2,264.16
Hydraulic Excavator (6.0cy)	Active	3.00	1.0	8	24.00	E	$322.48	incl. in rate	incl. in rate	$7,739.52
Loader, FE Rubber Tire (8.6cy)	Active	2.00	1.0	8	16.00	E	$221.50	incl. in rate	incl. in rate	$3,544.00
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
				Labor Hours	152				TOTAL LABOR	$9,410.48
				Equipment Hours	80				TOTAL EQUIPMENT	$15,333.92

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	1	EA	Cost per Mob	$2,500.00	$2,500.00
				TOTAL SUBCONTRACTS	$2,500.00

SUMMARY OF COSTS

Labor Cost	$9,410.48	Labor Burden @		49.7%	$0.00		$9,410.48
Material Cost	$0.00	Material Tax @		7.8%	$0.00		$0.00
Equipment Cost	$15,333.92	Equipment Tax @		0.0%	$0.00		$15,333.92
Subcontractors	$2,500.00						$2,500.00
DIRECT COST SUBTOTALS	$27,244				$0	DIRECT COST SUBTOTALS	$27,244
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$24,744.40		$3,711.66
Installing Contractors Profit@	8.0%				$24,744.40		$1,979.55
GC Markup on Subs @	5.0%				$2,500.00		$125.00
						TOTAL MARKUP COSTS	$5,816.21
General Contractors Insurance @	1.0%			on	$33,060.61		$331
Bond @	1.0%			on	$33,060.61		$331
Contingency @	0.0%			on	$33,721.82		$0
						TOTAL COST for pay item	$33,722

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B"

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.157		Project	: IRONGATE		
Description	: Camp Creek - 180'Lx16'Wx8'D Earth jetty to remove and/or regrade					
Quantity	: 855.00 CY					
Daily Production	: 200.00 CY per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 4.3 Days		Estimator	: Mihaela Tomulescu	CY per / Total Cost	Unit Price Per CY
Unit Price	: $73.54 per CY		Probable Low Cost Parameter	230	$53,445	$63
Total Cost	: $62,876		Probable High Cost Parameter	170	$72,307	$85

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.3	8	34.24	L	$46.27	incl. in rate	incl. in rate	$1,584.28
Equipment Operator (medium)	Active	3.00	4.3	8	102.72	L	$66.28	incl. in rate	incl. in rate	$6,808.28
Steelworker	Active	3.00	4.3	8	102.72	L	$65.52	incl. in rate	incl. in rate	$6,730.21
Electrician	Active	1.00	4.3	8	34.24	L	$45.23	incl. in rate	incl. in rate	$1,548.68
Truck Driver (heavy)	Active	2.00	4.3	8	68.48	L	$57.59	incl. in rate	incl. in rate	$3,943.76
Vibratory Hammer & Extractor	Active	1.00	4.3	8	34.24	E	$94.34	incl. in rate	incl. in rate	$3,230.20
Hydraulic Excavator (6.0cy)	Active	1.00	4.3	8	34.24	E	$322.48	incl. in rate	incl. in rate	$11,041.72
Loader, FE Rubber Tire (8.6cy)	Active	1.00	4.3	8	34.24	E	$221.50	incl. in rate	incl. in rate	$7,584.16
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	4.3	8	68.48	E	$111.64	incl. in rate	incl. in rate	$7,645.11
				Labor Hours	342.4				TOTAL LABOR	$20,615.22
				Equipment Hours	171.2				TOTAL EQUIPMENT	$29,501.18

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$20,615.22	Labor Burden @	49.7%	$0.00	$20,615.22
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$29,501.18	Equipment Tax @	0.0%	$0.00	$29,501.18
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$50,116			$0	DIRECT COST SUBTOTALS $50,116

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$50,116.40	$7,517.46
Installing Contractors Profit@	8.0%				$50,116.40	$4,009.31
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$11,526.77
General Contractors Insurance @	1.0%			on	$61,643.18	$616
Bond @	1.0%			on	$61,643.18	$616
Contingency @	0.0%			on	$62,876.04	$0
					TOTAL COST for pay item	$62,876

Additional Pay Item Notes :

Based on RS.Means - Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9 and B34B - Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.158		Project	: IRONGATE		
Description	: Camp Creek - Well house 10'x16' concrete block building					
Quantity	: 160.00 SF					
Daily Production	: 160.00 SF per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 1.0 Days		Estimator	: Mihaela Tomulescu	SF per	Total Cost	Unit Price Per SF
Unit Price	: $72.74 per SF		Probable Low Cost Parameter		176	$10,475	$65
Total Cost	: $11,638		Probable High Cost Parameter		144	$12,802	$80

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Truck Driver (heavy)	Active	2.00	1.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Hydraulic Excavator (1.5cy)	Active	1.00	1.0	8	8.00	E	$141.92	incl. in rate	incl. in rate	$1,135.36
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	incl. in rate	incl. in rate	$1,048.32
				Labor Hours	72				TOTAL LABOR	$3,964.80
				Equipment Hours	24				TOTAL EQUIPMENT	$2,921.60

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Harzardous waste disposal	1	LS		$2,800.00	$2,800.00
				TOTAL SUBCONTRACTS	$2,800.00

SUMMARY OF COSTS

Labor Cost	$3,964.80	Labor Burden @	49.7%	$0.00		$3,964.80
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$2,921.60	Equipment Tax @	0.0%	$0.00		$2,921.60
Subcontractors	$2,800.00					$2,800.00
DIRECT COST SUBTOTALS	$9,686			$0	DIRECT COST SUBTOTALS	$9,686

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,886.40	$1,032.96
Installing Contractors Profit@	8.0%				$6,886.40	$550.91
GC Markup on Subs @	5.0%				$2,800.00	$140.00
					TOTAL MARKUP COSTS	$1,723.87
General Contractors Insurance @	1.0%		on		$11,410.27	$114
Bond @	1.0%		on		$11,410.27	$114
Contingency @	0.0%		on		$11,638.48	$0
					TOTAL COST for pay item	$11,638

Additional Pay Item Notes :

The price of removing a building is based on several factors including the size of the space, structural additions on the property, required permits and waste material clearing. A complete demo of a house and its foundation or basement can cost much as $25,000.
The cost of removal can vary based on the area lived in and the typical wages in the region. Some estimates put a price tag of $18,000 on bulldozing a 1,500 square-foot house, while others show that the average estimate is around $4-$15 per square foot.
Hazardous waste can greatly impact the cost of clearing debris. Many older homes contain asbestos, and there are special fees and considerations associated with its removal and disposal. The national average cost to eliminate asbestos is about $200-$700 per hour. We take in consideration this aspect in our estimate assuming 3 Laborers working 1 days, 8 hours per day @$350

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.161	Project	: IRONGATE	
Description	:	Camp Creek - Concrete block double toilet bldg 10'x16'			
Quantity	:	160.00 SF			
Daily Production	:	160.00 SF per 8 hour shift	Project #	: Klamath Dams Removal	
Work Days	:	1.0 Days	Estimator	: Mihaela Tomulescu	
Unit Price	:	$72.74 per SF			
Total Cost	:	$11,638			

	SF per	Total Cost	Unit Price Per SF
Probable Low Cost Parameter	176	$10,475	$65
Probable High Cost Parameter	144	$12,802	$80

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Truck Driver (heavy)	Active	2.00	1.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	1.0	8	16.00	E	$111.64	incl. in rate	incl. in rate	$1,786.24
Hydraulic Excavator (1.5cy)	Active	1.00	1.0	8	8.00	E	$141.92	incl. in rate	incl. in rate	$1,135.36
Steelworker	Active	2.00	1.0	8	16.00	L	$65.52	incl. in rate	incl. in rate	$1,048.32

Labor Hours	72	TOTAL LABOR	$3,964.80
Equipment Hours	24	TOTAL EQUIPMENT	$2,921.60

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Harzardous waste disposal	1	LS		$2,800.00	$2,800.00
				TOTAL SUBCONTRACTS	$2,800.00

SUMMARY OF COSTS

Labor Cost	$3,964.80	Labor Burden @	49.7%	$0.00	$3,964.80
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$2,921.60	Equipment Tax @	0.0%	$0.00	$2,921.60
Subcontractors	$2,800.00				$2,800.00
DIRECT COST SUBTOTALS	$9,686			$0	DIRECT COST SUBTOTALS $9,686

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$6,886.40	$1,032.96
Installing Contractors Profit@	8.0%				$6,886.40	$550.91
GC Markup on Subs @	5.0%				$2,800.00	$140.00
					TOTAL MARKUP COSTS	$1,723.87

General Contractors Insurance @	1.0%	on	$11,410.27	$114
Bond @	1.0%	on	$11,410.27	$114
Contingency @	0.0%	on	$11,638.48	$0
			TOTAL COST for pay item	$11,638

Additional Pay Item Notes :

The price of removing a building is based on several factors including the size of the space, structural additions on the property, required permits and waste material clearing. A complete demo of a house and its foundation or basement can cost much as $25,000.
The cost of removal can vary based on the area lived in and the typical wages in the region. Some estimates put a price tag of $18,000 on bulldozing a 1,500 square-foot house, while others show that the average estimate is around $4-$15 per square foot.
Hazardous waste can greatly impact the cost of clearing debris. Many older homes contain asbestos, and there are special fees and considerations associated with its removal and disposal. The national average cost to eliminate asbestos is about $200-$700 per hour. We take in consideration this aspect in our estimate assuming 3 Laborers working 2 days, 8 hours per day @$350

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.162		Project	: IRONGATE		
Description	:	Camp Creek - Dump stations and approx. 2000 gal buried					
Quantity	:	1.00	EA				
Daily Production	:	1.50	EA per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	0.7	Days	Estimator	: Mihaela Tomulese	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$6,596.62	per EA	Probable Low Cost Parameter	1.725	$5,607	$5,607.12
Total Cost	:	$6,597		Probable High Cost Parameter	1.2	$7,916	$7,915.94

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman	Active	1.00	0.7	8	5.60	L	$48.27	$0.00		$270.31
Vibratory Hammer & Extractor	Active	1.00	0.7	8	5.60	E	$94.34	$94.34		$528.30
Backhoe Loader (91hp)	Active	1.00	0.7	8	5.60	E	$40.35	$40.35		$225.96
Equipment Operator (medium)	Active	2.00	0.7	8	11.20	L	$66.28	$0.00		$742.34
Truck Driver (heavy)	Active	2.00	0.7	8	11.20	L	$57.59	$0.00		$645.01
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.7	8	11.20	E	$111.64	$111.64		$1,250.37
Electrician	Active	1.00	0.7	8	5.60	L	$45.23	$0.00		$253.29
Laborer	Active	4.00	0.7	8	22.40	L	$45.80	$0.00		$1,025.92
				Labor Hours	56				TOTAL LABOR	$2,936.86
				Equipment Hours	22.4				TOTAL EQUIPMENT	$2,004.63

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$293.69	$293.69
					TOTAL MATERIAL	$293.69

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,936.86	Labor Burden @	49.7%	$0.00		$2,936.86
Material Cost	$293.69	Material Tax @	7.8%	$22.76		$316.45
Equipment Cost	$2,004.63	Equipment Tax @	0.0%	$0.00		$2,004.63
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$5,235			$23	DIRECT COST SUBTOTALS	$5,258

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$5,257.94		$788.69
Installing Contractors Profit@	8.0%				$5,257.94		$420.64
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$1,209.33
General Contractors Insurance @	1.0%			on	$6,467.27		$65
Bond @	1.0%			on	$6,467.27		$65
Contingency @	0.0%			on	$6,596.62		$0
						TOTAL COST for pay item	$6,597

Additional Pay Item Notes :

Assumed the process dumping stations and removing 2000 gal buried concrete tank is done in around 1/2 day by crew formed of 1 forman, 4 laborers and 2 equipment operators (Backhoe loader and Vibratory hammer). We 2 trucks for haulingand disposal.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.163	Project	: IRONGATE		
Description	:	Camp Creek - Power poles and lines				
Quantity	:	3.00 EA				
Daily Production	:	2.00 EA per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	1.5 Days	Estimator	: Mihaela Tomulescu		
				EA per	Total Cost	Unit Price Per EA
Unit Price	:	$1,818.16 per EA	Probable Low Cost Parameter	2.3	$4,636	$1,545
Total Cost	:	$5,454	Probable High Cost Parameter	1.6	$6,545	$2,182

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.5	8	12.00	L	$46.27	incl. in rate	incl. in rate	$555.24
Electrician	Active	1.00	1.5	8	12.00	L	$45.23	incl. in rate	incl. in rate	$542.76
Hydraulic Crane (17tn)	Active	1.00	1.0	8	8.00	E	$81.52	incl. in rate	incl. in rate	$652.16
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
Vibratory Hammer & Extractor	Active	1.00	1.0	8	8.00	E	$94.34	incl. in rate	incl. in rate	$754.72
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Utility, with Man-Basket	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
				Labor Hours	48				TOTAL LABOR	$2,291.52
				Equipment Hours	32				TOTAL EQUIPMENT	$1,917.28

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$114.58	$114.58
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	3.00	CY	1.000	3.00	$4.74	$14.22
					TOTAL MATERIAL	$128.80

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,291.52	Labor Burden @		49.7%	$0.00		$2,291.52
Material Cost	$128.80	Material Tax @		7.8%	$9.98		$138.78
Equipment Cost	$1,917.28	Equipment Tax @		0.0%	$0.00		$1,917.28
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$4,338				$10	DIRECT COST SUBTOTALS	$4,348

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$4,347.58		$652.14
Installing Contractors Profit@	8.0%				$4,347.58		$347.81
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$999.94
General Contractors Insurance @	1.0%		on		$5,347.52		$53
Bond @	1.0%		on		$5,347.52		$53
Contingency @	0.0%		on		$5,454.47		$0
						TOTAL COST for pay item	$5,454

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane). Considered 2 laborer and 1 Vibratory Hammer for demolish the pole foundation and helping placing poles in a designated place and loading them in the truck for disposal. This process includes filling in pole locations with gravel, clean fill and topsoil.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.168	Project	: Iron Gate		
Description	:	Camp Creek-Regrade				
Quantity	:	4.00 AC				
Daily Production	:	1.00 AC per 8 hour shift	Project #	: 4		
Work Days	:	4.0 Days	Estimator	: Eric Jones	AC per	Total Cost	Unit Price Per AC
Unit Price	:	$8,861.29 per AC	Probable Low Cost Parameter		1.15	$30,128	$7,532.09
Total Cost	:	$35,445	Probable High Cost Parameter		0.85	$40,762	$10,190.48

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Equipment Operator (medium)	Active	2.00	4.0	8	64.00	L	$66.28	incl. in rate	incl. in rate	$4,241.92
Laborer	Active	2.00	4.0	8	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Dozer (235hp)(CATD7)	Active	3.00	4.0	8	96.00	E	$165.11	incl. in rate	incl. in rate	$15,850.56
Roller, Single Drum (steel wheel, 12.0 - 14.9 MTn	Active	2.00	4.0	8	64.00	E	$72.79	incl. in rate	incl. in rate	$4,658.56
0	Active	1.00	4.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	4.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	4.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0	Active	1.00	4.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	4.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	4.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		1.00	4.0	8	32.00	0	$0.00	incl. in rate	incl. in rate	$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
			4.0	8	0.00					$0.00
				Labor Hours	160				TOTAL LABOR	$8,653.76
				Equipment Hours	160				TOTAL EQUIPMENT	$20,509.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		lbs PLS	1.000	0.00	$10.69	$0.00
		lbs PLS	1.000	0.00	$8.17	$0.00
		lbs PLS	1.000	0.00	$14.40	$0.00
		lbs PLS	1.000	0.00	$8.96	$0.00
		lbs PLS	1.000	0.00	$5.85	$0.00
		lbs PLS	1.000	0.00	$30.24	$0.00
		lbs	1.000	0.00	$34.02	$0.00
		lbs	1.000	0.00	$10.80	$0.00
		ea	1.000	0.00	$18.00	$0.00
		ea	1.000	0.00	$0.09	$0.00
		ea	1.000	0.00	$6.30	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
	-				$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$8,653.76	Labor Burden @	0.0%		$8,653.76
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$20,509.12	Equipment Tax @	7.75%	$1,589.46	$22,098.58
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$29,163			$1,589	DIRECT COST SUBTOTALS $30,752

		Crew	Material	Subs	Cost Basis	
Installi	5.0%				$30,752.34	$1,537.62
Installi	8.0%				$30,752.34	$2,460.19
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$3,997.80

General Contractors Insurance @	1.0%	on	$34,750.14	$348
Bond @	1.0%	on	$34,750.14	$348
Contingency @	0.0%	on	$35,445.14	$0
			TOTAL COST for pay item	$35,445

Additional Pay Item Notes :

Crew will grade, rip, and reseed 1/3 of anchor per day, All equipment will be staged at area during operation due to the location of the operation. Seeding was assumed to be the same seeding used on other parts of the job using the same ratio.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.170	**Project**	: IRONGATE			
Description	: Dutch Creek - 50'4'3' Dock Concrete Abutment					
Quantity	: 22.00 CY					
Daily Production	: 148.00 CY per 8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	: 0.2 Days	**Estimator**	: Mihaela Tomulescu	**CY per**	**Total Cost**	**Unit Price Per CY**
Unit Price	: $333.37 per CY	**Probable Low Cost Parameter**		**162.8**	**$6,601**	**$300**
Total Cost	: $7,334	**Probable High Cost Parameter**		**133.2**	**$8,068**	**$367**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	0.2	8	2.40	L	$46.27	incl. in rate	incl. in rate	$111.05
Equipment Operator (medium)	Active	8.00	0.2	8	9.60	L	$66.28	incl. in rate	incl. in rate	$636.29
Steelworker	Active	6.00	0.2	8	7.20	L	$65.52	incl. in rate	incl. in rate	$471.74
Electrician	Active	1.00	0.2	8	1.20	L	$45.23	incl. in rate	incl. in rate	$54.28
Truck Driver (heavy)	Active	2.00	0.2	8	2.40	L	$57.59	incl. in rate	incl. in rate	$138.22
Vibratory Hammer & Extractor	Active	3.00	0.2	8	3.60	E	$94.34	incl. in rate	incl. in rate	$339.62
Hydraulic Excavator (6.0cy)	Active	3.00	0.2	8	3.60	E	$322.48	incl. in rate	incl. in rate	$1,160.93
Loader, FE Rubber Tire (8.6cy)	Active	2.00	0.2	8	2.40	E	$221.50	incl. in rate	incl. in rate	$531.60
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.2	8	2.40	E	$111.64	incl. in rate	incl. in rate	$267.94
				Labor Hours	**22.8**				**TOTAL LABOR**	**$1,411.57**
				Equipment Hours	**12**				**TOTAL EQUIPMENT**	**$2,300.09**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	1	EA	**Cost per Mob**	$2,500.00	$2,500.00
				TOTAL SUBCONTRACTS	**$2,500.00**

SUMMARY OF COSTS

Labor Cost	$1,411.57	Labor Burden @		49.7%	$0.00		$1,411.57
Material Cost	$0.00	Material Tax @		7.8%	$0.00		$0.00
Equipment Cost	$2,300.09	Equipment Tax @		0.0%	$0.00		$2,300.09
Subcontractors	$2,500.00						$2,500.00
DIRECT COST SUBTOTALS	**$6,212**				**$0**	**DIRECT COST SUBTOTALS**	**$6,212**
		Crew	**Material**	**Subs**	**Cost Basis**		
Installing Contractors Overhead@	15.0%				$3,711.66		$556.75
Installing Contractors Profit@	8.0%				$3,711.66		$296.93
GC Markup on Subs @	5.0%				$2,500.00		$125.00
						TOTAL MARKUP COSTS	**$978.68**
General Contractors Insurance @	1.0%			on	$7,190.34		$72
Bond @	1.0%			on	$7,190.34		$72
Contingency @	0.0%			on	$7,334.15		$0
						TOTAL COST for pay item	**$7,334**

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B"

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.172		Project	: IRONGATE		
Description	: Mirror Cove - Concrete Total					
Quantity	: 89.00 CY					
Daily Production	: 150.00 CY per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 0.6 Days		Estimator	: Mihaela Tomulescu		
				CY per	Total Cost	Unit Price Per CY
Unit Price	: $235.88 per CY		Probable Low Cost Parameter	165	$18,894	$212
Total Cost	: $20,994		Probable High Cost Parameter	135	$23,093	$259

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	0.6	8	9.44	L	$46.27	incl. in rate	incl. in rate	$436.79
Equipment Operator (medium)	Active	8.00	0.6	8	37.76	L	$66.28	incl. in rate	incl. in rate	$2,502.73
Steelworker	Active	6.00	0.6	8	28.32	L	$65.52	incl. in rate	incl. in rate	$1,855.53
Electrician	Active	1.00	0.6	8	4.72	L	$45.23	incl. in rate	incl. in rate	$213.49
Truck Driver (heavy)	Active	2.00	0.6	8	9.44	L	$57.59	incl. in rate	incl. in rate	$543.65
Vibratory Hammer & Extractor	Active	3.00	0.6	8	14.16	E	$94.34	incl. in rate	incl. in rate	$1,335.85
Hydraulic Excavator (6.0cy)	Active	3.00	0.6	8	14.16	E	$322.48	incl. in rate	incl. in rate	$4,566.32
Loader, FE Rubber Tire (8.6cy)	Active	2.00	0.6	8	9.44	E	$221.50	incl. in rate	incl. in rate	$2,090.96
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.6	8	9.44	E	$111.64	incl. in rate	incl. in rate	$1,053.88
				Labor Hours	89.68				TOTAL LABOR	$5,552.18
				Equipment Hours	47.2				TOTAL EQUIPMENT	$9,047.01

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Concrete Saw Cutting	1	EA	Cost per Mob	$2,500.00	$2,500.00
				TOTAL SUBCONTRACTS	$2,500.00

SUMMARY OF COSTS

Labor Cost	$5,552.18	Labor Burden @	49.7%	$0.00		$5,552.18
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$9,047.01	Equipment Tax @	0.0%	$0.00		$9,047.01
Subcontractors	$2,500.00					$2,500.00
DIRECT COST SUBTOTALS	$17,099			$0	DIRECT COST SUBTOTALS	$17,099

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$14,599.20	$2,189.88
Installing Contractors Profit@	8.0%				$14,599.20	$1,167.94
GC Markup on Subs @	5.0%				$2,500.00	$125.00
					TOTAL MARKUP COSTS	$3,482.82
General Contractors Insurance @	1.0%			on	$20,582.01	$206
Bond @	1.0%			on	$20,582.01	$206
Contingency @	0.0%			on	$20,993.65	$0
					TOTAL COST for pay item	$20,994

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B"

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.173	**Project**	: IRONGATE		
Description	:	Mirror Cove - 10'x16' Toilet Vault				
Quantity	:	160.00 SF				
Daily Production	:	160.00 SF per 8 hour shift	**Project #**	: Klamath Dams Removal		
Work Days	:	1.0 Days	**Estimator**	: Mihaela Tomulescu	**SF per**	**Total Cost**	**Unit Price Per SF**
Unit Price	:	$96.23 per SF	**Probable Low Cost Parameter**		**176**	**$13,857**	**$87**
Total Cost	:	$15,397	**Probable High Cost Parameter**		**144**	**$16,937**	**$106**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Equipment Operator (medium)	Active	3.00	1.0	8	24.00	L	$66.28	incl. in rate	incl. in rate	$1,590.72
Laborer	Active	3.00	1.0	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Vibratory Hammer & Extractor	Active	1.00	1.0	8	8.00	E	$94.34	incl. in rate	incl. in rate	$754.72
Hydraulic Excavator (6.0cy)	Active	1.00	1.0	8	8.00	E	$322.48	incl. in rate	incl. in rate	$2,579.84
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
				Labor Hours	**72**				**TOTAL LABOR**	**$3,882.64**
				Equipment Hours	**32**				**TOTAL EQUIPMENT**	**$5,999.68**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Harzardous waste disposal	1	LS		$2,800.00	$2,800.00
				TOTAL SUBCONTRACTS	**$2,800.00**

SUMMARY OF COSTS

Labor Cost	$3,882.64	Labor Burden @		49.7%	$0.00		$3,882.64
Material Cost	$0.00	Material Tax @		7.8%	$0.00		$0.00
Equipment Cost	$5,999.68	Equipment Tax @		0.0%	$0.00		$5,999.68
Subcontractors	$2,800.00						$2,800.00
DIRECT COST SUBTOTALS	**$12,682**				**$0**	**DIRECT COST SUBTOTALS**	**$12,682**
		Crew	**Material**	**Subs**	**Cost Basis**		
Installing Contractors Overhead@	15.0%				$9,882.32		$1,482.35
Installing Contractors Profit@	8.0%				$9,882.32		$790.59
GC Markup on Subs @	5.0%				$2,800.00		$140.00
						TOTAL MARKUP COSTS	**$2,412.93**
General Contractors Insurance @	1.0%			on	$15,095.25		$151
Bond @	1.0%			on	$15,095.25		$151
Contingency @	0.0%			on	$15,397.16		$0
						TOTAL COST for pay item	**$15,397**

Additional Pay Item Notes :

The price of removing a building is based on several factors including the size of the space, structural additions on the property, required permits and waste material clearing. A complete demo of a house and its foundation or basement can cost much as $25,000.
The cost of removal can vary based on the area lived in and the typical wages in the region. Some estimates put a price tag of $18,000 on bulldozing a 1,500 square-foot house, while others show that the average estimate is around $4-$15 per square foot.
Hazardous waste can greatly impact the cost of clearing debris. Many older homes contain asbestos, and there are special fees and considerations associated with its removal and disposal. The national average cost to eliminate asbestos is about $200-$700 per hour. We take in consideration this aspect in our estimate assuming 3 Laborers working 1 days, 8 hours per day @$350

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.174	Project	: IRONGATE
Description	: Mirror Cove - 2, 30'x5' Composite Gangplanks w/ aluminum		
Quantity	: 300.00 SF		
Daily Production	: 300.00 SF per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $21.43 per SF		
Total Cost	: $6,430		

	SF per	Total Cost	Unit Price Per SF
Probable Low Cost Parameter	330	$5,787	$19
Probable High Cost Parameter	270	$7,073	$24

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Laborer	Active	3.00	1.0	8	24.00	L	$45.80	incl. in rate	incl. in rate	$1,099.20
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	1.0	8	8.00	E	$111.64	incl. in rate	incl. in rate	$893.12
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Loader, FE Rubber Tire (8.6cy)	Active	1.00	1.0	8	8.00	E	$221.50	incl. in rate	incl. in rate	$1,772.00

Labor Hours	48	TOTAL LABOR	$2,460.32
Equipment Hours	16	TOTAL EQUIPMENT	$2,665.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,460.32	Labor Burden @	49.7%	$0.00	$2,460.32
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$2,665.12	Equipment Tax @	0.0%	$0.00	$2,665.12
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$5,125			$0	DIRECT COST SUBTOTALS $5,125

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,125.44	$768.82
Installing Contractors Profit@	8.0%				$5,125.44	$410.04
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$1,178.85

General Contractors Insurance @	1.0%	on	$6,304.29	$63
Bond @	1.0%	on	$6,304.29	$63
Contingency @	0.0%	on	$6,430.38	$0
			TOTAL COST for pay item	$6,430

Additional Pay Item Notes :

The cost of removal can vary based on the area lived in and the typical wages in the region. We assumed that we need 1 Forman, 3 Laboreres and 1 Loader to load the rubbish in the truck in 1/2 day.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.177		Project	: IRONGATE		
Description	: Mirror Cove - Regrade site					
Quantity	: 3.00 AC					
Daily Production	: 0.50 AC per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 6.0 Days		Estimator	: Mihaela Tomulescu		
				AC per	Total Cost	Unit Price Per AC
Unit Price	: $12,512.61 per AC		Probable Low Cost Parameter	0.575	$31,907	$10,636
Total Cost	: $37,538		Probable High Cost Parameter	0.425	$43,169	$14,390

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	6.0	8	48.00	L	$46.27	incl. in rate	incl. in rate	$2,220.96
Equipment Operator (medium)	Active	2.00	6.0	8	96.00	L	$66.28	incl. in rate	incl. in rate	$6,362.88
Laborer	Active	4.00	6.0	8	192.00	L	$45.80	incl. in rate	incl. in rate	$8,793.60
Grader. 180hp, 13' blade	Active	1.00	6.0	8	48.00	E	$80.79	incl. in rate	incl. in rate	$3,877.92
Dozer (235hp)(CATD7)	Active	1.00	2.0	8	16.00	E	$165.11	incl. in rate	incl. in rate	$2,641.76
	Active		2.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active		2.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
Brush Chipper	Active	1.00	0.0	8	16.00	E	$50.55			$808.80
Crawler Loader 3CY Bucket	Active	1.00	0.0	8	32.00	E	$160.13			$5,124.16
Chain Saw, Gas, 36" Long	Active	2.00	0.0	8	16.00	E	$5.63			$90.08
				Labor Hours	336				TOTAL LABOR	$17,377.44
				Equipment Hours	128				TOTAL EQUIPMENT	$12,542.72

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs	1.000	0.00		$0.00
		lbs	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$17,377.44	Labor Burden @	49.7%	$0.00		$17,377.44
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$12,542.72	Equipment Tax @	0.0%	$0.00		$12,542.72
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$29,920			$0	DIRECT COST SUBTOTALS	$29,920

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$29,920.16		$4,488.02
Installing Contractors Profit@	8.0%				$29,920.16		$2,393.61
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$6,881.64
General Contractors Insurance @	1.0%			on	$36,801.80		$368
Bond @	1.0%			on	$36,801.80		$368
Contingency @	0.0%			on	$37,537.83		$0
						TOTAL COST for pay item	$37,538

Additional Pay Item Notes :

Crew is based off clear and grub crew B7 off of RSM means. Production for the crew in .69 ac per day to clear and process the trees/ strubs on site. Assumed Seeding, mechanical seeding, 215 lb./acre with crew B66.The amount and type of seed are assumed and calculated as 215 lbs per acre in total.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.181	Project	: IRONGATE
Description	: Overlook Point - Regrade steep access road and site to natural contours		
Quantity	: 0.50 AC		
Daily Production	: 0.50 AC per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $30,630.71 per AC		
Total Cost	: $15,315		

	AC per	Total Cost	Unit Price Per AC
Probable Low Cost Parameter	0.575	$13,018	$26,036
Probable High Cost Parameter	0.425	$17,613	$35,225

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	1.0	8	8.00	L	$46.27	incl. in rate	incl. in rate	$370.16
Equipment Operator (medium)	Active	2.00	1.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Laborer	Active	4.00	1.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Grader. 180hp, 13' blade	Active	1.00	1.0	8	8.00	E	$80.79	incl. in rate	incl. in rate	$646.32
Dozer (235hp)(CATD7)	Active	1.00	2.0	8	16.00	E	$165.11	incl. in rate	incl. in rate	$2,641.76
	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	2.0	8	16.00	0	$0.00	incl. in rate	incl. in rate	$0.00
Brush Chipper	Active	1.00	0.0	8	16.00	E	$50.55			$808.80
Crawler Loader 3CY Bucket	Active	1.00	0.0	8	32.00	E	$160.13			$5,124.16
Chain Saw, Gas, 36" Long	Active	2.00	0.0	8	16.00	E	$5.63			$90.08
				Labor Hours	56				TOTAL LABOR	$2,896.24
				Equipment Hours	88				TOTAL EQUIPMENT	$9,311.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Idaho fescue (Festuca idahoensis)		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs PLS	1.000	0.00		$0.00
		lbs	1.000	0.00		$0.00
		lbs	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
		ea	1.000	0.00		$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,896.24	Labor Burden @	49.7%	$0.00	$2,896.24
Material Cost	$0.00	Material Tax @	7.8%	$0.00	$0.00
Equipment Cost	$9,311.12	Equipment Tax @	0.0%	$0.00	$9,311.12
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$12,207			$0	DIRECT COST SUBTOTALS $12,207

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$12,207.36	$1,831.10
Installing Contractors Profit@	8.0%				$12,207.36	$976.59
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$2,807.69
General Contractors Insurance @	1.0%		on		$15,015.05	$150
Bond @	1.0%		on		$15,015.05	$150
Contingency @	0.0%		on		$15,315.35	$0
					TOTAL COST for pay item	$15,315

Additional Pay Item Notes :

Crew is based off clear and grub crew B7 off of RSM means. Production for the crew in .69 ac per day to clear and process the trees/ strubs on site. Assumed Seeding, mechanical seeding, 215 lb./acre with crew B66.The amount and type of seed are calculated as 215 lbs per acre in total.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	4.182	Project	: IRONGATE		
Description	:	Long Gulch - 80'x25x4" Concrete boat ramp to be removed				
Quantity	:	25.00 CY				
Daily Production	:	100.00 CY per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	0.3 Days	Estimator	: Mihaela Tomulescu	CY per	Total Cost	Unit Price Per CY
Unit Price	:	$310.44 per CY	Probable Low Cost Parameter		110	$6,985	$279
Total Cost	:	$7,761	Probable High Cost Parameter		90	$8,537	$341

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	0.3	8	4.00	L	$46.27	incl. in rate	incl. in rate	$185.08
Equipment Operator (medium)	Active	8.00	0.3	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Steelworker	Active	6.00	0.3	8	12.00	L	$65.52	incl. in rate	incl. in rate	$786.24
Electrician	Active	1.00	0.3	8	2.00	L	$45.23	incl. in rate	incl. in rate	$90.46
Truck Driver (heavy)	Active	2.00	0.3	8	4.00	L	$57.59	incl. in rate	incl. in rate	$230.36
Vibratory Hammer & Extractor	Active	3.00	0.3	8	6.00	E	$94.34	incl. in rate	incl. in rate	$566.04
Hydraulic Excavator (6.0cy)	Active	3.00	0.3	8	6.00	E	$322.48	incl. in rate	incl. in rate	$1,934.88
Loader, FE Rubber Tire (8.6cy)	Active	2.00	0.3	8	4.00	E	$221.50	incl. in rate	incl. in rate	$886.00
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.3	8	4.00	E	$111.64	incl. in rate	incl. in rate	$446.56
				Labor Hours	38				TOTAL LABOR	$2,352.62
				Equipment Hours	20				TOTAL EQUIPMENT	$3,833.48

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
						TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
					TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,352.62	Labor Burden @		49.7%	$0.00		$2,352.62
Material Cost	$0.00	Material Tax @		7.8%	$0.00		$0.00
Equipment Cost	$3,833.48	Equipment Tax @		0.0%	$0.00		$3,833.48
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$6,186				$0	DIRECT COST SUBTOTALS	$6,186
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$6,186.10		$927.92
Installing Contractors Profit@	8.0%				$6,186.10		$494.89
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$1,422.80
General Contractors Insurance @	1.0%			on	$7,608.90		$76
Bond @	1.0%			on	$7,608.90		$76
Contingency @	0.0%			on	$7,761.08		$0
						TOTAL COST for pay item	$7,761

Additional Pay Item Notes :

Based on RS.Means - "Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping, 650 CY - work done with crew B9" and "Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 15 min load/wait/unload, 12 C.Y. truck, cycle 30 miles, 50 MPH, excludes loading equipment Crew B34B"

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 4.185		Project	: IRONGATE		
Description	: Concrete Lining Installation for Diversion Tunnel					
Quantity	: 1.00 LS					
Daily Production	: 0.04 LS per	8 hour shift	Project #	: Klamath Dams Removal		
Work Days	: 25.0 Days		Estimator	: Mihaela Tomulescu		
				LS per	Total Cost	Unit Price Per LS
Unit Price	: $1,196,251.74 per LS		Probable Low Cost Parameter	0.044	$1,076,627	$1,076,627
Total Cost	: $1,196,252		Probable High Cost Parameter	0.036	$1,315,877	$1,315,877

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
	Active	1.00	25.0	8	200.00	0	$0.00	incl. in rate	incl. in rate	$0.00
				Labor Hours	0				TOTAL LABOR	$0.00
				Equipment Hours	0				TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Tunnel Lining (Shotcrete with Reinforcement)	1.00	LS	RSMs (2780 CY @ $401.78/CY)	$1,116,948.40	$1,116,948.40
				TOTAL SUBCONTRACTS	$1,116,948.40

SUMMARY OF COSTS

Labor Cost	$0.00	Labor Burden @		49.7%	$0.00		$0.00
Material Cost	$0.00	Material Tax @		7.8%	$0.00		$0.00
Equipment Cost	$0.00	Equipment Tax @		0.0%	$0.00		$0.00
Subcontractors	$1,116,948.40						$1,116,948.40
DIRECT COST SUBTOTALS	$1,116,948				$0	DIRECT COST SUBTOTALS	$1,116,948
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$0.00		$0.00
Installing Contractors Profit@	8.0%				$0.00		$0.00
GC Markup on Subs @	5.0%				$1,116,948.40		$55,847.42
						TOTAL MARKUP COSTS	$55,847.42
General Contractors Insurance @	1.0%			on	$1,172,795.82		$11,728
Bond @	1.0%			on	$1,172,795.82		$11,728
Contingency @	0.0%			on	$1,196,251.74		$0
						TOTAL COST for pay item	$1,196,252

Additional Pay Item Notes :

Subcontractor will install reinforcement and shotcrete concrete lining in diversion tunnel.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.000	Project	: JC BOYLE			
Description	:	Remove Frame dead end structures 60-80 ft high					
Quantity	:	2.00 EA					
Daily Production	:	1.00 EA per 8 hour shift	Project #	: Klamath Dams Removal			
Work Days	:	2.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$7,101.59 per EA	Probable Low Cost Parameter		1.1	$12,783	$6,391.43
Total Cost	:	$14,203	Probable High Cost Parameter		0.8	$17,044	$8,521.91

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Hydraulic Excavator (1.5cy)	Active	1.00	2.0	8	16.00	E	$141.92	incl. in rate	incl. in rate	$2,270.72
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Water Tanker (5,000gal)	Active	1.00	2.0	8	16.00	E	$74.56	incl. in rate	incl. in rate	$1,192.96
Gas Welding Machine	Active	1.00	2.0	8	16.00	E	$2.88	incl. in rate	incl. in rate	$46.03
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Truck Driver (heavy)	Active	1.00	2.0	8	16.00	L	$57.59	incl. in rate	incl. in rate	$921.44
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	2.0	8	16.00	E	$70.35	incl. in rate	incl. in rate	$1,125.60
Vibratory Hammer & Extractor	Active	1.00	2.0	8	16.00	E	$94.34	incl. in rate	incl. in rate	$1,509.44
				Labor Hours	96				TOTAL LABOR	$4,911.52
				Equipment Hours	80				TOTAL EQUIPMENT	$6,144.75

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$245.58	$245.58
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$245.58

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$4,911.52	Labor Burden @		49.7%	$0.00		$4,911.52
Material Cost	$245.58	Material Tax @		7.8%	$19.03		$264.61
Equipment Cost	$6,144.75	Equipment Tax @		0.0%	$0.00		$6,144.75
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$11,302				$19	DIRECT COST SUBTOTALS	$11,321

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$11,320.88		$1,698.13
Installing Contractors Profit@	8.0%				$11,320.88		$905.67
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$2,603.80
General Contractors Insurance @	1.0%		on		$13,924.68		$139
Bond @	1.0%		on		$13,924.68		$139
Contingency @	0.0%		on		$14,203.18		$0
						TOTAL COST for pay item	$14,203

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1 Excavator, 1 Hammer. Considered one welder for cutting frame/ support of equipment, 2 laborer to load demolished equipment /materials in the truck for disposal.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.001		Project	: JC BOYLE		
Description	:	Remove (incl foundation) and Save Transformers 230KV					
Quantity	:	2.00 EA					
Daily Production	:	1.79 EA per	8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	1.1 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$2,688.70 per EA		Probable Low Cost Parameter	1.969	$4,840	$2,419.83
Total Cost	:	$5,377		Probable High Cost Parameter	1.5215	$6,184	$3,092.00

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.1	8	8.96	L	$47.23	incl. in rate	incl. in rate	$423.18
Electrician	Active	1.00	1.1	8	8.96	L	$45.23	incl. in rate	incl. in rate	$405.26
Hydraulic Crane (50tn)	Active	1.00	1.1	8	8.96	E	$134.32	incl. in rate	incl. in rate	$1,203.51
Equipment Operator (crane)	Active	1.00	1.1	8	8.96	L	$68.41	incl. in rate	incl. in rate	$612.95
Vibratory Hammer & Extractor	Active	1.00	1.1	8	8.96	E	$94.34	incl. in rate	incl. in rate	$845.29
Truck, Utility, with Man-Basket	Active	1.00	1.1	8	8.96	E	$31.90	incl. in rate	incl. in rate	$285.82
Laborer	Active	1.00	1.1	8	8.96	L	$45.80	incl. in rate	incl. in rate	$410.37
				Labor Hours	35.84				TOTAL LABOR	$1,851.76
				Equipment Hours	26.88				TOTAL EQUIPMENT	$2,334.62

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$92.59	$92.59
					TOTAL MATERIAL	$92.59

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$1,851.76	Labor Burden @		49.7%	$0.00		$1,851.76
Material Cost	$92.59	Material Tax @		7.8%	$7.18		$99.76
Equipment Cost	$2,334.62	Equipment Tax @		0.0%	$0.00		$2,334.62
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$4,279				$7	DIRECT COST SUBTOTALS	$4,286
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$4,286.14		$642.92
Installing Contractors Profit@	8.0%				$4,286.14		$342.89
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$985.81
General Contractors Insurance @	1.0%		on		$5,271.96		$53
Bond @	1.0%		on		$5,271.96		$53
Contingency @	0.0%		on		$5,377.40		$0
						TOTAL COST for pay item	$5,377

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1 Crane to load the transformer in the truck for disposal. In normal circumstances, decontaminated residual components could be accepted at landfill sites.

PAY ITEM COST DETAIL WORKSHEET — **5.002 Remove (incl foundation) and Save Power Circuit Breakers 230KV**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.002	Project	: JC BOYLE
Description	: Remove (incl foundation) and Save Power Circuit Breakers 230KV		
Quantity	: 2.00 EA		
Daily Production	: 1.00 EA per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 2.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $3,640.83 per EA		
Total Cost	: $7,282		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	1.05	$6,918	$3,458.79
Probable High Cost Parameter	0.9	$8,010	$4,004.91

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Hydraulic Crane (35tn)	Active	1.00	2.0	8	16.00	E	$116.30	incl. in rate	incl. in rate	$1,860.80
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Laborer	Active	1.00	2.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	2.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40

Labor Hours	64	TOTAL LABOR	$3,257.28
Equipment Hours	32	TOTAL EQUIPMENT	$2,371.20

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$162.86	$162.86
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
TOTAL MATERIAL						$162.86

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
TOTAL SUBCONTRACTS					$0.00

SUMMARY OF COSTS

Labor Cost	$3,257.28	Labor Burden @	49.7%	$0.00	$3,257.28
Material Cost	$162.86	Material Tax @	7.8%	$12.62	$175.49
Equipment Cost	$2,371.20	Equipment Tax @	0.0%	$0.00	$2,371.20
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$5,791			$13	DIRECT COST SUBTOTALS $5,804

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$5,803.97	$870.59
Installing Contractors Profit@	8.0%				$5,803.97	$464.32
GC Markup on Subs @	5.0%				$0.00	$0.00
TOTAL MARKUP COSTS						$1,334.91

General Contractors Insurance @	1.0%	on	$7,138.88	$71
Bond @	1.0%	on	$7,138.88	$71
Contingency @	0.0%	on	$7,281.66	$0

TOTAL COST for pay item **$7,282**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1Crane. Considered 1 laborer to help loading circuit breakers in the truck for saving it in the designated place.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.003		Project	: JC BOYLE		
Description	: Substation Tie Structure 230KV					
Quantity	: 1.00 EA					
Daily Production	: 0.25 EA per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 4.0 Days		Estimator	: Mihaela Tomulescu	EA per / Total Cost	Unit Price Per EA
Unit Price	: $41,482.05 per EA		Probable Low Cost Parameter	0.275	$37,334	$37,333.84
Total Cost	: $41,482		Probable High Cost Parameter	0.2125	$47,704	$47,704.36

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	4.0	8	64.00	L	$46.27	incl. in rate	incl. in rate	$2,961.28
Electrician	Active	4.00	4.0	8	128.00	L	$45.23	incl. in rate	incl. in rate	$5,789.44
Hydraulic Crane (35tn)	Active	2.00	4.0	8	64.00	E	$116.30	incl. in rate	incl. in rate	$7,443.20
Equipment Operator (medium)	Active	2.00	4.0	8	64.00	L	$66.28	incl. in rate	incl. in rate	$4,241.92
Truck, Utility, with Man-Basket	Active	2.00	4.0	8	64.00	E	$31.90	incl. in rate	incl. in rate	$2,041.60
Truck, Pickup (4x4, 3/4tn)	Active	2.00	4.0	8	64.00	E	$16.94	incl. in rate	incl. in rate	$1,084.16
				Labor Hours	256				TOTAL LABOR	$12,992.64
				Equipment Hours	192				TOTAL EQUIPMENT	$10,568.96

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$649.63	$649.63
Ceramis Insulators	96.00	Bells	1.000	96.00	$18.00	$1,728.00
V-String Hardware	3.00	EA	1.000	3.00	$230.00	$690.00
Grounding	1.00	EA	1.000	1.00	$150.00	$150.00
					TOTAL MATERIAL	$3,217.63

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable tensioning rig, for high voltage line work - Rent per day	2.00	days		$535.00	$1,070.00
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	2.00	days		$3,000.00	$6,000.00
				TOTAL SUBCONTRACTS	$7,070.00

SUMMARY OF COSTS

Labor Cost	$12,992.64	Labor Burden @	49.7%	$0.00		$12,992.64
Material Cost	$3,217.63	Material Tax @	7.8%	$249.37		$3,467.00
Equipment Cost	$10,568.96	Equipment Tax @	0.0%	$0.00		$10,568.96
Subcontractors	$7,070.00					$7,070.00
DIRECT COST SUBTOTALS	$33,849			$249	DIRECT COST SUBTOTALS	$34,099

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$27,028.60		$4,054.29
Installing Contractors Profit@	8.0%				$27,028.60		$2,162.29
GC Markup on Subs @	5.0%				$7,070.00		$353.50
						TOTAL MARKUP COSTS	$6,570.08
General Contractors Insurance @	1.0%		on		$40,668.68		$407
Bond @	1.0%		on		$40,668.68		$407
Contingency @	0.0%		on		$41,482.05		$0
						TOTAL COST for pay item	$41,482

Additional Pay Item Notes :

Production is based off of RSMs using 2 Crew formed of 1 Forman, 1 Electrician,1Crane.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.004		Project	: JC BOYLE		
Description	: Remove Chain Link Fence					
Quantity	: 601.00 LF					
Daily Production	: 300.00 LF per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 2.0 Days		Estimator	: Mihaela Tomulescu	LF per	Total Cost	Unit Price Per LF
Unit Price	: $17.70 per LF		Probable Low Cost Parameter		330	$9,575	$15.93
Total Cost	: $10,639		Probable High Cost Parameter		270	$11,703	$19.47

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Truck Driver (light)	Active	1.00	2.0	8	16.00	L	$56.29	incl. in rate	incl. in rate	$900.64
Hydraulic Excavator (2.5cy)	Active	1.00	2.0	8	16.00	E	$203.63	incl. in rate	incl. in rate	$3,258.08
Equipment Operator (light)	Active	1.00	2.0	8	16.00	L	$64.90	incl. in rate	incl. in rate	$1,038.40
Truck, Flatbed (4x4, 10,000 gvw)	Active	2.00	2.0	8	32.00	E	$31.90	incl. in rate	incl. in rate	$1,020.80
				Labor Hours	64				TOTAL LABOR	$3,404.64
				Equipment Hours	48				TOTAL EQUIPMENT	$4,278.88

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$170.23	$170.23
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	120.00	CY	1.000	120.00	$4.74	$568.80
					TOTAL MATERIAL	$739.03

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$3,404.64	Labor Burden @	49.7%	$0.00		$3,404.64
Material Cost	$739.03	Material Tax @	7.8%	$57.27		$796.31
Equipment Cost	$4,278.88	Equipment Tax @	0.0%	$0.00		$4,278.88
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$8,423			$57	DIRECT COST SUBTOTALS	$8,480

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$8,479.83		$1,271.97
Installing Contractors Profit@	8.0%				$8,479.83		$678.39
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$1,950.36
General Contractors Insurance @	1.0%		on		$10,430.19		$104
Bond @	1.0%		on		$10,430.19		$104
Contingency @	0.0%		on		$10,638.79		$0
						TOTAL COST for pay item	$10,639

Additional Pay Item Notes :

Production is based off of RSMs using Crew B80c, 2 laborers and 1 truck driver light. Considered using an excavator for the CLF foundation removal.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.005	Project	: JC BOYLE
Description	: Demolish overhead distribution 2.5 miles (30-45 poles)		
Quantity	: 45.00 EA		
Daily Production	: 3.50 EA per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 12.9 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $1,160.01 per EA		
Total Cost	: $52,200		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	3.85	$46,980	$1,044.01
Probable High Cost Parameter	2.8	$62,640	$1,392.01

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	12.9	8	103.20	L	$46.27	incl. in rate	incl. in rate	$4,775.06
Electrician	Active	1.00	12.9	8	103.20	L	$45.23	incl. in rate	incl. in rate	$4,667.74
Hydraulic Crane (17tn)	Active	1.00	12.9	8	103.20	E	$81.52	incl. in rate	incl. in rate	$8,412.86
Equipment Operator (medium)	Active	1.00	12.9	8	103.20	L	$66.28	incl. in rate	incl. in rate	$6,840.10
Truck Driver (heavy)	Active	1.00	5.0	8	40.00	L	$57.59	incl. in rate	incl. in rate	$2,303.60
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	5.0	8	40.00	E	$111.64	incl. in rate	incl. in rate	$4,465.60
Laborer	Active	2.00	5.0	8	80.00	L	$45.80	incl. in rate	incl. in rate	$3,664.00
Vibratory Hammer & Extractor	Active	1.00	5.0	8	40.00	E	$94.34	incl. in rate	incl. in rate	$3,773.60
Truck, Utility, with Man-Basket	Active	1.00	5.0	8	40.00	E	$31.90	incl. in rate	incl. in rate	$1,276.00

Labor Hours	429.6	TOTAL LABOR	$22,250.50
Equipment Hours	223.2	TOTAL EQUIPMENT	$17,928.06

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,112.52	$1,112.52
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	45.00	CY	1.000	45.00	$4.74	$213.30
					TOTAL MATERIAL	$1,325.82

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$22,250.50	Labor Burden @	49.7%	$0.00		$22,250.50
Material Cost	$1,325.82	Material Tax @	7.8%	$102.75		$1,428.58
Equipment Cost	$17,928.06	Equipment Tax @	0.0%	$0.00		$17,928.06
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$41,504			$103	DIRECT COST SUBTOTALS	$41,607

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$41,607.14		$6,241.07
Installing Contractors Profit@	8.0%				$41,607.14		$3,328.57
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$9,569.64
General Contractors Insurance @	1.0%		on		$51,176.78		$512
Bond @	1.0%		on		$51,176.78		$512
Contingency @	0.0%		on		$52,200.31		$0
						TOTAL COST for pay item	$52,200

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane and 1 man-basket truck to help untie the line). Considered 2 laborer and 1 Vibratory Hammer for demolish the pole foundation, helping placing poles in a designated place and loading them in the truck for disposal. This process includes filling in pole locations with gravel, clean fill and topsoil.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.006	Project	: COPCO 1
Description	: Remove Frame dead end structures 60-80 ft high @Switchyard		
Quantity	: 4.00 EA		
Daily Production	: 1.00 EA per 8 hour shift	Project #	: 2
Work Days	: 4.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $6,436.15 per EA		
Total Cost	: $25,745		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	1.15	$21,883	$5,470.72
Probable High Cost Parameter	0.7	$33,468	$8,366.99

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Electrician	Active	1.00	4.0	8	32.00	L	$45.23	incl. in rate	incl. in rate	$1,447.36
Hydraulic Excavator (1.5cy)	Active	1.00	4.0	8	32.00	E	$141.92	incl. in rate	incl. in rate	$4,541.44
Equipment Operator (medium)	Active	1.00	4.0	8	32.00	L	$66.28	incl. in rate	incl. in rate	$2,120.96
Welder	Active	1.00	4.0	8	32.00	L	$7.84	incl. in rate	incl. in rate	$250.80
Gas Welding Machine	Active	1.00	4.0	8	32.00	E	$2.88	incl. in rate	incl. in rate	$92.06
Laborer	Active	2.00	4.0	8	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Truck Driver (heavy)	Active	1.00	4.0	8	32.00	L	$57.59	incl. in rate	incl. in rate	$1,842.88
Truck, On-Highway Dump (6x4, 12cy)	Active	1.00	4.0	8	32.00	E	$70.35	incl. in rate	incl. in rate	$2,251.20
Vibratory Hammer & Extractor	Active	1.00	4.0	8	32.00	E	$94.34	incl. in rate	incl. in rate	$3,018.88

Labor Hours	224	TOTAL LABOR	$10,073.84
Equipment Hours	128	TOTAL EQUIPMENT	$9,903.58

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$503.69	$503.69
						$0.00
						$0.00
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$503.69

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$10,073.84	Labor Burden @	49.7%	$0.00	$10,073.84
Material Cost	$503.69	Material Tax @	7.8%	$39.04	$542.73
Equipment Cost	$9,903.58	Equipment Tax @	0.0%	$0.00	$9,903.58
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$20,481			$39	DIRECT COST SUBTOTALS $20,520

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$20,520.15	$3,078.02
Installing Contractors Profit@	8.0%	☑	☑	☐	$20,520.15	$1,641.61
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	$4,719.63

General Contractors Insurance @	1.0%	on	$25,239.79	$252
Bond @	1.0%	on	$25,239.79	$252
Contingency @	0.0%	on	$25,744.58	$0
			TOTAL COST for pay item	$25,745

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1 Excavator, 1 Hammer. Considered one welder for cutting frame/ support of equipment, 2 laborer to load demolished equipment /materials in the truck for disposal. Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.007	Project	: COPCO 1		
Description	: Remove Power Circuit Breakers 69KV @Switchyard				
Quantity	: 2.00 EA				
Daily Production	: 1.00 EA per 8 hour shift	Project #	: 2		
Work Days	: 2.0 Days	Estimator	: Mihaela Tomulescu		
			EA per	Total Cost	Unit Price Per EA
Unit Price	: $5,681.20 per EA	Probable Low Cost Parameter	1.1	$10,226	$5,113.08
Total Cost	: $11,362	Probable High Cost Parameter	0.75	$14,203	$7,101.50

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	2.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Electrician	Active	2.00	2.0	8	32.00	L	$45.23	incl. in rate	incl. in rate	$1,447.36
Hydraulic Crane (35tn)	Active	1.00	1.0	8	8.00	E	$116.30	incl. in rate	incl. in rate	$930.40
Equipment Operator (crane)	Active	1.00	1.0	8	8.00	L	$68.41	incl. in rate	incl. in rate	$547.28
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	2.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40
Truck, Utility, with Man-Basket	Active	1.00	2.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40
Truck Driver (light)	Active	2.00	2.0	8	32.00	L	$56.29	incl. in rate	incl. in rate	$1,801.28
				Labor Hours	136				TOTAL LABOR	$6,742.16
				Equipment Hours	40				TOTAL EQUIPMENT	$1,951.20

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$337.11	$337.11
					TOTAL MATERIAL	$337.11

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$6,742.16	Labor Burden @	49.7%	$0.00	$6,742.16
Material Cost	$337.11	Material Tax @	7.8%	$26.13	$363.23
Equipment Cost	$1,951.20	Equipment Tax @	0.0%	$0.00	$1,951.20
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$9,030			$26	DIRECT COST SUBTOTALS $9,057

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$9,056.59	$1,358.49
Installing Contractors Profit@	8.0%	☑	☑	☐	$9,056.59	$724.53
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	$2,083.02
General Contractors Insurance @	1.0%		on		$11,139.61	$111
Bond @	1.0%		on		$11,139.61	$111
Contingency @	0.0%		on		$11,362.40	$0
					TOTAL COST for pay item	$11,362

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1Crane. Considered 1 laborer to help loading circuit breakers in the truck for saving it in the designated place. 1 utility truck access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.008	Project	: COPCO 1
Description	: Remove Disconnect Switches @Switchyard		
Quantity	: 4.00 EA		
Daily Production	: 1.00 EA per 8 hour shift	Project #	: 2
Work Days	: 4.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $9,731.40 per EA		
Total Cost	: $38,926		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	1.1	$35,033	$8,758.26
Probable High Cost Parameter	0.75	$48,657	$12,164.25

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Electrician	Active	2.00	4.0	8	64.00	L	$45.23	incl. in rate	incl. in rate	$2,894.72
Hydraulic Excavator (6.0cy)	Active	1.00	4.0	8	32.00	E	$322.48	incl. in rate	incl. in rate	$10,319.36
Equipment Operator (medium)	Active	1.00	4.0	8	32.00	L	$66.28	incl. in rate	incl. in rate	$2,120.96
Laborer	Active	2.00	4.0	8	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	2.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40
Truck, Utility, with Man-Basket	Active	2.00	4.0	8	64.00	E	$31.90	incl. in rate	incl. in rate	$2,041.60
Truck Driver (light)	Active	2.00	4.0	8	64.00	L	$56.29	incl. in rate	incl. in rate	$3,602.56
Vibratory Hammer & Extractor	Active	1.00	4.0	8	32.00	E	$94.34	incl. in rate	incl. in rate	$3,018.88

Labor Hours	256	TOTAL LABOR	$13,030.08
Equipment Hours	144	TOTAL EQUIPMENT	$15,890.24

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 15% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,954.51	$1,954.51
TOTAL MATERIAL						$1,954.51

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
TOTAL SUBCONTRACTS					$0.00

SUMMARY OF COSTS

Labor Cost	$13,030.08	Labor Burden @	49.7%	$0.00	$13,030.08
Material Cost	$1,954.51	Material Tax @	7.8%	$151.47	$2,105.99
Equipment Cost	$15,890.24	Equipment Tax @	0.0%	$0.00	$15,890.24
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$30,875			$151	DIRECT COST SUBTOTALS $31,026

	%	Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$31,026.31	$4,653.95
Installing Contractors Profit@	8.0%	☑	☑	☐	$31,026.31	$2,482.10
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
TOTAL MARKUP COSTS						$7,136.05

General Contractors Insurance @	1.0%	on	$38,162.36	$382
Bond @	1.0%	on	$38,162.36	$382
Contingency @	0.0%	on	$38,925.60	$0
TOTAL COST for pay item				$38,926

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane). Considered two laborer for loding it in the truck for disposal and for hauling the demolished foundation (same structure as circuit breakers).Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.009	Project	: COPCO 1		
Description	: Remove all associated auxiliary equipment @Switchyard (Allowance)				
Quantity	: 1.00 LS				
Daily Production	: 1.00 LS per 8 hour shift	Project #	: 2		
Work Days	: 3.0 Days	Estimator	: Mihaela Tomulescu		
			LS per	Total Cost	Unit Price Per LS
Unit Price	: $48,501.71 per LS	Probable Low Cost Parameter	1.1	$43,652	$43,651.54
Total Cost	: $48,502	Probable High Cost Parameter	0.75	$60,627	$60,627.14

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.0	8	24.00	L	$46.27	incl. in rate	incl. in rate	$1,110.48
Electrician	Active	4.00	3.0	8	96.00	L	$45.23	incl. in rate	incl. in rate	$4,342.08
Hydraulic Excavator (1.5cy)	Active	1.00	3.0	8	24.00	E	$141.92	incl. in rate	incl. in rate	$3,406.08
Equipment Operator (medium)	Active	2.00	3.0	8	48.00	L	$66.28	incl. in rate	incl. in rate	$3,181.44
Truck, Utility, with Man-Basket	Active	1.00	3.0	8	24.00	E	$31.90	incl. in rate	incl. in rate	$765.60
Hydraulic Crane (17tn)	Active	1.00	3.0	8	24.00	E	$81.52	incl. in rate	incl. in rate	$1,956.48
Laborer	Active	4.00	3.0	8	96.00	L	$45.80	incl. in rate	incl. in rate	$4,396.80
Truck Driver (heavy)	Active	2.00	3.0	8	48.00	L	$57.59	incl. in rate	incl. in rate	$2,764.32
Truck, On-Highway Dump (6x4, 12cy)	Active	2.00	3.0	8	48.00	E	$70.35	incl. in rate	incl. in rate	$3,376.80
Vibratory Hammer & Extractor	Active	1.00	3.0	8	24.00	E	$94.34	incl. in rate	incl. in rate	$2,264.16
				Labor Hours	312				TOTAL LABOR	$15,795.12
				Equipment Hours	144				TOTAL EQUIPMENT	$11,769.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$789.76	$789.76
					TOTAL MATERIAL	$789.76

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	1.00	days		4.00	$3,000.00	$12,000.00
					TOTAL SUBCONTRACTS	$12,000.00

SUMMARY OF COSTS

Labor Cost	$15,795.12	Labor Burden @	49.7%	$0.00		$15,795.12
Material Cost	$789.76	Material Tax @	7.8%	$61.21		$850.96
Equipment Cost	$11,769.12	Equipment Tax @	0.0%	$0.00		$11,769.12
Subcontractors	$12,000.00					$12,000.00
DIRECT COST SUBTOTALS	$40,354			$61	DIRECT COST SUBTOTALS	$40,415

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$28,415.20	$4,262.28
Installing Contractors Profit@	8.0%	☑	☑	☐	$28,415.20	$2,273.22
GC Markup on Subs @	5.0%	☐	☐	☑	$12,000.00	$600.00
					TOTAL MARKUP COSTS	$7,135.50

General Contractors Insurance @	1.0%	on	$47,550.70	$476
Bond @	1.0%	on	$47,550.70	$476
Contingency @	0.0%	on	$48,501.71	$0
			TOTAL COST for pay item	$48,502

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 4 Electrician, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck,, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations, 1 utility truck access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard.

PAY ITEM COST DETAIL WORKSHEET **5.010 Remove Distribution lines 69 Kv between Copco 1 Switchyard and HE Plant (6 Poles)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.010	**Project**	: COPCO 1		
Description	:	Poles)				
Quantity	:	6.00 EA				
Daily Production	:	3.00 EA per 8 hour shift	**Project #**	: 2		
Work Days	:	2.0 Days	**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$1,402.44 per EA	**Probable Low Cost Parameter**		**3.3**	**$7,573**	**$1,262.20**
Total Cost	:	$8,415	**Probable High Cost Parameter**		**2.25**	**$10,518**	**$1,753.05**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Hydraulic Crane (17tn)	Active	1.00	2.0	8	16.00	E	$81.52	incl. in rate	incl. in rate	$1,304.32
Equipment Operator (medium)	Active	1.00	2.0	8	16.00	L	$66.28	incl. in rate	incl. in rate	$1,060.48
Laborer	Active	1.00	2.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Truck Driver (light)	Active	1.00	2.0	8	16.00	L	$56.29	incl. in rate	incl. in rate	$900.64
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	2.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40
Truck, Utility, with Man-Basket	Active	1.00	2.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40

Labor Hours	**80**	**TOTAL LABOR**	**$4,157.92**
Equipment Hours	**48**	**TOTAL EQUIPMENT**	**$2,325.12**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$207.90	$207.90
					TOTAL MATERIAL	**$207.90**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$4,157.92	Labor Burden @	49.7%	$0.00		$4,157.92
Material Cost	$207.90	Material Tax @	7.8%	$16.11		$224.01
Equipment Cost	$2,325.12	Equipment Tax @	0.0%	$0.00		$2,325.12
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$6,691**			**$16**	**DIRECT COST SUBTOTALS**	**$6,707**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$6,707.05	$1,006.06
Installing Contractors Profit@	8.0%	☑	☑	☐	$6,707.05	$536.56
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	**$1,542.62**
General Contractors Insurance @	1.0%		on		$8,249.67	$82
Bond @	1.0%		on		$8,249.67	$82
Contingency @	0.0%		on		$8,414.66	$0
					TOTAL COST for pay item	**$8,415**

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane). Considered one laborer for demolish the pole and helping placing poles in a designated place and loding it in the truck for disposal. Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.011	Project	: COPCO 1		
Description	: Diversion Dam				
Quantity	: 8.00 EA				
Daily Production	: 2.00 EA per 8 hour shift	Project #	: 2		
Work Days	: 4.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $1,950.45 per EA	Probable Low Cost Parameter	2.2	$14,043	$1,755.41
Total Cost	: $15,604	Probable High Cost Parameter	1.5	$19,505	$2,438.07

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	4.0	8	32.00	L	$46.27	incl. in rate	incl. in rate	$1,480.64
Electrician	Active	1.00	4.0	8	32.00	L	$45.23	incl. in rate	incl. in rate	$1,447.36
Hydraulic Crane (17tn)	Active	1.00	4.0	8	32.00	E	$81.52	incl. in rate	incl. in rate	$2,608.64
Equipment Operator (medium)	Active	1.00	4.0	8	32.00	L	$66.28	incl. in rate	incl. in rate	$2,120.96
Truck Driver (heavy)	Active	1.00	4.0	8	32.00	L	$57.59	incl. in rate	incl. in rate	$1,842.88
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	4.0	8	32.00	E	$31.90	incl. in rate	incl. in rate	$1,020.80
Laborer	Active	1.00	4.0	8	32.00	L	$45.80	incl. in rate	incl. in rate	$1,465.60

Labor Hours	160	TOTAL LABOR	$8,357.44
Equipment Hours	64	TOTAL EQUIPMENT	$3,629.44

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$417.87	$417.87
TOTAL MATERIAL						$417.87

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
TOTAL SUBCONTRACTS					$0.00

SUMMARY OF COSTS

Labor Cost	$8,357.44	Labor Burden @	49.7%	$0.00	$8,357.44
Material Cost	$417.87	Material Tax @	7.8%	$32.39	$450.26
Equipment Cost	$3,629.44	Equipment Tax @	0.0%	$0.00	$3,629.44
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$12,405			$32	DIRECT COST SUBTOTALS $12,437

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$12,437.14	$1,865.57
Installing Contractors Profit@	8.0%	☑	☑	☐	$12,437.14	$994.97
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
TOTAL MARKUP COSTS						$2,860.54

General Contractors Insurance @	1.0%	on	$15,297.68	$153
Bond @	1.0%	on	$15,297.68	$153
Contingency @	0.0%	on	$15,603.63	$0
TOTAL COST for pay item				$15,604

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane). Considered one laborer for demolish the pole and helping placing poles in a designated place and loding it in the truck for disposal. Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.012	Project	: COPCO 1		
Description	: Remove "Production Poles" in general area Copco#1				
Quantity	: 7.00 EA				
Daily Production	: 2.00 EA per 8 hour shift	Project #	: 2		
Work Days	: 3.5 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $1,956.86 per EA	Probable Low Cost Parameter	2.3	$11,643	$1,663.33
Total Cost	: $13,698	Probable High Cost Parameter	1.4	$17,807	$2,543.92

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.5	8	28.00	L	$46.27	incl. in rate	incl. in rate	$1,295.56
Electrician	Active	1.00	3.5	8	28.00	L	$45.23	incl. in rate	incl. in rate	$1,266.44
Hydraulic Crane (17tn)	Active	1.00	3.5	8	28.00	E	$81.52	incl. in rate	incl. in rate	$2,282.56
Equipment Operator (medium)	Active	1.00	3.5	8	28.00	L	$66.28	incl. in rate	incl. in rate	$1,855.84
Laborer	Active	1.00	3.5	8	28.00	L	$45.80	incl. in rate	incl. in rate	$1,282.40
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	3.5	8	28.00	E	$31.90	incl. in rate	incl. in rate	$893.20
Truck Driver (heavy)	Active	1.00	3.5	8	28.00	L	$57.59	incl. in rate	incl. in rate	$1,612.52
				Labor Hours	140				TOTAL LABOR	$7,312.76
				Equipment Hours	56				TOTAL EQUIPMENT	$3,175.76

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$365.64	$365.64
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	7.00	CY	1.000	7.00	$4.74	$33.18
					TOTAL MATERIAL	$398.82

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$7,312.76	Labor Burden @	49.7%	$0.00	$7,312.76
Material Cost	$398.82	Material Tax @	7.8%	$30.91	$429.73
Equipment Cost	$3,175.76	Equipment Tax @	0.0%	$0.00	$3,175.76
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$10,887			$31	DIRECT COST SUBTOTALS $10,918

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$10,918.25	$1,637.74
Installing Contractors Profit@	8.0%	☑	☑	☐	$10,918.25	$873.46
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	$2,511.20
General Contractors Insurance @	1.0%		on		$13,429.44	$134
Bond @	1.0%		on		$13,429.44	$134
Contingency @	0.0%		on		$13,698.03	$0
					TOTAL COST for pay item	$13,698

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane). Considered one laborer for demolish the pole and helping placing poles in a designated place and loding them in the truck for disposal. This process includes filling in pole locations with gravel, clean fill and topsoil. Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.013		Project	: COPCO 1			
Description	:	Remove "Village Houses Distribution Poles" near dam (assumed 10)						
Quantity	:	10.00	EA					
Daily Production	:	3.00	EA per 8 hour shift	Project #	: 2			
Work Days	:	3.3	Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$1,293.71	per EA	Probable Low Cost Parameter		3.45	$10,997	$1,099.65
Total Cost	:	$12,937		Probable High Cost Parameter		2.1	$16,818	$1,681.82

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	3.3	8	26.40	L	$46.27	incl. in rate	incl. in rate	$1,221.53
Electrician	Active	1.00	3.3	8	26.40	L	$45.23	incl. in rate	incl. in rate	$1,194.07
Hydraulic Crane (17tn)	Active	1.00	3.3	8	26.40	E	$81.52	incl. in rate	incl. in rate	$2,152.13
Equipment Operator (medium)	Active	1.00	3.3	8	26.40	L	$66.28	incl. in rate	incl. in rate	$1,749.79
Truck Driver (heavy)	Active	1.00	3.3	8	26.40	L	$57.59	incl. in rate	incl. in rate	$1,520.38
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	3.3	8	26.40	E	$31.90	incl. in rate	incl. in rate	$842.16
Laborer	Active	1.00	3.3	8	26.40	L	$45.80	incl. in rate	incl. in rate	$1,209.12
				Labor Hours	132				TOTAL LABOR	$6,894.89
				Equipment Hours	52.8				TOTAL EQUIPMENT	$2,994.29

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$344.74	$344.74
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	10.00	CY	1.000	10.00	$4.74	$47.40
					TOTAL MATERIAL	$392.14

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$6,894.89	Labor Burden @	49.7%	$0.00	$6,894.89
Material Cost	$392.14	Material Tax @	7.8%	$30.39	$422.54
Equipment Cost	$2,994.29	Equipment Tax @	0.0%	$0.00	$2,994.29
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$10,281			$30	DIRECT COST SUBTOTALS $10,312

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$10,311.71	$1,546.76
Installing Contractors Profit@	8.0%	☑	☑	☐	$10,311.71	$824.94
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	$2,371.69

General Contractors Insurance @	1.0%	on	$12,683.41	$127
Bond @	1.0%	on	$12,683.41	$127
Contingency @	0.0%	on	$12,937.07	$0
			TOTAL COST for pay item	$12,937

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane). Considered one laborer for demolish the pole and helping placing poles in a designated place and loding them in the truck for disposal. This process includes filling in pole locations with gravel, clean fill and topsoil. Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.014	Project	: Fall Creak
Description	: Remove 69 KV Distribution line 1.6 miles (30 poles)		
Quantity	: 30.00 EA		
Daily Production	: 4.00 EA per 8 hour shift	Project #	: 2
Work Days	: 7.5 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $2,096.19 per EA		
Total Cost	: $62,886		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	4.6	$53,453	$1,781.76
Probable High Cost Parameter	2.8	$81,751	$2,725.04

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	7.5	8	60.00	L	$46.27	incl. in rate	incl. in rate	$2,776.20
Electrician	Active	4.00	7.5	8	240.00	L	$45.23	incl. in rate	incl. in rate	$10,855.20
Hydraulic Crane (17tn)	Active	1.00	7.5	8	60.00	E	$81.52	incl. in rate	incl. in rate	$4,891.20
Equipment Operator (medium)	Active	1.00	7.5	8	60.00	L	$66.28	incl. in rate	incl. in rate	$3,976.80
Truck Driver (heavy)	Active	1.00	7.5	8	60.00	L	$57.59	incl. in rate	incl. in rate	$3,455.40
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	7.5	8	60.00	E	$31.90	incl. in rate	incl. in rate	$1,914.00
Laborer	Active	4.00	7.5	8	240.00	L	$45.80	incl. in rate	incl. in rate	$10,992.00
Truck, Utility, with Man-Basket	Active	4.00	7.5	8	240.00	E	$31.90	incl. in rate	incl. in rate	$7,656.00

Labor Hours	660	TOTAL LABOR	$32,055.60
Equipment Hours	360	TOTAL EQUIPMENT	$14,461.20

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 10% labor (saw blades, drill bits,etc)	1.00	LS	1.000	1.00	$3,205.56	$3,205.56
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	30.00	CY	1.000	30.00	$4.74	$142.20
					TOTAL MATERIAL	$3,347.76

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$32,055.60	Labor Burden @	49.7%	$0.00	$32,055.60
Material Cost	$3,347.76	Material Tax @	7.8%	$259.45	$3,607.21
Equipment Cost	$14,461.20	Equipment Tax @	0.0%	$0.00	$14,461.20
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$49,865			$259	DIRECT COST SUBTOTALS $50,124

	Rate	Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	✓	✓	☐	$50,124.01	$7,518.60
Installing Contractors Profit@	8.0%	✓	✓	☐	$50,124.01	$4,009.92
GC Markup on Subs @	5.0%	☐	☐	✓	$0.00	$0.00
					TOTAL MARKUP COSTS	$11,528.52

General Contractors Insurance @	1.0%	on	$61,652.53	$617
Bond @	1.0%	on	$61,652.53	$617
Contingency @	0.0%	on	$62,885.58	$0
			TOTAL COST for pay item	$62,886

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane). Considered one laborer for demolish the pole foundation and helping placing poles in a designated place and loding them in the truck for disposal.This process includes filling in pole locations with gravel, clean fill and topsoil. Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM COST DETAIL WORKSHEET

5.015 Remove Transmission conductors on poles 1X/001 and 2X/001 but keep distribution intact

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.015		Project	: Fall Creak			
Description	: intact						
Quantity	: 2.00 EA						
Daily Production	: 2.00 EA per	8 hour shift	Project #	: 2			
Work Days	: 1.0 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $2,686.44 per EA		Probable Low Cost Parameter		2.3	$4,567	$2,283.48
Total Cost	: $5,373		Probable High Cost Parameter		1.4	$6,985	$3,492.37

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	1.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Electrician	Active	4.00	1.0	8	32.00	L	$45.23	incl. in rate	incl. in rate	$1,447.36
Truck, Pickup (4x4, 3/4tn)	Active	1.00	1.0	8	8.00	E	$16.94	incl. in rate	incl. in rate	$135.52
Equipment Operator (medium)	Active	1.00	1.0	8	8.00	L	$66.28	incl. in rate	incl. in rate	$530.24
Truck, Utility, with Man-Basket	Active	2.00	1.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80

Labor Hours	72	TOTAL LABOR	$3,450.72
Equipment Hours	24	TOTAL EQUIPMENT	$645.92

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$172.54	$172.54
					TOTAL MATERIAL	$172.54

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$3,450.72	Labor Burden @	49.7%	$0.00		$3,450.72
Material Cost	$172.54	Material Tax @	7.8%	$13.37		$185.91
Equipment Cost	$645.92	Equipment Tax @	0.0%	$0.00		$645.92
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$4,269			$13	DIRECT COST SUBTOTALS	$4,283

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	✓	✓		$4,282.55	$642.38
Installing Contractors Profit@	8.0%	✓	✓		$4,282.55	$342.60
GC Markup on Subs @	5.0%			✓	$0.00	$0.00
					TOTAL MARKUP COSTS	$984.99
General Contractors Insurance @	1.0%	on			$5,267.53	$53
Bond @	1.0%	on			$5,267.53	$53
Contingency @	0.0%	on			$5,372.88	$0
					TOTAL COST for pay item	$5,373

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed from 2 Forman and 4 Electrician,2 Laborer, 2 utility truck access poles, string conductor, modify structure arms, provide guard structures., 2 Laborer to help ground side.Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.016		Project	: COPCO 1
Description	: Remove Transmission conductors 1.3 miles Copco#1 to Copco#2			
Quantity	: 6,864.00 LF			
Daily Production	: 600.00 LF per	8 hour shift	Project #	: 2
Work Days	: 11.4 Days		Estimator	: Mihaela Tomulescu
Unit Price	: $7.16 per LF			
Total Cost	: $49,138			

	LF per	Total Cost	Unit Price Per LF
Probable Low Cost Parameter	690	$41,767	$6.09
Probable High Cost Parameter	420	$63,880	$9.31

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	2.00	11.4	8	182.40	L	$46.27	incl. in rate	incl. in rate	$8,439.65
Electrician	Active	2.00	11.4	8	182.40	L	$45.23	incl. in rate	incl. in rate	$8,249.95
Truck, Pickup (4x4, 3/4tn)	Active	1.00	11.4	8	91.20	E	$16.94	incl. in rate	incl. in rate	$1,544.93
Truck Driver (light)	Active	1.00	11.4	8	91.20	L	$56.29	incl. in rate	incl. in rate	$5,133.65
Truck, Utility, with Man-Basket	Active	2.00	11.4	8	182.40	E	$31.90	incl. in rate	incl. in rate	$5,818.56
Laborer	Active	2.00	11.4	8	182.40	L	$45.80	incl. in rate	incl. in rate	$8,353.92

Labor Hours	638.4	TOTAL LABOR	$30,177.17
Equipment Hours	273.6	TOTAL EQUIPMENT	$7,363.49

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$1,508.86	$1,508.86
					TOTAL MATERIAL	$1,508.86

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$30,177.17	Labor Burden @	49.7%	$0.00	$30,177.17
Material Cost	$1,508.86	Material Tax @	7.8%	$116.94	$1,625.79
Equipment Cost	$7,363.49	Equipment Tax @	0.0%	$0.00	$7,363.49
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$39,050			$117	DIRECT COST SUBTOTALS $39,166

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%	☑	☑	☐	$39,166.45	$5,874.97
Installing Contractors Profit@	8.0%	☑	☑	☐	$39,166.45	$3,133.32
GC Markup on Subs @	5.0%	☐	☐	☑	$0.00	$0.00
					TOTAL MARKUP COSTS	$9,008.28

General Contractors Insurance @	1.0%	on	$48,174.73	$482
Bond @	1.0%	on	$48,174.73	$482
Contingency @	0.0%	on	$49,138.23	$0
			TOTAL COST for pay item	$49,138

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed from 2 Forman and 4 Electrician, 4 utility truck access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, power plant and switchyard.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.017		Project	: COPCO2		
Description	: Disconnect and remove MV Transformers 115 KV @ Substation					
Quantity	: 2.00 EA					
Daily Production	: 1.79 EA per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 1.1 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $678.35 per EA		Probable Low Cost Parameter		1.969	$1,221	$610.51
Total Cost	: $1,357		Probable High Cost Parameter		1.432	$1,628	$814.02

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.1	8	8.96	L	$47.23	$0.00		$423.18
Electrician	Active	1.00	1.1	8	8.96	L	$45.23	$0.00		$405.26
Hydraulic Excavator (1.5cy)	Active	1.00	0.2	8	1.20	E	$141.92	$141.92		$170.30
Equipment Operator (light)	Active	0.50	0.2	8	0.60	L	$64.90	$0.00		$38.94
				Labor Hours	18.52				TOTAL LABOR	$867.38
				Equipment Hours	1.2				TOTAL EQUIPMENT	$170.30

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$43.37	$43.37
					TOTAL MATERIAL	$43.37

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$867.38	Labor Burden @	49.7%	$0.00		$867.38
Material Cost	$43.37	Material Tax @	7.8%	$3.36		$46.73
Equipment Cost	$170.30	Equipment Tax @	0.0%	$0.00		$170.30
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$1,081			$3	DIRECT COST SUBTOTALS	$1,084

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,084.42		$162.66
Installing Contractors Profit@	8.0%				$1,037.69		$83.01
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$245.68
General Contractors Insurance @	1.0%			on	$1,330.09		$13
Bond @	1.0%			on	$1,330.09		$13
Contingency @	0.0%			on	$1,356.69		$0
						TOTAL COST for pay item	$1,357

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1 Excavator to load the transformer in the truck for disposal.

PAY ITEM COST DETAIL WORKSHEET — **5.018 Disconnect and remove Medium Voltage Circuit Breakers 69KV @ Substation**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.018	Project	: COPCO2		
Description	:	Disconnect and remove Medium Voltage Circuit Breakers 69KV @ Substation				
Quantity	:	5.00 EA				
Daily Production	:	2.00 EA per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	:	2.5 Days	Estimator	: Mihaela Tomulescu		
				EA per	**Total Cost**	**Unit Price Per EA**
Unit Price	:	$590.84 per EA	Probable Low Cost Parameter	2.2	$2,659	$531.76
Total Cost	:	$2,954	Probable High Cost Parameter	1.6	$3,545	$709.01

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.5	8	20.00	L	$46.27	$0.00		$925.40
Electrician	Active	1.00	2.5	8	20.00	L	$45.23	$0.00		$904.60
Hydraulic Crane (35tn)	Active	1.00	0.2	8	1.60	E	$116.30	$116.30		$186.08
Equipment Operator (medium)	Active	1.00	0.2	8	1.60	L	$66.28	$0.00		$106.05
Laborer	Active	1.00	0.2	8	1.60	L	$45.80	$0.00		$73.28
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.2	8	1.60	E	$31.90	$31.90		$51.04
				Labor Hours	43.2			TOTAL LABOR		$2,009.33
				Equipment Hours	3.2			TOTAL EQUIPMENT		$237.12

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$100.47	$100.47
					TOTAL MATERIAL	$100.47

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,009.33	Labor Burden @	49.7%	$0.00	$2,009.33
Material Cost	$100.47	Material Tax @	7.8%	$7.79	$108.25
Equipment Cost	$237.12	Equipment Tax @	0.0%	$0.00	$237.12
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$2,347			$8	DIRECT COST SUBTOTALS $2,355

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,354.70	$353.21
Installing Contractors Profit@	8.0%				$2,354.70	$188.38
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$541.58
General Contractors Insurance @	1.0%		on		$2,896.28	$29
Bond @	1.0%		on		$2,896.28	$29
Contingency @	0.0%		on		$2,954.21	$0
					TOTAL COST for pay item	**$2,954**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1Crane. Considered 1 laborer to help loading circuit breakers in the truck for saving it in the designated place.

PAY ITEM COST DETAIL WORKSHEET

5.019 Disconnect and remove MV Transformers 12 KV @ Substation

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.019		**Project**	: COPCO2
Description	: Disconnect and remove MV Transformers 12 KV @ Substation			
Quantity	: 1.00 EA			
Daily Production	: 4.00 EA per 8 hour shift		**Project #**	: Klamath Dams Removal
Work Days	: 0.3 Days		**Estimator**	: Mihaela Tomulescu
Unit Price	: $816.83 per EA			
Total Cost	: $817			

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	4.4	$735	$735.15
Probable High Cost Parameter	3.2	$980	$980.20

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.3	8	2.00	L	$47.23	$0.00		$94.46
Electrician	Active	1.00	0.3	8	2.00	L	$45.23	$0.00		$90.46
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.2	8	1.20	E	$221.50	$221.50		$265.80
Equipment Operator (light)	Active	1.00	0.2	8	1.20	L	$64.90	$0.00		$77.88
Truck Driver (light)	Active	1.00	0.2	8	1.20	L	$56.29	$0.00		$67.55
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	0.2	8	1.20	E	$31.90	$31.90		$38.28

Labor Hours	**6.4**	**TOTAL LABOR**	**$330.35**
Equipment Hours	**2.4**	**TOTAL EQUIPMENT**	**$304.08**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$16.52	$16.52
					TOTAL MATERIAL	**$16.52**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$330.35	Labor Burden @	49.7%	$0.00	$330.35
Material Cost	$16.52	Material Tax @	7.8%	$1.28	$17.80
Equipment Cost	$304.08	Equipment Tax @	0.0%	$0.00	$304.08
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$651**			**$1**	**DIRECT COST SUBTOTALS** **$652**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$652.23	$97.83
Installing Contractors Profit@	8.0%				$634.43	$50.75
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$148.59**
General Contractors Insurance @	1.0%		on		$800.81	$8
Bond @	1.0%		on		$800.81	$8
Contingency @	0.0%		on		$816.83	$0
					TOTAL COST for pay item	**$817**

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician,1 Loader to discharge the transformer in the truck for disposal.

PAY ITEM INFORMATION

PAY ITEM NUMBER :	5.020	Project :	COPCO2		
Description :	Disconnect and remove cable connection between Copco#2 sub and HE plant @ Substation				
Quantity :	0.10 Mile				
Daily Production :	0.05 Mile per 8 hour shift	Project # :	Klamath Dams Removal		
Work Days :	2.0 Days	Estimator :	Mihaela Tomulescu		
			Mile per	Total Cost	Unit Price Per Mile
Unit Price :	$94,661.96 per Mile	Probable Low Cost Parameter	0.055	$8,520	$85,195.77
Total Cost :	$9,466	Probable High Cost Parameter	0.04	$11,359	$113,594.36

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.0	8	16.00	L	$47.23	$0.00		$755.68
Electrician	Active	2.00	2.0	8	32.00	L	$45.23	$0.00		$1,447.36
Truck, Utility, with Man-Basket	Active	1.00	0.2	8	1.20	E	$31.90	$31.90		$38.28
Truck Driver (light)	Active	1.00	0.2	8	1.20	L	$56.29	$0.00		$67.55

Labor Hours	49.2	TOTAL LABOR	$2,270.59
Equipment Hours	1.2	TOTAL EQUIPMENT	$38.28

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$113.53	$113.53
					TOTAL MATERIAL	$113.53

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	2.00	days		$3,000.00	$6,000.00
				TOTAL SUBCONTRACTS	$6,000.00

SUMMARY OF COSTS

Labor Cost	$2,270.59	Labor Burden @	49.7%	$0.00		$2,270.59
Material Cost	$113.53	Material Tax @	7.8%	$8.80		$122.33
Equipment Cost	$38.28	Equipment Tax @	0.0%	$0.00		$38.28
Subcontractors	$6,000.00					$6,000.00
DIRECT COST SUBTOTALS	$8,422			$9	DIRECT COST SUBTOTALS	$8,431

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$2,431.20	$364.68
Installing Contractors Profit@	8.0%				$2,308.87	$184.71
GC Markup on Subs @	5.0%				$6,000.00	$300.00
					TOTAL MARKUP COSTS	$849.39
General Contractors Insurance @	1.0%		on		$9,280.58	$93
Bond @	1.0%		on		$9,280.58	$93
Contingency @	0.0%		on		$9,466.20	$0
					TOTAL COST for pay item	$9,466

Additional Pay Item Notes :

Production is based off of RSMs using Crew formed of 1 Forman, 1 Electrician. Equipment": 1 Utility Man-Basket Truck, Trailer with cable pulling rig, for high voltage line work.

PAY ITEM COST DETAIL WORKSHEET — **5.021 Remove all associated auxiliary equipment @ Substation (Allowance)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.021	Project	: COPCO2			
Description	: Remove all associated auxiliary equipment @ Substation (Allowance)					
Quantity	: 1.00 LS					
Daily Production	: 1.00 LS per 8 hour shift	Project #	: Klamath Dams Removal			
Work Days	: 2.0 Days	Estimator	: Mihaela Tomulescu	LS per	Total Cost	Unit Price Per LS
Unit Price	: $24,184.84 per LS	Probable Low Cost Parameter		1.1	$21,766	$21,766.36
Total Cost	: $24,185	Probable High Cost Parameter		0.8	$29,022	$29,021.81

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.0	8	16.00	L	$47.23	$0.00		$755.68
Electrician	Active	4.00	2.0	8	64.00	L	$45.23	$0.00		$2,894.72
Truck, Utility, with Man-Basket	Active	1.00	2.0	8	16.00	E	$31.90	$31.90		$510.40
Truck Driver (light)	Active	1.00	2.0	8	16.00	L	$56.29	$0.00		$900.64
Laborer	Active	2.00	2.0	8	32.00	L	$45.80	$0.00		$1,465.60
Hydraulic Excavator (1.5cy)	Active	1.00	2.0	8	16.00	E	$141.92	$141.92		$2,270.72
Hydraulic Crane (17tn)	Active	1.00	2.0	8	16.00	E	$81.52	$81.52		$1,304.32
Equipment Operator (crane)	Active	1.00	2.0	8	16.00	L	$68.41	$0.00		$1,094.56
Equipment Operator (light)	Active	1.00	2.0	8	16.00	L	$64.90	$0.00		$1,038.40
Vibratory Hammer & Extractor	Active	1.00	2.0	8	16.00	E	$94.34	$94.34		$1,509.44
				Labor Hours	160				TOTAL LABOR	$8,149.60
				Equipment Hours	64				TOTAL EQUIPMENT	$5,594.88

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$407.48	$407.48
					TOTAL MATERIAL	$407.48

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	2.00	days		$3,000.00	$6,000.00
				TOTAL SUBCONTRACTS	$6,000.00

SUMMARY OF COSTS

Labor Cost	$8,149.60	Labor Burden @	49.7%	$0.00		$8,149.60
Material Cost	$407.48	Material Tax @	7.8%	$31.58		$439.06
Equipment Cost	$5,594.88	Equipment Tax @	0.0%	$0.00		$5,594.88
Subcontractors	$6,000.00					$6,000.00
DIRECT COST SUBTOTALS	$20,152			$32	DIRECT COST SUBTOTALS	$20,184

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$14,183.54		$2,127.53
Installing Contractors Profit@	8.0%				$13,744.48		$1,099.56
GC Markup on Subs @	5.0%				$6,000.00		$300.00
						TOTAL MARKUP COSTS	$3,527.09
General Contractors Insurance @	1.0%		on		$23,710.63		$237
Bond @	1.0%		on		$23,710.63		$237
Contingency @	0.0%		on		$24,184.84		$0
						TOTAL COST for pay item	$24,185

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator& 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete) for demo :4 Electrician,, 1 utility truck access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. .

PAY ITEM COST DETAIL WORKSHEET — **5.022 Demolish overhead transmission line and structure 69 KV Copco#1 to Iron Gate**

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.022	**Project**	: COPCO2
Description	: Demolish overhead transmission line and structure 69 KV Copco#1 to Iron Gate		
Quantity	: 5.00 Miles		
Daily Production	: 0.10 Miles per 8 hour shift	**Project #**	: Klamath Dams Removal
Work Days	: 50.0 Days	**Estimator**	: Mihaela Tomulescu
Unit Price	: $118,983.58 per Miles		
Total Cost	: $594,918		

	Miles per	Total Cost	Unit Price Per Miles
Probable Low Cost Parameter	0.11	$535,426	$107,085.22
Probable High Cost Parameter	0.08	$713,901	$142,780.29

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	50.0	8	400.00	L	$47.23	$0.00		$18,892.00
Electrician	Active	2.00	50.0	8	800.00	L	$45.23	$0.00		$36,184.00
Truck, Utility, with Man-Basket	Active	2.00	50.0	8	800.00	E	$31.90	$31.90		$25,520.00
Truck Driver (heavy)	Active	2.00	50.0	8	800.00	L	$57.59	$0.00		$46,072.00
Laborer	Active	2.00	50.0	8	800.00	L	$45.80	$0.00		$36,640.00
Hydraulic Excavator (1.5cy)	Active	1.00	50.0	8	400.00	E	$141.92	$141.92		$56,768.00
Hydraulic Crane (80tn)	Active	1.00	50.0	8	400.00	E	$190.46	$190.46		$76,184.00
Equipment Operator (crane)	Active	1.00	50.0	8	400.00	L	$68.41	$0.00		$27,364.00
Equipment Operator (light)	Active	1.00	50.0	8	400.00	L	$64.90	$0.00		$25,960.00
Vibratory Hammer & Extractor	Active	1.00	50.0	8	400.00	E	$94.34	$94.34		$37,736.00
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	50.0	8	400.00	E	$31.90	$31.90		$12,760.00

Labor Hours	3600	**TOTAL LABOR**	$191,112.00
Equipment Hours	2400	**TOTAL EQUIPMENT**	$208,968.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$9,555.60	$9,555.60
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	96.00	CY	1.000	96.00	$4.74	$455.04
					TOTAL MATERIAL	$10,010.64

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	25.00	days		$3,000.00	$75,000.00
				TOTAL SUBCONTRACTS	$75,000.00

SUMMARY OF COSTS

Labor Cost	$191,112.00	Labor Burden @	49.7%	$0.00	$191,112.00
Material Cost	$10,010.64	Material Tax @	7.8%	$775.82	$10,786.46
Equipment Cost	$208,968.00	Equipment Tax @	0.0%	$0.00	$208,968.00
Subcontractors	$75,000.00				$75,000.00
DIRECT COST SUBTOTALS	$485,091			$776	**DIRECT COST SUBTOTALS** $485,866

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$410,866.46	$61,629.97
Installing Contractors Profit@	8.0%				$400,080.00	$32,006.40
GC Markup on Subs @	5.0%				$75,000.00	$3,750.00
					TOTAL MARKUP COSTS	$97,386.37

General Contractors Insurance @	1.0%	on	$583,252.83	$5,833
Bond @	1.0%	on	$583,252.83	$5,833
Contingency @	0.0%	on	$594,917.89	$0
			TOTAL COST for pay item	**$594,918**

Additional Pay Item Notes :

When a transmission line is decommissioned and is not converted to another use, the decommissioning typically includes the removal of all infrastructure if it is no longer required, or has reached end-of-life conditions. Removed parts will be re-used, recycled or disposed. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :2 Electrician,, 1 utility truck to access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. Transmission line poles or structures are commonly between 60 and 140 feet tall. There are several different kinds of transmission structures. Transmission structures can be constructed of metal or wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. Assumed based on RSMs we have "Communications transmission tower, radio towers self-supporting, wind load 70 mph basic wind speed, 120' high" (33811310). Pole height and load capacity limitations determine the distance between poles (span length) either on the basis of ground clearance or ability to support heavy wind and ice loads. Assumed average span between structures to be 275 feet so for 5 miles of overhead transmission we will have approximately 96 structures. In areas where single-pole structures are preferred, weak or wet soils may require concrete foundations for support. Where a transmission line must cross a street or slightly change direction, larger angle structures or guy wires may be required. Poles with guy wires impact a much larger area. Angle structures are usually more than double the diameter of other steel poles. They are made of steel, usually five to six feet in diameter, and have a large concrete base. The base may be buried ten or more feet below the ground surface. The diameter of the pole and the depth the base is buried depends on the condition of the soils and the voltage of the line. Assumed the structures are disposed to Yreka recycling, 34 miles away. This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.023		Project	: COPCO2		
Description	: Demolish transmission conductor from existing structure pole. Structures remain.					
Quantity	: 1.50 Miles					
Daily Production	: 0.75 Miles per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 2.0 Days		Estimator	: Mihaela Tomulescu	Miles per	Total Cost	Unit Price Per Miles
Unit Price	: $7,073.23 per Miles		Probable Low Cost Parameter	0.825	$9,549	$6,365.91
Total Cost	: $10,610		Probable High Cost Parameter	0.6	$12,732	$8,487.88

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	2.0	8	16.00	L	$47.23	$0.00		$755.68
Electrician	Active	2.00	2.0	8	32.00	L	$45.23	$0.00		$1,447.36
Truck, Utility, with Man-Basket	Active	2.00	2.0	8	32.00	E	$31.90	$31.90		$1,020.80
				Labor Hours	48				TOTAL LABOR	$2,203.04
				Equipment Hours	32				TOTAL EQUIPMENT	$1,020.80

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$110.15	$110.15
					TOTAL MATERIAL	$110.15

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	2.00	days		$3,000.00	$6,000.00
				TOTAL SUBCONTRACTS	$6,000.00

SUMMARY OF COSTS

Labor Cost	$2,203.04	Labor Burden @	49.7%	$0.00		$2,203.04
Material Cost	$110.15	Material Tax @	7.8%	$8.54		$118.69
Equipment Cost	$1,020.80	Equipment Tax @	0.0%	$0.00		$1,020.80
Subcontractors	$6,000.00					$6,000.00
DIRECT COST SUBTOTALS	$9,334			$9	DIRECT COST SUBTOTALS	$9,343

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$3,342.53	$501.38
Installing Contractors Profit@	8.0%				$3,223.84	$257.91
GC Markup on Subs @	5.0%				$6,000.00	$300.00
					TOTAL MARKUP COSTS	$1,059.29
General Contractors Insurance @	1.0%		on		$10,401.82	$104
Bond @	1.0%		on		$10,401.82	$104
Contingency @	0.0%		on		$10,609.85	$0
					TOTAL COST for pay item	$10,610

Additional Pay Item Notes :

Production is based off of RSMs using Crew Elec2: 2 Electrician,, 2 utility truck to access poles, string conductor, etc. assumed they need to rent trailer with cable pulling rig, for high voltage line work. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard. This estimate is made as the best AECOM assumption, as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM COST DETAIL WORKSHEET

5.024 Remove structures between pole 2/007 and Iron Gate

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.024	**Project**	: COPCO2			
Description	: Remove structures between pole 2/007 and Iron Gate					
Quantity	: 6.00 EA					
Daily Production	: 2.00 EA per 8 hour shift	**Project #**	: Klamath Dams Removal			
Work Days	: 3.0 Days	**Estimator**	: Mihaela Tomulescu	**EA per**	**Total Cost**	**Unit Price Per EA**
Unit Price	: $3,754.31 per EA	**Probable Low Cost Parameter**		**2.2**	**$20,273**	**$3,378.88**
Total Cost	: $22,526	**Probable High Cost Parameter**		**1.6**	**$27,031**	**$4,505.17**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	3.0	8	24.00	L	$47.23	$0.00		$1,133.52
Electrician	Active	1.00	3.0	8	24.00	L	$45.23	$0.00		$1,085.52
Truck, Utility, with Man-Basket	Active	1.00	3.0	8	24.00	E	$31.90	$31.90		$765.60
Truck Driver (light)	Active	1.00	3.0	8	24.00	L	$56.29	$0.00		$1,350.96
Laborer	Active	2.00	3.0	8	48.00	L	$45.80	$0.00		$2,198.40
Hydraulic Excavator (1.5cy)	Active	1.00	2.0	8	16.00	E	$141.92	$141.92		$2,270.72
Hydraulic Crane (50tn)	Active	1.00	3.0	8	24.00	E	$134.32	$134.32		$3,223.68
Equipment Operator (crane)	Active	1.00	3.0	8	24.00	L	$68.41	$0.00		$1,641.84
Equipment Operator (light)	Active	1.00	3.0	8	24.00	L	$64.90	$0.00		$1,557.60
Vibratory Hammer & Extractor	Active	1.00	2.0	8	16.00	E	$94.34	$94.34		$1,509.44
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	3.0	8	24.00	E	$31.90	$31.90		$765.60
				Labor Hours	**168**				**TOTAL LABOR**	**$8,967.84**
				Equipment Hours	**104**				**TOTAL EQUIPMENT**	**$8,535.04**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$448.39	$448.39
					TOTAL MATERIAL	**$448.39**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$8,967.84	Labor Burden @		49.7%	$0.00		$8,967.84
Material Cost	$448.39	Material Tax @		7.8%	$34.75		$483.14
Equipment Cost	$8,535.04	Equipment Tax @		0.0%	$0.00		$8,535.04
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	**$17,951**				**$35**	**DIRECT COST SUBTOTALS**	**$17,986**
		Crew	**Material**	**Subs**	**Cost Basis**		
Installing Contractors Overhead@	15.0%				$17,986.02		$2,697.90
Installing Contractors Profit@	8.0%				$17,502.88		$1,400.23
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	**$4,098.13**
General Contractors Insurance @	1.0%		on		$22,084.16		$221
Bond @	1.0%		on		$22,084.16		$221
Contingency @	0.0%		on		$22,525.84		$0
						TOTAL COST for pay item	**$22,526**

Additional Pay Item Notes :

The switchyard site and transmission line rights-of-way will be restored to the natural conditions. Production is based off of RSMs using Crew B-1C and B-3 (1 Forman, 2 laborer, 1 Excavator& 1 crane for lift, position and load in the truck, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations and concrete for demo :4 Electrician,, 1 utility truck access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment. Assumed the structures are disposed to Yreka recycling, 34 miles away. These are only estimates as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.025	Project	: IRONGATE		
Description	: Remove Distribution Poles near Iron Gate Hydro Plant				
Quantity	: 5.00 EA				
Daily Production	: 2.50 EA per 8 hour shift	Project #	: Klamath Dams Removal		
Work Days	: 2.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost / Unit Price Per EA
Unit Price	: $1,190.24 per EA	Probable Low Cost Parameter		2.875	$5,059 / $1,012
Total Cost	: $5,951	Probable High Cost Parameter		2	$7,141 / $1,428

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	2.0	8	16.00	L	$46.27	incl. in rate	incl. in rate	$740.32
Electrician	Active	1.00	2.0	8	16.00	L	$45.23	incl. in rate	incl. in rate	$723.68
Hydraulic Crane (17tn)	Active	1.00	1.0	8	8.00	E	$81.52	incl. in rate	incl. in rate	$652.16
Laborer	Active	2.00	1.0	8	16.00	L	$45.80	incl. in rate	incl. in rate	$732.80
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
Vibratory Hammer & Extractor	Active	1.00	1.0	8	8.00	E	$94.34	incl. in rate	incl. in rate	$754.72
Truck Driver (heavy)	Active	1.00	1.0	8	8.00	L	$57.59	incl. in rate	incl. in rate	$460.72
Truck, Utility, with Man-Basket	Active	1.00	1.0	8	8.00	E	$31.90	incl. in rate	incl. in rate	$255.20
				Labor Hours	56				TOTAL LABOR	$2,657.52
				Equipment Hours	32				TOTAL EQUIPMENT	$1,917.28

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$132.88	$132.88
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	5.00	CY	1.000	5.00	$4.74	$23.70
					TOTAL MATERIAL	$156.58

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$2,657.52	Labor Burden @			49.7%	$0.00	$2,657.52
Material Cost	$156.58	Material Tax @			7.8%	$12.13	$168.71
Equipment Cost	$1,917.28	Equipment Tax @			0.0%	$0.00	$1,917.28
Subcontractors	$0.00						$0.00
DIRECT COST SUBTOTALS	$4,731					$12	DIRECT COST SUBTOTALS $4,744
		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$4,743.51		$711.53
Installing Contractors Profit@	8.0%				$4,743.51		$379.48
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$1,091.01
General Contractors Insurance @	1.0%		on		$5,834.52		$58
Bond @	1.0%		on		$5,834.52		$58
Contingency @	0.0%		on		$5,951.21		$0
						TOTAL COST for pay item	$5,951

Additional Pay Item Notes :

Production is based off of RSMs using Crew R3 (1 Forman and 1 Electrician,1 Crane). Considered 2 laborer and 1 Vibratory Hammer for demolish the pole foundation and helping placing poles in a designated place and loading them in the truck for disposal. This process includes filling in pole locations with gravel, clean fill and topsoil.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.026		Project	: IRONGATE			
Description	: Remove 69kV/6.6kV Transformer @Substation						
Quantity	: 1.00 EA						
Daily Production	: 2.50 EA per	8 hour shift	Project #	: Klamath Dams Removal			
Work Days	: 0.4 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $2,273.46 per EA		Probable Low Cost Parameter		2.875	$1,932	$1,932
Total Cost	: $2,273		Probable High Cost Parameter		1.875	$2,842	$2,842

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	0.4	8	3.20	L	$47.23	incl. in rate	incl. in rate	$151.14
Electrician	Active	1.00	0.4	8	3.20	L	$45.23	incl. in rate	incl. in rate	$144.74
Loader, FE Rubber Tire (8.6cy)	Active	1.00	0.4	8	3.20	E	$221.50	incl. in rate	incl. in rate	$708.80
Truck Driver (light)	Active	1.00	0.4	8	3.20	L	$56.29	incl. in rate	incl. in rate	$180.13
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.4	8	3.20	E	$111.64	incl. in rate	incl. in rate	$357.25
Equipment Operator (light)	Active	1.00	0.4	8	3.20	L	$64.90	incl. in rate	incl. in rate	$207.68
				Labor Hours	12.8				TOTAL LABOR	$683.68
				Equipment Hours	6.4				TOTAL EQUIPMENT	$1,066.05

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$34.18	$34.18
Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	5.00	CY	1.000	5.00	$4.74	$23.70
					TOTAL MATERIAL	$57.88

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$683.68	Labor Burden @	49.7%	$0.00		$683.68
Material Cost	$57.88	Material Tax @	7.8%	$4.49		$62.37
Equipment Cost	$1,066.05	Equipment Tax @	0.0%	$0.00		$1,066.05
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$1,808			$4	DIRECT COST SUBTOTALS	$1,812

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,812.10		$271.81
Installing Contractors Profit@	8.0%				$1,812.10		$144.97
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$416.78
General Contractors Insurance @	1.0%		on		$2,228.88		$22
Bond @	1.0%		on		$2,228.88		$22
Contingency @	0.0%		on		$2,273.46		$0
						TOTAL COST for pay item	$2,273

Additional Pay Item Notes :

Production is based off of RSMs using Crew Elec2 : 1 El. Forman and 1 Electrician,1 Loader and 1 truck for disposal.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.027	Project	: IRONGATE			
Description	: Remove 6.6kV Power Circuit Breaker @Substation					
Quantity	: 1.00 EA					
Daily Production	: 1.00 EA per 8 hour shift	Project #	: Klamath Dams Removal			
Work Days	: 1.0 Days	Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	: $1,524.31 per EA	Probable Low Cost Parameter		1.15	$1,296	$1,296
Total Cost	: $1,524	Probable High Cost Parameter		0.75	$1,905	$1,905

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	1.0	8	8.00	L	$47.23	incl. in rate	incl. in rate	$377.84
Electrician	Active	1.00	1.0	8	8.00	L	$45.23	incl. in rate	incl. in rate	$361.84
Loader, FE Rubber Tire (3.5cy)	Active	1.00	0.2	8	1.60	E	$64.23	incl. in rate	incl. in rate	$102.77
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	incl. in rate	incl. in rate	$178.62
Truck Driver (light)	Active	1.00	0.2	8	1.60	L	$56.29	incl. in rate	incl. in rate	$90.06
Equipment Operator (light)	Active	1.00	0.2	8	1.60	L	$64.90	incl. in rate	incl. in rate	$103.84
				Labor Hours	19.2				TOTAL LABOR	$933.58
				Equipment Hours	3.2				TOTAL EQUIPMENT	$281.39

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$933.58	Labor Burden @	49.7%	$0.00		$933.58
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$281.39	Equipment Tax @	0.0%	$0.00		$281.39
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$1,215			$0	DIRECT COST SUBTOTALS	$1,215

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$1,214.98		$182.25
Installing Contractors Profit@	8.0%				$1,214.98		$97.20
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$279.44
General Contractors Insurance @	1.0%		on		$1,494.42		$15
Bond @	1.0%		on		$1,494.42		$15
Contingency @	0.0%		on		$1,524.31		$0
						TOTAL COST for pay item	$1,524

Additional Pay Item Notes :

Production is based off of RSMs using Crew Elec2 : 1 El. Forman and 1 Electrician,1 Loader and 1 truck for disposal.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.028		Project	: IRONGATE		
Description	:	Remove Generator @Substation					
Quantity	:	1.00 EA					
Daily Production	:	0.25 EA per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	:	4.0 Days		Estimator	: Mihaela Tomulescu	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$4,767.78 per EA		Probable Low Cost Parameter		0.2875	$4,053	$4,053
Total Cost	:	$4,768		Probable High Cost Parameter		0.1875	$5,960	$5,960

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	4.0	8	32.00	L	$47.23	incl. in rate	incl. in rate	$1,511.36
Electrician	Active	1.00	4.0	8	32.00	L	$45.23	incl. in rate	incl. in rate	$1,447.36
Hydraulic Crane (17tn)	Active	1.00	0.2	8	1.60	E	$81.52	incl. in rate	incl. in rate	$130.43
Truck, Off-Road, Articulated Rear, 20cy	Active	1.00	0.2	8	1.60	E	$111.64	incl. in rate	incl. in rate	$178.62
Truck Driver (light)	Active	1.00	0.2	8	1.60	L	$56.29	incl. in rate	incl. in rate	$90.06
Equipment Operator (crane)	Active	1.00	0.2	8	1.60	L	$68.41	incl. in rate	incl. in rate	$109.46
	Active	1.00	0.2	8	1.60	E	$208.09	incl. in rate	incl. in rate	$332.94
				Labor Hours	67.2				TOTAL LABOR	$3,158.24
				Equipment Hours	4.8				TOTAL EQUIPMENT	$642.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$3,158.24	Labor Burden @	49.7%	$0.00		$3,158.24
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$642.00	Equipment Tax @	0.0%	$0.00		$642.00
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	$3,800			$0	DIRECT COST SUBTOTALS	$3,800

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$3,800.24		$570.04
Installing Contractors Profit@	8.0%				$3,800.24		$304.02
GC Markup on Subs @	5.0%				$0.00		$0.00
						TOTAL MARKUP COSTS	$874.06
General Contractors Insurance @	1.0%		on		$4,674.30		$47
Bond @	1.0%		on		$4,674.30		$47
Contingency @	0.0%		on		$4,767.78		$0
						TOTAL COST for pay item	$4,768

Additional Pay Item Notes :

Production is based off of RSMs using Crew Elec2 : 1 El. Forman and 1 Electrician,1 Crane , 1 Laborer and 1 truck for disposal.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.029		Project	: IRONGATE		
Description	: Remove all auxiliary equipment @Substation (Allowance)					
Quantity	: 1.00 LS					
Daily Production	: 0.25 LS per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	: 3.0 Days		Estimator	: Mihaela Tomulescu	LS per	Total Cost	Unit Price Per LS
Unit Price	: $26,865.48 per LS		Probable Low Cost Parameter		0.2875	$22,836	$22,836
Total Cost	: $26,865		Probable High Cost Parameter		0.1875	$33,582	$33,582

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Electrician Foreman	Active	1.00	3.0	8	24.00	L	$47.23	incl. in rate	incl. in rate	$1,133.52
Electrician	Active	2.00	3.0	8	48.00	L	$45.23	incl. in rate	incl. in rate	$2,171.04
Hydraulic Crane (17tn)	Active	1.00	0.2	8	1.60	E	$81.52	incl. in rate	incl. in rate	$130.43
Truck, Off-Road, Articulated Rear, 20cy	Active	2.00	0.2	8	3.20	E	$111.64	incl. in rate	incl. in rate	$357.25
Truck Driver (light)	Active	2.00	0.2	8	3.20	L	$56.29	incl. in rate	incl. in rate	$180.13
Equipment Operator (crane)	Active	1.00	0.2	8	1.60	L	$68.41	incl. in rate	incl. in rate	$109.46
Laborer	Active	2.00	4.0	8	64.00	L	$45.80	incl. in rate	incl. in rate	$2,931.20
Hydraulic Excavator (2.5cy)	Active	1.00	4.0	8	32.00	E	$203.63	incl. in rate	incl. in rate	$6,516.16
Truck, Utility, with Man-Basket	Active	1.00	2.0	8	16.00	E	$31.90	incl. in rate	incl. in rate	$510.40
Vibratory Hammer & Extractor	Active	1.00	0.2	8	1.60	E	$94.34	incl. in rate	incl. in rate	$150.94
Equipment Operator (light)	Active	1.00	4.0	8	32.00	L	$64.90	incl. in rate	incl. in rate	$2,076.80
Grader. 180hp, 13' blade	Active	1.00	4.0	8	32.00	E	$80.79	incl. in rate	incl. in rate	$2,585.28
				Labor Hours	172.8				TOTAL LABOR	$8,602.14
				Equipment Hours	86.4				TOTAL EQUIPMENT	$10,250.46

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price		Material Cost
Soils for earthwork, common borrow, spread with 200 H.P. dozer, includes load at pit and haul, 2 miles round trip, excludes compaction		CY	1.000	0.00	$21.00		$0.00
						TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price		Contract or Quote Amount
Rent trailer with cable pulling rig, for high voltage line work - Rent per day	1.00	days		$3,000.00		$3,000.00
					TOTAL SUBCONTRACTS	$3,000.00

SUMMARY OF COSTS

Labor Cost	$8,602.14	Labor Burden @		49.7%	$0.00		$8,602.14
Material Cost	$0.00	Material Tax @		7.8%	$0.00		$0.00
Equipment Cost	$10,250.46	Equipment Tax @		0.0%	$0.00		$10,250.46
Subcontractors	$3,000.00						$3,000.00
DIRECT COST SUBTOTALS	**$21,853**				**$0**	**DIRECT COST SUBTOTALS**	**$21,853**

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$18,852.61		$2,827.89
Installing Contractors Profit@	8.0%				$18,852.61		$1,508.21
GC Markup on Subs @	5.0%				$3,000.00		$150.00
						TOTAL MARKUP COSTS	**$4,486.10**
General Contractors Insurance @	1.0%		on		$26,338.71		$263
Bond @	1.0%		on		$26,338.71		$263
Contingency @	0.0%		on		$26,865.48		$0
						TOTAL COST for pay item	**$26,865**

Additional Pay Item Notes :

Assumed 3 days of work to clean and the substation rights-of-way to be restored to the natural conditions. Production is based off of RSMs using Crew formed of 1 Forman, 4 Electrician, 2 laborer, 1 Excavator & 1 crane for lift, position and load in the truck,, 1 Hydraulic rock-splitting/rock-drilling equipment to break equipment foundations, 1 utility truck access poles, string conductor, modify structure arms, provide guard structures, etc. Crews may be working simultaneously along the project alignment and substations, hydro plant and switchyard.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	5.030		Project	: IRONGATE		
Description	:	New Connection @Iron Gate Hatchery from PacifiCorp's Hornbrook Substation (Allowance)					
Quantity	:	1.00 LS					
Daily Production	:	1.00 LS per 8 hour shift		Project #	: Klamath Dams Removal		
Work Days	:	10.0 Days		Estimator	: Mihaela Tomulescu	LS per	Total Cost	Unit Price Per LS
Unit Price	:	$298,809.00 per LS		Probable Low Cost Parameter		1.1	$268,928	$268,928
Total Cost	:	$298,809		Probable High Cost Parameter		0.9	$328,690	$328,690

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
				Labor Hours	0				TOTAL LABOR	$0.00
				Equipment Hours	0				TOTAL EQUIPMENT	$0.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
						$0.00
						$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
New Connection (Allowance)	0.90	miles		310,000.00	$279,000.00
				TOTAL SUBCONTRACTS	$279,000.00

SUMMARY OF COSTS

Labor Cost	$0.00	Labor Burden @	49.7%	$0.00		$0.00
Material Cost	$0.00	Material Tax @	7.8%	$0.00		$0.00
Equipment Cost	$0.00	Equipment Tax @	0.0%	$0.00		$0.00
Subcontractors	$279,000.00					$279,000.00
DIRECT COST SUBTOTALS	$279,000			$0	DIRECT COST SUBTOTALS	$279,000

		Crew	Material	Subs	Cost Basis		
Installing Contractors Overhead@	15.0%				$0.00		$0.00
Installing Contractors Profit@	8.0%				$0.00		$0.00
GC Markup on Subs @	5.0%				$279,000.00		$13,950.00
						TOTAL MARKUP COSTS	$13,950.00
General Contractors Insurance @	1.0%			on	$292,950.00		$2,930
Bond @	1.0%			on	$292,950.00		$2,930
Contingency @	0.0%			on	$298,809.00		$0
						TOTAL COST for pay item	$298,809

Additional Pay Item Notes :

Iron Gate Hatchery located near the Klamath River downstream of Iron Gate Dam will require a new connection from PacifiCorp's Hornbrook Substation (5G19). Details for connection requirements are unknown at this stage, this estimate is just an allowance for assumed 0.9 miles of overhead distribution line. Transmission line poles or structures are commonly between 60 and 140 feet tall. Distribution line structures are approximately 40 to 60 feet tall.

There are several different kinds of transmission structures. Transmission structures can be constructed of metal or wood. They can be single-poled or multi-poled. They can be single-circuited, carrying one set of transmission lines or double-circuited with two sets of lines. . A typical new 69 kV overhead single-circuit transmission line costs approximately $315,000 per mile as opposed to $1.6 million per mile for a new 69 kV underground line (without the terminals).

PAY ITEM COST DETAIL WORKSHEET

5.032 Install 230kV strain transmission structures outside JC Boyle Substation

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 5.032	Project	: JC BOYLE
Description	: Install 230kV strain transmission structures outside JC Boyle Substation		
Quantity	: 2.00 EA		
Daily Production	: 0.10 EA per 8 hour shift	Project #	: Klamath Dams Removal
Work Days	: 20.0 Days	Estimator	: Mihaela Tomulescu
Unit Price	: $132,241.37 per EA		
Total Cost	: $264,483		

	EA per	Total Cost	Unit Price Per EA
Probable Low Cost Parameter	0.11	$238,034	$119,017.23
Probable High Cost Parameter	0.08	$317,379	$158,689.64

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	20.0	8	160.00	L	$46.27	incl. in rate	incl. in rate	$7,403.20
Electrician	Active	2.00	20.0	8	320.00	L	$45.23	incl. in rate	incl. in rate	$14,473.60
Hydraulic Crane (35tn)	Active	2.00	20.0	8	320.00	E	$116.30	incl. in rate	incl. in rate	$37,216.00
Equipment Operator (crane)	Active	2.00	20.0	8	320.00	L	$68.41	incl. in rate	incl. in rate	$21,891.20
Truck Driver (heavy)	Active	1.00	20.0	8	160.00	L	$57.59	incl. in rate	incl. in rate	$9,214.40
Truck, Flatbed (4x4, 10,000 gvw)	Active	1.00	20.0	8	160.00	E	$31.90	incl. in rate	incl. in rate	$5,104.00
Steelworker	Active	2.00	20.0	8	320.00	L	$65.52	incl. in rate	incl. in rate	$20,966.40
Truck, Utility, with Man-Basket	Active	1.00	20.0	8	160.00	E	$31.90	incl. in rate	incl. in rate	$5,104.00
Truck, Pickup (4x4, 3/4tn)	Active	1.00	20.0	8	160.00	E	$16.94	incl. in rate	incl. in rate	$2,710.40
Grader. 180hp, 13' blade	Active	1.00	1.0	8	8.00	E	$80.79	incl. in rate	incl. in rate	$646.32
Leverman	Active	1.00	1.0	8	8.00	L	$70.34	incl. in rate	incl. in rate	$562.72
Hydraulic Excavator (2.5cy)	Active	1.00	1.0	8	8.00	E	$203.63	incl. in rate	incl. in rate	$1,629.04
Loader, FE Rubber Tire (3.5cy)	Active	1.00	2.0	8	16.00	E	$64.23	incl. in rate	incl. in rate	$1,027.68

Labor Hours	1288	TOTAL LABOR	$74,511.52
Equipment Hours	832	TOTAL EQUIPMENT	$53,437.44

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
Consumables 5% labor (saw blades, drill bits, etc)	1.00	LS	1.000	1.00	$3,725.58	$3,725.58
Steel Tower - Large Angle	2.00	EA	1.000	2.00	$25,500.00	$51,000.00
Foundation	48.00	CY	1.000	48.00	$155.00	$7,440.00
Piles	8.00	EA	1.000	8.00	$1,200.00	$9,600.00
Ceramic Insulators	192.00	Bells	1.000	192.00	$18.00	$3,456.00
V-String Hardware	6.00	EA	1.000	6.00	$230.00	$1,380.00
Grounding	2.00	EA	1.000	2.00	$150.00	$300.00
					TOTAL MATERIAL	$76,901.58

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
				TOTAL SUBCONTRACTS	$0.00

SUMMARY OF COSTS

Labor Cost	$74,511.52	Labor Burden @	49.7%	$0.00	$74,511.52
Material Cost	$76,901.58	Material Tax @	7.8%	$5,959.87	$82,861.45
Equipment Cost	$53,437.44	Equipment Tax @	0.0%	$0.00	$53,437.44
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	$204,851			$5,960	DIRECT COST SUBTOTALS $210,810

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$210,810.41	$31,621.56
Installing Contractors Profit@	8.0%				$210,810.41	$16,864.83
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	$48,486.39
General Contractors Insurance @	1.0%	on			$259,296.80	$2,593
Bond @	1.0%	on			$259,296.80	$2,593
Contin	0.0%	on			$264,482.74	$0
					TOTAL COST for pa	$264,483

Additional Pay Item Notes :

Engineering and construction costs only. Environmental, Permitting, and Right of way Acquisition costs are not included. The following is a summary of anticipated equipment to be used for each construction activity. Survey work only requires the use of pickup trucks or ATVs. To dig holes and install the directly embedded structures or install 230-kV foundations it is anticipated that pickup trucks, 2-ton trucks, hole diggers, bulldozers, concrete trucks, carry alls, cranes, hydro crane, wagon drill, dump trucks, and front-end loaders will be used. Hauling lattice steel members, tubular poles, braces and hardware to the structure sites will require the use of steel haul trucks; carry all's, cranes, and forklifts. For assembly and erection of structures it is anticipated that pickup trucks, 2-ton trucks, carry all's, cranes, and a heavy lift helicopter may be used, not included here. Final cleanup, reclamation, and restoration will utilize pickups, 2-ton trucks, bulldozers, motor graders, dump trucks, front-end loaders.. The contractor will mobilize equipment and personnel to the construction site at various stages in the Project schedule depending on operational requirements. Assumed 230KV Single Circuit Tower. Estimate includes just towers and not included the transmission line to tie existing 230kV transmission line north and south of JC Boyle Substation together. The estimated costs can vary due to fluctuations in steel pricing, subsurface conditions, contractor availability and the time of year. Taking into account these fluctuations, the estimates are subject to a contingency of 20%. These are only estimates as actual pricing would occur during the detailed engineering and construction bid process.

PAY ITEM INFORMATION

PAY ITEM NUMBER	: 6.001	**Project**	: Yreka Waterline			
Description	: Yreka Waterline Replacement (Microtunneling)					
Quantity	: 612.00 LF					
Daily Production	: 20.00 LF per 8 hour shift	**Project #**	: 6			
Work Days	: 30.6 Days	**Estimator**	: Eric Jones	**LF per**	**Total Cost**	**Unit Price Per LF**
Unit Price	: $1,558.34 per LF	**Probable Low Cost Parameter**		**24**	**$762,961**	**$1,324.59**
Total Cost	: $953,701	**Probable High Cost Parameter**		**12**	**$1,335,182**	**$2,025.84**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	30.6	8	244.80	L	$46.27	incl. in rate	incl. in rate	$11,326.90
Laborer	Active	2.00	30.6	8	489.60	L	$45.80	incl. in rate	incl. in rate	$22,423.68
Truck, Pickup (4x4, 3/4tn)	Active	1.00	30.6	8	244.80	E	$16.94	incl. in rate	incl. in rate	$4,146.91
		0.00	30.6	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.6	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.6	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.6	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.6	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.6	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.6	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	30.6	8	0.00	0	$0.00	$0.00		$0.00
		0.00	30.6	8	0.00	0	$0.00	$0.00		$0.00
			30.6	8	0.00	E	$250.00	incl. in rate	incl. in rate	$0.00
			30.6	8	0.00					$0.00
			30.6	8	0.00					$0.00
			30.6	8	0.00					$0.00
			30.6	8	0.00					$0.00
				Labor Hours	**734.4**				**TOTAL LABOR**	**$33,750.58**
				Equipment Hours	**244.8**				**TOTAL EQUIPMENT**	**$4,146.91**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Microtunneling 36" ID Casing	1	LS	**RSM Data Base**	$730,454.00	$730,454.00
Mobilization/ Demobilization	1	LS	**RSM Data Base**	$115,252.72	$115,252.72
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$845,706.72**

SUMMARY OF COSTS

Labor Cost	$33,750.58	Labor Burden @	0.0%			$33,750.58
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$4,146.91	Equipment Tax @	7.75%	$321.39		$4,468.30
Subcontractors	$845,706.72					$845,706.72
DIRECT COST SUBTOTALS	**$883,604**			**$321**	**DIRECT COST SUBTOTALS**	**$883,926**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$38,218.87	$5,732.83
Installing Contractors Profit@	8.0%				$38,218.87	$3,057.51
GC Markup on Subs @	5.0%				$845,706.72	$42,285.34
					TOTAL MARKUP COSTS	**$51,075.68**
General Contractors Insurance @	1.0%			on	$935,001.27	$9,350
Bond @	1.0%			on	$935,001.27	$9,350
Contingency @	0.0%			on	$953,701.30	$0
					TOTAL COST for pay item	**$953,701**

Additional Pay Item Notes :

Mircrotunneling will be completed by subcontractor, Operation cost will be $535,500.00 Operating technician will be onsite for 30days to support operation $18,900.00, and Material cost for 36" permanenet casing will be $176,054.00. This does not includded pit construction. Crew listed above is to support subbcontractor needs.

PAY ITEM COST DETAIL WORKSHEET — **6.002 Yreka Waterline Replacement (Pile and Lagging Pre Drilling)**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	6.002	**Project**	: Yreka Waterline		
Description	:	Yreka Waterline Replacement (Pile and Lagging Pre Drilling)				
Quantity	:	458.00 LF				
Daily Production	:	45.80 LF per 8 hour shift	**Project #**	: 6		
Work Days	:	10.0 Days	**Estimator**	: Eric Jones	**LF per**	**Total Cost**
Unit Price	:	$150.68 per LF	**Probable Low Cost Parameter**	**54.96**	**$55,208**	**$128.07**
Total Cost	:	$69,010	**Probable High Cost Parameter**	**27.48**	**$96,613**	**$195.88**

(Column heading of last column: **Unit Price Per LF**)

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	10.0	8	80.00	L	$46.27	incl. in rate	incl. in rate	$3,701.60
Laborer	Active	3.00	10.0	8	240.00	L	$45.80	incl. in rate	incl. in rate	$10,992.00
Equipment Operator (crane)	Active	1.00	10.0	8	80.00	L	$68.41	incl. in rate	incl. in rate	$5,472.80
Equipment Operator (oiler)	Active	1.00	10.0	8	80.00	L	$62.94	incl. in rate	incl. in rate	$5,035.20
0			10.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	10.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	10.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	10.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	10.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	10.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	10.0	8	0.00	0	$0.00	$0.00		$0.00
		0.00	10.0	8	0.00	0	$0.00	$0.00		$0.00
Drillrig Truck mounted	Active	1.00	10.0	8	80.00	E	$345.75	incl. in rate	incl. in rate	$27,660.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
			10.0	8	0.00					$0.00
				Labor Hours	**480**				**TOTAL LABOR**	**$25,201.60**
				Equipment Hours	**80**				**TOTAL EQUIPMENT**	**$27,660.00**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		SF	1.000	0.00	$38.80	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$25,201.60	Labor Burden @	0.0%		$25,201.60
Material Cost	$0.00	Material Tax @	7.75%	$0.00	$0.00
Equipment Cost	$27,660.00	Equipment Tax @	7.75%	$2,143.65	$29,803.65
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$52,862**			**$2,144**	**DIRECT COST SUBTOTALS** **$55,005**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$55,005.25	$8,250.79
Installing Contractors Profit@	8.0%				$55,005.25	$4,400.42
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$12,651.21**
General Contractors Insurance @	1.0%			on	$67,656.46	$677
Bond @	1.0%			on	$67,656.46	$677
Contingency @	0.0%			on	$69,009.59	$0
					TOTAL COST for pay item	**$69,010**

Additional Pay Item Notes :

Crew is based off of B43 for the predrilling of the H pile for the pile and lagging wall. Prodcution is expecting crew to take a week per side to predrill holes due to the material hardness.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	6.003	**Project**	: Yreka Waterline		
Description	:	Yreka Waterline Replacement (Pile and Lagging Wall Installation)				
Quantity	:	13,715.00 SF				
Daily Production	:	457.17 SF per 8 hour shift	**Project #**	: 6		
Work Days	:	30.0 Days	**Estimator**	: Eric Jones	**SF per**	**Total Cost**
Unit Price	:	$73.01 per SF	**Probable Low Cost Parameter**		**548.604**	**$801,038**
Total Cost	:	$1,001,297	**Probable High Cost Parameter**		**274.302**	**$1,401,816**

	Unit Price Per SF
Probable Low Cost Parameter	$62.06
Probable High Cost Parameter	$94.91

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Equipment Operator (crane)	Active	2.00	30.0	8	480.00	L	$68.41	incl. in rate	incl. in rate	$32,836.80
Equipment Operator (oiler)	Active	1.00	30.0	8	240.00	L	$62.94	incl. in rate	incl. in rate	$15,105.60
Laborer	Active	3.00	30.0	8	720.00	L	$45.80	incl. in rate	incl. in rate	$32,976.00
Crawler Crane (90tn)	Active	1.00	30.0	8	240.00	E	$208.09	incl. in rate	incl. in rate	$49,941.60
Air Compressor 600 cfm	Active	1.00	30.0	8	240.00	E	$21.74	incl. in rate	incl. in rate	$5,217.34
0		0.00	30.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	30.0	8	0.00	0	$0.00	$0.00		$0.00
		0.00	30.0	8	0.00	0	$0.00	$0.00		$0.00
Pile Driver	Active	4.00	30.0	8	960.00	L	$49.50	incl. in rate	incl. in rate	$47,520.00
Pile Driver Foreman	Active	1.00	30.0	8	240.00	L	$51.50	incl. in rate	incl. in rate	$12,360.00
Lead 60' High	Active	1.00	30.0	8	240.00	E	$9.50	incl. in rate	incl. in rate	$2,280.00
Hammer Diesel 15K ft-lbs	Active	1.00	30.0	8	240.00	E	$75.72	incl. in rate	incl. in rate	$18,172.80
50' Air Hoses 3"	Active	2.00	30.0	8	480.00	E	$1.86	incl. in rate	incl. in rate	$892.80
Chainsaw Gas, 36"	Active	1.00	30.0	8	240.00	E	$5.63			$1,351.20
				Labor Hours	**2640**				**TOTAL LABOR**	**$140,798.40**
				Equipment Hours	**1680**				**TOTAL EQUIPMENT**	**$77,855.74**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Pile and Lagging	13,715.00	SF	1.000	13,715.00	$38.80	$532,169.43
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$532,169.43**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$140,798.40	Labor Burden @	0.0%		$140,798.40
Material Cost	$532,169.43	Material Tax @	7.75%	$41,243.13	$573,412.56
Equipment Cost	$77,855.74	Equipment Tax @	7.75%	$6,033.82	$83,889.56
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$750,824**			**$47,277**	**DIRECT COST SUBTOTALS** **$798,101**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$798,100.52	$119,715.08
Installing Contractors Profit@	8.0%				$798,100.52	$63,848.04
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$183,563.12**
General Contractors Insurance @	1.0%			on	$981,663.64	$9,817
Bond @	1.0%			on	$981,663.64	$9,817
Contingency @	0.0%			on	$1,001,296.91	$0
					TOTAL COST for pay item	**$1,001,297**

Additional Pay Item Notes :

Adjusted RSM Crew B50 to account for tight work area. Equipment matches Crew B50 from RSM. Figure it will take 3 weeks per side to install wall there will be some equipment downtime due to having to do the pile and lagging wall being built from top down.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	6.004	**Project**	: Yreka Waterline		
Description	:	Yreka Waterline Replacement (Pipe Installation)				
Quantity	:	2,106.00 LF				
Daily Production	:	70.00 LF per 8 hour shift	**Project #**	: 6		
Work Days	:	30.1 Days	**Estimator**	: Eric Jones	**LF per**	**Total Cost**
Unit Price	:	$133.76 per LF	**Probable Low Cost Parameter**		**84**	**$225,358**
Total Cost	:	$281,698	**Probable High Cost Parameter**		**42**	**$394,377**

	Unit Price Per LF
Probable Low Cost Parameter	**$113.70**
Probable High Cost Parameter	**$173.89**

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	30.1	8	240.80	L	$46.27	incl. in rate	incl. in rate	$11,141.82
Laborer	Active	1.00	30.1	8	240.80	L	$45.80	incl. in rate	incl. in rate	$11,028.64
Equipment Operator (crane)	Active	1.00	30.1	8	240.80	L	$68.41	incl. in rate	incl. in rate	$16,473.13
Hydraulic Crane (17tn)	Active	1.00	30.1	8	240.80	E	$81.52	incl. in rate	incl. in rate	$19,630.02
Welder, Portable	Active	1.00	30.1	8	240.80	E	$7.84	incl. in rate	incl. in rate	$1,887.27
Steelworker		0.00	30.1	8	0.00	L	$65.52	incl. in rate	incl. in rate	$0.00
0		0.00	30.1	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.1	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.1	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	30.1	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	30.1	8	0.00	0	$0.00	$0.00		$0.00
		0.00	30.1	8	0.00	0	$0.00	$0.00		$0.00
Plumber	Active	1.00	30.1	8	240.80	L	$61.80	incl. in rate	incl. in rate	$14,881.44
Plumber Apprentice	Active	1.00	30.1	8	240.80	L	$49.45	incl. in rate	incl. in rate	$11,907.56
	Active	0.00	30.1	8	0.00	E	$9.50	incl. in rate	incl. in rate	$0.00
	Active	0.00	30.1	8	0.00	E	$75.72	incl. in rate	incl. in rate	$0.00
	Active	0.00	30.1	8	0.00	E	$1.86	incl. in rate	incl. in rate	$0.00
	Active	0.00	30.1	8	0.00	E	$5.63			$0.00
				Labor Hours	**1204**				**TOTAL LABOR**	**$65,432.58**
				Equipment Hours	**481.6**				**TOTAL EQUIPMENT**	**$21,517.29**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
Pipe Material	1,053.00	LF	1.000	1,053.00	$119.79	$126,138.87
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$50.00	$0.00
					TOTAL MATERIAL	**$126,138.87**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$65,432.58	Labor Burden @	0.0%		$65,432.58
Material Cost	$126,138.87	Material Tax @	7.75%	$9,775.76	$135,914.63
Equipment Cost	$21,517.29	Equipment Tax @	7.75%	$1,667.59	$23,184.88
Subcontractors	$0.00				$0.00
DIRECT COST SUBTOTALS	**$213,089**			**$11,443**	**DIRECT COST SUBTOTALS** **$224,532**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$224,532.09	$33,679.81
Installing Contractors Profit@	8.0%				$224,532.09	$17,962.57
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$51,642.38**

General Contractors Insurance @	1.0%	on	$276,174.47	$2,762
Bond @	1.0%	on	$276,174.47	$2,762
Contingency @	0.0%	on	$281,697.96	$0

TOTAL COST for pay item **$281,698**

Additional Pay Item Notes :

Figuring it will take 1 month to install pipe complete including welding joints.

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	6.005	Project	: Yreka Waterline			
Description	:	Yreka Waterline Replacement (Excavation and Backfill)					
Quantity	:	3,653.00 CY					
Daily Production	:	91.00 CY per 8 hour shift	Project #	: 6			
Work Days	:	40.1 Days	Estimator	: Eric Jones	CY per	Total Cost	Unit Price Per CY
Unit Price	:	$88.45 per CY	Probable Low Cost Parameter		109.2	$258,477	$75.18
Total Cost	:	$323,097	Probable High Cost Parameter		54.6	$452,335	$114.98

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Equipment Operator (crane)	Active	1.00	***30.1***	8	240.60	L	$68.41	incl. in rate	incl. in rate	$16,459.45
Equipment Operator (oiler)	Active	1.00	***30.1***	8	240.60	L	$62.94	incl. in rate	incl. in rate	$15,143.36
Laborer	Active	5.00	40.1	8	1,604.00	L	$45.80	incl. in rate	incl. in rate	$73,463.20
Equipment Operator (medium)	Active	2.00	40.1	8	641.60	L	$66.28	incl. in rate	incl. in rate	$42,525.25
Labor Foreman (out)	Active	1.00	40.1	8	320.80	L	$46.27	incl. in rate	incl. in rate	$14,843.42
Crawler Crane (90tn)	Active	1.00	***30.1***	8	240.60	E	$208.09	incl. in rate	incl. in rate	$50,066.45
Dozer (235hp)(CATD7)	Active	1.00	***20.1***	8	160.40	E	$165.11	incl. in rate	incl. in rate	$26,483.64
Roller, Dbl Drum (steel wheel, 5.0 - 7.9 MTn)	Active	1.00	***20.1***	8	160.40	E	$64.77	incl. in rate	incl. in rate	$10,389.11
Gas Engine Tamp	Active	1.00	40.1	8	320.80	E	$4.10	incl. in rate	incl. in rate	$1,316.01
0		0.00	40.1	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	40.1	8	0.00	0	$0.00	$0.00		$0.00
		0.00	40.1	8	0.00	0	$0.00	$0.00		$0.00
	Active	0.00	40.1	8	0.00	L	$49.50	incl. in rate	incl. in rate	$0.00
	Active	0.00	40.1	8	0.00	L	$51.50	incl. in rate	incl. in rate	$0.00
	Active	0.00	40.1	8	0.00	E	$9.50	incl. in rate	incl. in rate	$0.00
	Active	0.00	40.1	8	0.00	E	$75.72	incl. in rate	incl. in rate	$0.00
	Active	0.00	40.1	8	0.00	E	$1.86	incl. in rate	incl. in rate	$0.00
	Active	0.00	40.1	8	0.00	E	$5.63			$0.00
				Labor Hours	**3047.6**				**TOTAL LABOR**	**$162,434.67**
				Equipment Hours	**882.2**				**TOTAL EQUIPMENT**	**$88,255.22**

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		SF	1.000	0.00	$38.80	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	**$0.00**

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
					$0.00
					$0.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	**$0.00**

SUMMARY OF COSTS

Labor Cost	$162,434.67	Labor Burden @	0.0%			$162,434.67
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$88,255.22	Equipment Tax @	7.75%	$6,839.78		$95,094.99
Subcontractors	$0.00					$0.00
DIRECT COST SUBTOTALS	**$250,690**			**$6,840**	**DIRECT COST SUBTOTALS**	**$257,530**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$257,529.67	$38,629.45
Installing Contractors Profit@	8.0%				$257,529.67	$20,602.37
GC Markup on Subs @	5.0%				$0.00	$0.00
					TOTAL MARKUP COSTS	**$59,231.82**
General Contractors Insurance @	1.0%			on	$316,761.49	$3,168
Bond @	1.0%			on	$316,761.49	$3,168
Contingency @	0.0%			on	$323,096.72	$0
					TOTAL COST for pay item	**$323,097**

Additional Pay Item Notes :

Figuring material will be piled near excavation due to material needing me reused for backfilling pits and new watermain. Figuring crane will be used 3/4 of the time to backfill pits. Figured dozer and roller will be used 1/2 of the time to backfill open excavation area.

PAY ITEM COST DETAIL WORKSHEET — **10.01 Raising of Existing Residential/ Commericial Structures**

PAY ITEM INFORMATION

PAY ITEM NUMBER	:	10.01	Project	: Flood Mitigation		
Description	:	Raising of Existing Residential/ Commericial Structures				
Quantity	:	45.00 EA				
Daily Production	:	0.20 EA per 8 hour shift	Project #	: 6		
Work Days	:	225.0 Days	Estimator	: Eric Jones	EA per	Total Cost	Unit Price Per EA
Unit Price	:	$30,187.71 per EA	Probable Low Cost Parameter	0.24	$1,086,758	$24,150.17
Total Cost	:	$1,358,447	Probable High Cost Parameter	0.14	$1,765,981	$36,225.25

CREW COSTS

Description	Active Idle	# in crew	Days Worked	Hours /day	Total Hours	L/E	Hourly Rate	Hrly oper. Cost	Burden Rate	Labor / Equipment Cost
Labor Foreman (out)	Active	1.00	225.0	8	1,800.00	L	$46.27	incl. in rate	incl. in rate	$83,286.00
Laborer	Active	2.00	225.0	8	3,600.00	L	$45.80	incl. in rate	incl. in rate	$164,880.00
Truck, Pickup (4x4, 3/4tn)	Active	1.00	225.0	8	1,800.00	E	$16.94	incl. in rate	incl. in rate	$30,492.00
		0.00	225.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	225.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	225.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	225.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	225.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	225.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
0		0.00	225.0	8	0.00	0	$0.00	incl. in rate	incl. in rate	$0.00
		0.00	225.0	8	0.00	0	$0.00	$0.00		$0.00
		0.00	225.0	8	0.00	0	$0.00	$0.00		$0.00
			225.0	8	0.00	E	$250.00	incl. in rate	incl. in rate	$0.00
			225.0	8	0.00					$0.00
			225.0	8	0.00					$0.00
			225.0	8	0.00					$0.00
			225.0	8	0.00					$0.00
				Labor Hours	5400				TOTAL LABOR	$248,166.00
				Equipment Hours	1800				TOTAL EQUIPMENT	$30,492.00

MATERIAL COSTS

Description	Item Quantity	Order Unit	Conversion Factor / Waste	Order Quantity	Order Price	Material Cost
						$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ea	1.000	0.00	$50.00	$0.00
		ls	1.000	0.00	$8,000.00	$0.00
					TOTAL MATERIAL	$0.00

SUBCONTRACT COSTS

Description	Quantity	Units	Notes / Company	Unit Price	Contract or Quote Amount
Cost to Raise Homes	45	EA	**California Highend to Raise Home**	$18,473.00	$831,285.00
Set of stairs per house	90	EA	**RSM Data Base**	$1,199.00	$107,910.00
					$0.00
					$0.00
				TOTAL SUBCONTRACTS	$939,195.00

SUMMARY OF COSTS

Labor Cost	$248,166.00	Labor Burden @	0.0%			$248,166.00
Material Cost	$0.00	Material Tax @	7.75%	$0.00		$0.00
Equipment Cost	$30,492.00	Equipment Tax @	7.75%	$2,363.13		$32,855.13
Subcontractors	$939,195.00					$939,195.00
DIRECT COST SUBTOTALS	**$1,217,853**			**$2,363**	**DIRECT COST SUBTOTALS**	**$1,220,216**

		Crew	Material	Subs	Cost Basis	
Installing Contractors Overhead@	15.0%				$281,021.13	$42,153.17
Installing Contractors Profit@	8.0%				$281,021.13	$22,481.69
GC Markup on Subs @	5.0%				$939,195.00	$46,959.75
					TOTAL MARKUP COSTS	**$111,594.61**
General Contractors Insurance @	1.0%			on	$1,331,810.74	$13,318
Bond @	1.0%			on	$1,331,810.74	$13,318
Contingency @	0.0%			on	$1,358,446.95	$0
					TOTAL COST for pay item	**$1,358,447**

Additional Pay Item Notes :

Figuring that it will take 5 days to raise each house. The cost listed is the average cost for raising a building in California. Foreman and laborer are supporting subcontractor. Stair cost is total cost from RSM Data base.

Attachment C Risk Distribution Model Inputs

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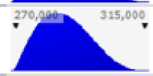
Risk Distribution Model Inputs

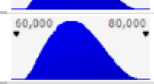
ENGINEERING & CONSTRUCTION MANAGEMENT

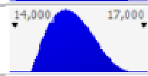
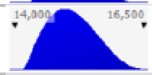
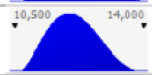
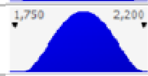
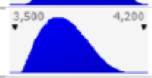
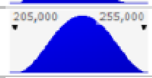
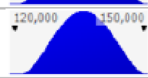
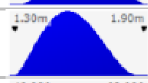
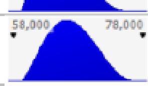
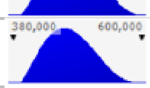
Name	Cell	Graph	Function	Min	Mean	Max
31ProjectDetail attached	U95		RiskPert(S95,R95,T95,RiskName(B95&C95&H95))	1892400	2008600	$2,191,200.00
32ProjectDetail attached	U98		RiskPert(S98,R98,T98,RiskName(B98&C98&H98))	280250	297458.3	$324,500.00
32Project	U99		RiskPert(S99,R99,T99,RiskName(B99&C99&H99))	3405750	3614875	$3,943,500.00
32Project	U100		RiskPert(S100,R100,T100,RiskName(B100&C100&H100))	1852500	1966250	$2,145,000.00
32Project	U101		RiskPert(S101,R101,T101,RiskName(B101&C101&H101))	270750	287375	$313,500.00
33ProjectDetail attached	U104		RiskPert(S104,R104,T104,RiskName(B104&C104&H104))	5861700	6730100	$8,466,900.00
34ProjectDetail attached	U107		RiskPert(S107,R107,T107,RiskName(B107&C107&H107))	960996.1	1020005	$1,112,732.00
35ProjectDetail attached	U110		RiskPert(S110,R110,T110,RiskName(B110&C110&H110))	10085770	10705070	$11,678,260.00

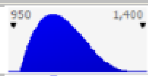
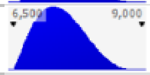
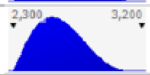
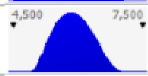
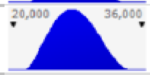
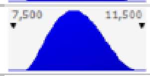
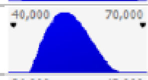
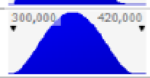
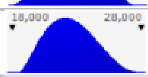
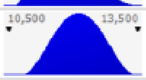
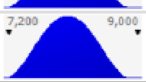
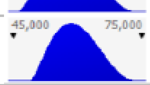
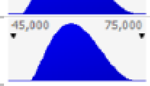
<u>CONSTRUCTION</u>

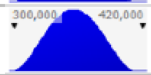
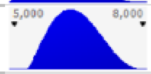
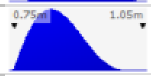
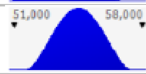
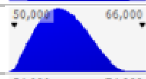
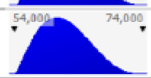
DAM REMOVAL

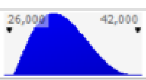
JC Boyle

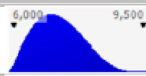
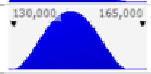
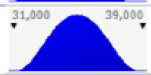
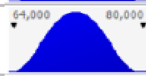
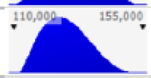
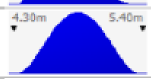
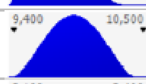
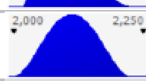
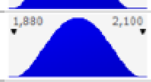
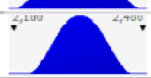
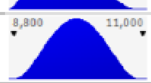
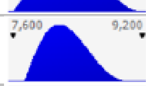
Name	Cell	Graph	Function	Min	Mean	Max
41JC BoyleRemoval of Diversion Conduit Bulkheads	U114		RiskPert(S114,R114,T114,RiskName(B114&C114&H114))	19792.93	20834.66	$21,876.40
41JC BoyleRemove Water from behind Tailrace Cofferdam	U115		RiskPert(S115,R115,T115,RiskName(B115&C115&H115))	5374.84	6021.81	$6,867.85
41JC BoyleProvide Dewatering behind Tailrace Cofferdam	U116		RiskPert(S116,R116,T116,RiskName(B116&C116&H116))	61791.86	69229.77	$78,956.27
41JC BoyleConstruct Embankment Cofferdam in Tailrace around Powerhouse	U117		RiskPert(S117,R117,T117,RiskName(B117&C117&H117))	220246.9	248797.4	$293,662.50
41JC BoyleRemove Spillway Concrete	U118		RiskPert(S118,R118,T118,RiskName(B118&C118&H118))	662853.1	786325.7	$935,792.60
41JC BoyleRemove Monorail Structural Steel Components	U119		RiskPert(S119,R119,T119,RiskName(B119&C119&H119))	9688.4	11213.42	$14,532.60
41JC BoyleRemove Fish Ladder Concrete	U120		RiskPert(S120,R120,T120,RiskName(B120&C120&H120))	614464.3	682738.1	$751,011.90
41JC BoyleRemove Gravity Dam Section Concrete	U121		RiskPert(S121,R121,T121,RiskName(B121&C121&H121))	194820.9	231111	$275,041.20
41JC BoyleRemove Timber Equipment Ramp on left side of Dam	U122		RiskPert(S122,R122,T122,RiskName(B122&C122&H122))	6663.72	8100.99	$10,583.55
41JC BoyleRemove Pressure-Treated Lumber from Footbridge around Intake Structure	U123		RiskPert(S123,R123,T123,RiskName(B123&C123&H123))	26206.81	29361.33	$33,486.48
41JC BoyleRemove Storage Shed located on access road	U124		RiskPert(S124,R124,T124,RiskName(B124&C124&H124))	133063.1	141233.7	$154,073.10
41JC BoyleRemove Warehouse located on access road	U125		RiskPert(S125,R125,T125,RiskName(B125&C125&H125))	100609.3	106787.1	$116,495.00

Name	Cell	Graph	Function	Min	Mean	Max
41JC BoyleRemove Warehouse located on access road	U125		RiskPert(S125,R125,T125,RiskName(B125&C125&H125))	100609.3	106787.1	$116,495.00
41JC BoyleRemove Fire System Control Bldg. on left abutment	U126		RiskPert(S126,R126,T126,RiskName(B126&C126&H126))	14448.33	15335.5	$16,729.64
41JC BoyleRemove Dam Communication Bldg. on left abutment	U127		RiskPert(S127,R127,T127,RiskName(B127&C127&H127))	14247.2	15122.03	$16,496.76
41JC BoyleRemove Concrete Slab on left abutment for former Control House	U128		RiskPert(S128,R128,T128,RiskName(B128&C128&H128))	10803.52	12103.94	$13,804.50
41JC BoyleRemove 4'x5' Metal Hatch on top of Concrete Pull Box on left abutment	U129		RiskPert(S129,R129,T129,RiskName(B129&C129&H129))	1791.36	1990.4	$2,189.44
41JC BoyleRemove Reservoir Level Gauge House on Dam Crest	U130		RiskPert(S130,R130,T130,RiskName(B130&C130&H130))	3556.86	3775.26	$4,118.47
41JC BoyleUpstream Riprap	U131		RiskPert(S131,R131,T131,RiskName(B131&C131&H131))	208125.7	231250.8	$254,375.80
41JC BoyleDownstream Riprap	U132		RiskPert(S132,R132,T132,RiskName(B132&C132&H132))	122426.9	136029.9	$149,632.80
41JC BoyleMiscellaneous Excavation	U133		RiskPert(S133,R133,T133,RiskName(B133&C133&H133))	1319586	1565391	$1,862,945.00
41JC BoyleCutoff Wall Concrete Demolition	U134		RiskPert(S134,R134,T134,RiskName(B134&C134&H134))	49044.27	52485.97	$59,369.37
41JC BoyleCutoff Wall Anchors	U135		RiskPert(S135,R135,T135,RiskName(B135&C135&H135))	3915.18	4155.59	$4,533.37
41JC BoyleRemove & Dispose Hand Rails and Light Poles	U136		RiskPert(S136,R136,T136,RiskName(B136&C136&H136))	4516.91	4833.89	$5,467.84
41JC BoyleRemove & Dispose Spillway Radial Gates and Hoists	U137		RiskPert(S137,R137,T137,RiskName(B137&C137&H137))	268170	310381.9	$402,255.00
41JC BoyleRemove & Dispose Stop Logs and Slots (steel)	U138		RiskPert(S138,R138,T138,RiskName(B138&C138&H138))	87798.53	99179.82	$117,064.70
41JC BoyleRemove & Dispose of 24" Slide Gate at Entrance to Fish Ladder Structure	U139		RiskPert(S139,R139,T139,RiskName(B139&C139&H139))	3119.5	3502.6	$4,761.34
41JC BoyleRemove petroleum products from Red Barn Area	U140		RiskPert(S140,R140,T140,RiskName(B140&C140&H140))	20401.73	24602.08	$31,202.64
41JC BoyleRemove & Dispose of Spillway gate motor & control panel	U141		RiskPert(S141,R141,T141,RiskName(B141&C141&H141))	1298.21	1466.49	$1,730.94
41JC BoyleRemove & Dispose of Distribution equipment, panelboards	U142		RiskPert(S142,R142,T142,RiskName(B142&C142&H142))	5950.3	6721.64	$7,933.73
41JC BoyleRemove Powerhouse Concrete down to Elevation 3324.0	U143		RiskPert(S143,R143,T143,RiskName(B143&C143&H143))	829908.5	937489.3	$1,106,545.00
41JC BoyleRemove Structural Steel Item associated with Powerhouse	U144		RiskPert(S144,R144,T144,RiskName(B144&C144&H144))	59804.68	67003.39	$76,417.09
41JC BoyleRemove Warehouse near Powerhouse	U145		RiskPert(S145,R145,T145,RiskName(B145&C145&H145))	178143.7	189082.3	$206,271.60
41JC BoyleRemove & Dispose of 2 - Governor oil systems	U146		RiskPert(S146,R146,T146,RiskName(B146&C146&H146))	44806.73	47951.06	$54,239.72
41JC BoyleRemove & Dispose of Cooling water and bearing oil systems	U147		RiskPert(S147,R147,T147,RiskName(B147&C147&H147))	6990.83	7832.32	$8,932.73
41JC BoyleRemove & Dispose of 2 - Francis Turbines	U148		RiskPert(S148,R148,T148,RiskName(B148&C148&H148))	398903.4	477119.7	$586,622.60
41JC BoyleRemove & Dispose of 150 Ton crane	U149		RiskPert(S149,R149,T149,RiskName(B149&C149&H149))	187781	222759.8	$265,102.50

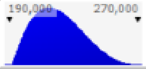
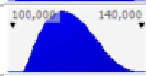
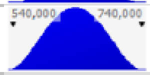
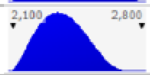
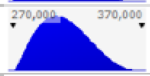
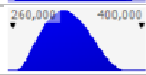
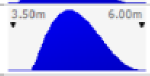
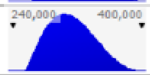
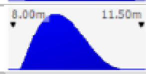
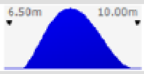
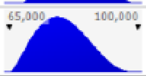
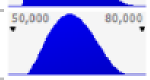
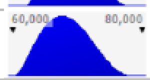
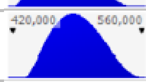
Name	Cell	Graph	Function	Min	Mean	Max
41JC BoyleRemove & Dispose of Compressed Air systems	U150		RiskPert(S150,R150,T150,RiskName(B150&C150&H150))	984.76	1121.54	$1,367.73
41JC BoyleRemove & Dispose of 2 - CO2 systems	U151		RiskPert(S151,R151,T151,RiskName(B151&C151&H151))	6584.39	7437.92	$8,779.18
41JC BoyleRemove & Dispose of Plant Water and Fire Protection	U152		RiskPert(S152,R152,T152,RiskName(B152&C152&H152))	2326.05	2627.58	$3,101.40
41JC BoyleRemove & Dispose of Transformer Oil Fire Protection	U153		RiskPert(S153,R153,T153,RiskName(B153&C153&H153))	4978.53	5905.91	$7,028.52
41JC BoyleRemove & Dispose of Unwatering Piping	U154		RiskPert(S154,R154,T154,RiskName(B154&C154&H154))	21913.42	27620.04	$34,239.71
41JC BoyleRemove & Dispose of Drainage Piping	U155		RiskPert(S155,R155,T155,RiskName(B155&C155&H155))	7986.64	9474.35	$11,275.26
41JC BoyleRemove & Dispose of 2-Oil Sump pumps	U156		RiskPert(S156,R156,T156,RiskName(B156&C156&H156))	2567.54	2876.6	$3,280.75
41JC BoyleRemove & Dispose of Draft Tube Bulk Head Gates and Hoists at the Powerhouse	U157		RiskPert(S157,R157,T157,RiskName(B157&C157&H157))	44323.04	53013.83	$65,180.94
41JC BoyleRemove petroleum products from Mechanical Equipment	U158		RiskPert(S158,R158,T158,RiskName(B158&C158&H158))	26518.51	31978.21	$40,557.73
41JC BoyleRemove & Dispose of Outdoor Vertical AC Generator, Unit 1: 53 MVA	U159		RiskPert(S159,R159,T159,RiskName(B159&C159&H159))	302720.9	356142.2	$409,563.50
41JC BoyleRemove & Dispose of Generator Switchgear, 15kV - (6 sections)	U163		RiskPert(S163,R163,T163,RiskName(B163&C163&H163))	18865.19	22564.24	$27,742.92
41JC BoyleRemove & Dispose of Station Service Switchgear, 600 volt - (5 sections)	U164		RiskPert(S164,R164,T164,RiskName(B164&C164&H164))	10914	12126.66	$13,339.33
41JC BoyleRemove & Dispose of Unit and plant control switchboard	U165		RiskPert(S165,R165,T165,RiskName(B165&C165&H165))	5976.34	6640.38	$7,304.42
41JC BoyleRemove & Dispose of Battery system	U166		RiskPert(S166,R166,T166,RiskName(B166&C166&H166))	7522.56	8358.4	$9,194.24
41JC BoyleRemove & Dispose of Raceways, Conduit and Cable	U167		RiskPert(S167,R167,T167,RiskName(B167&C167&H167))	14063.83	15626.48	$17,189.12
41JC BoyleRemove & Dispose of Misc. power & control boards	U168		RiskPert(S168,R168,T168,RiskName(B168&C168&H168))	7228.46	8031.62	$8,834.78
41JC BoyleRemove & Dispose of 5 Gantry Crane motors - hoist (50Hp), aux hoist*	U169		RiskPert(S169,R169,T169,RiskName(B169&C169&H169))	1750.92	1977.89	$2,334.56
41JC BoyleRemove & Dispose of Gantry Crane control equipment (3 cubicles)	U170		RiskPert(S170,R170,T170,RiskName(B170&C170&H170))	5941.94	6602.15	$7,262.37
41JC BoyleRemove & Dispose of Conduit and Cable	U171		RiskPert(S171,R171,T171,RiskName(B171&C171&H171))	10692.66	12078.75	$14,256.88
41JC BoyleRemove & Dispose of Exterior Lighting	U172		RiskPert(S172,R172,T172,RiskName(B172&C172&H172))	10772.44	12069.13	$13,764.79
41JC BoyleRemove & Dispose of Transmission Line No. 59	U173		RiskPert(S173,R173,T173,RiskName(B173&C173&H173))	49856.34	59632.09	$73,318.15
41JC BoyleRemove & Dispose of Transmission Line No. 98	U174		RiskPert(S174,R174,T174,RiskName(B174&C174&H174))	6359.95	7607	$9,352.86
41JC BoyleRemove & Dispose of Transmission Line No. 58	U175		RiskPert(S175,R175,T175,RiskName(B175&C175&H175))	49856.34	59632.09	$73,318.15
41JC BoyleRemove Intake Structure Concrete	U176		RiskPert(S176,R176,T176,RiskName(B176&C176&H176))	477513.4	539413.3	$636,684.60
41JC BoyleRemove Fish Screen Building	U177		RiskPert(S177,R177,T177,RiskName(B177&C177&H177))	151333.4	160625.8	$175,228.10

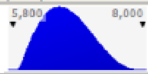
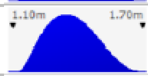
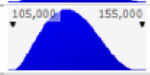
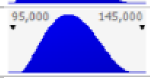
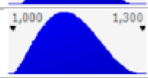
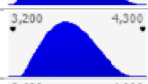
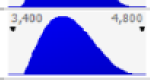
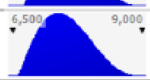
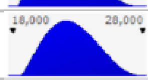
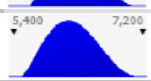
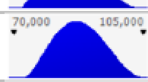
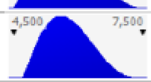
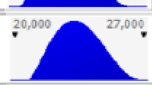
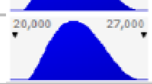
Name	Cell	Graph	Function	Min	Mean	Max
41JC BoyleRemove 24-inch-dia. Steel Fish Discharge Pipe	U178		RiskPert(S178,R178,T178,RiskName(B178&C178&H178))	11285.99	13498.93	$16,597.04
41JC BoyleRemove Concrete Items associated with the 14-ft-diameter Steel Pipe	U179		RiskPert(S179,R179,T179,RiskName(B179&C179&H179))	302857.3	356302.7	$409,748.10
41JC BoyleRemove Open Concrete Flume	U180		RiskPert(S180,R180,T180,RiskName(B180&C180&H180))	7014533	7923824	$9,352,710.00
41JC BoyleRemove Structural Steel Items associated with the Forebay Trash rack Piers	U181		RiskPert(S181,R181,T181,RiskName(B181&C181&H181))	5381.22	6436.36	$7,913.55
41JC BoyleRemove Fore bay Concrete	U182		RiskPert(S182,R182,T182,RiskName(B182&C182&H182))	756196.6	854222.1	$1,008,262.00
41JC BoylePlace Concrete Plugs at Tunnel Portals	U183		RiskPert(S183,R183,T183,RiskName(B183&C183&H183))	51815.16	54542.28	$57,269.39
41JC BoyleRemove Head gate Control Building at Flume Entrance	U185		RiskPert(S185,R185,T185,RiskName(B185&C185&H185))	50155.08	56192.27	$64,087.05
41JC BoyleRemove Fore bay Spillway Gate House	U186		RiskPert(S186,R186,T186,RiskName(B186&C186&H186))	55104.99	62248.23	$73,473.33
41JC BoyleRemove Fore bay Control Building	U187		RiskPert(S187,R187,T187,RiskName(B187&C187&H187))	54810.8	61915.9	$73,081.06
41JC BoyleRemove Insulated Generator Building next to Fore bay Control Building	U188		RiskPert(S188,R188,T188,RiskName(B188&C188&H188))	15151.93	17116.07	$20,202.57
41JC BoyleRemove Fixed Wheel Gate (gate, Frame, and Hoist)	U189		RiskPert(S189,R189,T189,RiskName(B189&C189&H189))	26177.9	32995.07	$40,902.97
41JC BoyleRemove Trash rack and trash rake (steel)	U190		RiskPert(S190,R190,T190,RiskName(B190&C190&H190))	34238.27	43154.48	$53,497.29
41JC BoyleRemove stop Logs and slots (steel)	U191		RiskPert(S191,R191,T191,RiskName(B191&C191&H191))	108699.4	123796.5	$150,971.40
41JC BoyleRemove Traveling Water Screen	U192		RiskPert(S192,R192,T192,RiskName(B192&C192&H192))	63282.28	72071.48	$87,892.05
41JC BoyleRemove Fish By-Pass and Supports (steel)	U193		RiskPert(S193,R193,T193,RiskName(B193&C193&H193))	474783.1	531932.9	$606,667.30
41JC BoyleRemove Gates and Hoists	U194		RiskPert(S194,R194,T194,RiskName(B194&C194&H194))	8460.21	10202.01	$12,939.14

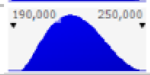
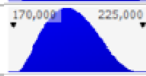
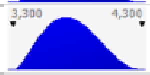
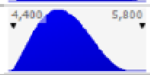
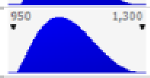
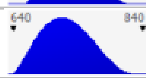
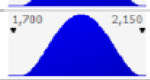
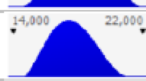
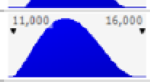
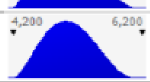
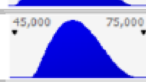
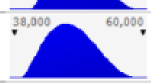
41JC BoyleRemove Trash rack and trash rake (steel)	U195		RiskPert(S195,R195,T195,RiskName(B195&C195&H195))	26997.64	32555.97	$41,290.50
41JC BoyleRemove stop Logs and slots (steel)	U196		RiskPert(S196,R196,T196,RiskName(B196&C196&H196))	22150.77	26711.22	$33,877.64
41JC BoyleRemove & Dispose Penstocks and bifurcation (steel)	U197		RiskPert(S197,R197,T197,RiskName(B197&C197&H197))	1063430	1261519	$1,501,312.00
41JC BoyleRemove & Dispose Surge Tank (steel)	U198		RiskPert(S198,R198,T198,RiskName(B198&C198&H198))	65242.39	74907.93	$94,239.02
41JC BoyleRemove & Dispose 2 - 108" Butterfly valves	U199		RiskPert(S199,R199,T199,RiskName(B199&C199&H199))	111198.2	127672	$160,619.60
41JC BoyleRemove & Dispose Gate, Stem and Frame	U200		RiskPert(S200,R200,T200,RiskName(B200&C200&H200))	20129.42	22738.79	$26,839.23
41JC BoyleRemove & Dispose of Steel Transition Manifolds on Upstream and Downstream	U201		RiskPert(S201,R201,T201,RiskName(B201&C201&H201))	153806.7	185472.8	$235,233.70
41JC BoyleRemove petroleum products from Mechanical Equipment	U202		RiskPert(S202,R202,T202,RiskName(B202&C202&H202))	6008.49	7245.53	$9,189.45

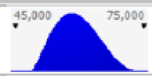
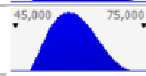
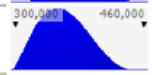
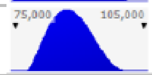
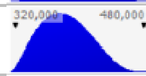
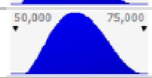
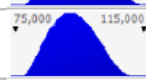
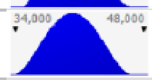
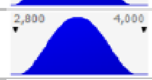
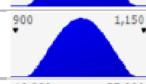
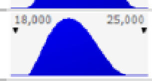
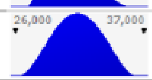
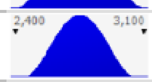
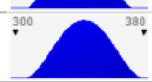
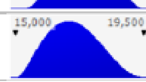
Name	Cell	Graph	Function	Min	Mean	Max
41JC BoyleRemove petroleum products from Mechanical Equipment	U202		RiskPert(S202,R202,T202,RiskName(B202&C202&H202))	6008.49	7245.53	$9,189.45
41JC BoyleClear and Grub Disposal Area (Embankment)	U203		RiskPert(S203,R203,T203,RiskName(B203&C203&H203))	131152.5	145725	$160,297.50
41JC BoyleClear and Grub, 40' width	U204		RiskPert(S204,R204,T204,RiskName(B204&C204&H204))	31476.6	34974	$38,471.39
41JC Boyle4" thick gravel surfacing	U205		RiskPert(S205,R205,T205,RiskName(B205&C205&H205))	64551.57	71723.96	$78,896.36
41JC BoyleSoil Cover over Concrete Rubble	U206		RiskPert(S206,R206,T206,RiskName(B206&C206&H206))	113738.5	128482.4	$151,651.40
41JC BoyleEmbankment Fill in Waste way (Fore bay) Scour Hole	U207		RiskPert(S207,R207,T207,RiskName(B207&C207&H207))	4366807	4852008	$5,337,209.00
41JC BoyleTopsy Recreational Area - Concrete total	U208		RiskPert(S208,R208,T208,RiskName(B208&C208&H208))	33039.63	35068.38	$38,256.42
41JC BoyleTopsy Recreational Area - 6'x80' Floating dock made of lumber and composite decking	U209		RiskPert(S209,R209,T209,RiskName(B209&C209&H209))	9421.17	9917.02	$10,412.88
41JC BoyleTopsy Recreational Area - 5'x20' Walkway leading to hex fishing platform	U210		RiskPert(S210,R210,T210,RiskName(B210&C210&H210))	2142.27	2255.02	$2,367.78
41JC BoyleTopsy Recreational Area - Regrade to natural contour	U211		RiskPert(S211,R211,T211,RiskName(B211&C211&H211))	4691.34	4979.41	$5,432.08
41JC BoylePioneer Park - Picnic tables to be removed and hauled away	U212		RiskPert(S212,R212,T212,RiskName(B212&C212&H212))	2008.42	2114.13	$2,219.84
41JC BoylePioneer Park - 12 Concrete fire rings	U213		RiskPert(S213,R213,T213,RiskName(B213&C213&H213))	1890.88	1990.4	$2,089.92
41JC BoylePioneer Park - Portable toilets to be removed and hauled away	U214		RiskPert(S214,R214,T214,RiskName(B214&C214&H214))	2142.27	2255.02	$2,367.78
41JC BoylePioneer Park - Signs to be removed and hauled away	U215		RiskPert(S215,R215,T215,RiskName(B215&C215&H215))	904.8	952.42	$1,000.04
41JC BoylePioneer Park - Dumpster to be removed and hauled away	U216		RiskPert(S216,R216,T216,RiskName(B216&C216&H216))	3007.8	3369.85	$3,843.30
41JC BoylePioneer Park - Regrade to natural contour	U217		RiskPert(S217,R217,T217,RiskName(B217&C217&H217))	8888.86	9876.51	$10,864.16
41JC BoyleRemove Frame dead end structures 60-80 ft high	U218		RiskPert(S218,R218,T218,RiskName(B218&C218&H218))	14378.98	16242.92	$19,171.97
41JC BoyleRemove (incl foundation) and Save Transformers 230KV	U219		RiskPert(S219,R219,T219,RiskName(B219&C219&H219))	5443.96	6099.25	$6,956.17
41JC BoyleRemove (incl foundation) and Save Power Circuit Breakers 230KV	U220		RiskPert(S220,R220,T220,RiskName(B220&C220&H220))	7781.33	8259.13	$9,009.96
41JC BoyleSubstation Tie Structure 230KV	U221		RiskPert(S221,R221,T221,RiskName(B221&C221&H221))	41995.5	47050.51	$53,660.91
41JC BoyleRemove Chain Link Fence	U222		RiskPert(S222,R222,T222,RiskName(B222&C222&H222))	10770.47	11967.19	$13,163.91
41JC BoyleDemolish overhead distribution 2.5 miles (30-45 poles)	U223		RiskPert(S223,R223,T223,RiskName(B223&C223&H223))	52846.43	59696.89	$70,461.91
41JC BoyleInstall 230kV strain transmission structures outside JC Boyle Substation	U224		RiskPert(S224,R224,T224,RiskName(B224&C224&H224))	267756.4	302465.6	$357,008.50

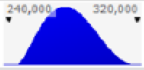
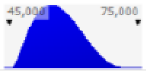
Copco 1

Name	Cell	Graph	Function	Min	Mean	Max
41Copco 1Furnish, Install, and Remove Barge-Mounted Crane in Reservoir for Dam Removal	U226		RiskPert(S226,R226,T226,RiskName(B226&C226&H226))	194197.5	221169.3	$269,718.70
41Copco 1Remove Sediment from Diversion Tunnel Intake to provide access	U227		RiskPert(S227,R227,T227,RiskName(B227&C227&H227))	104315.9	117838.3	$139,087.80
41Copco 1Furnish, Install, and Remove Large Crane on Right Abutment	U228		RiskPert(S228,R228,T228,RiskName(B228&C228&H228))	541999.8	637646.8	$733,293.90
41Copco 1Remove Water from behind Tailrace Cofferdam	U229		RiskPert(S229,R229,T229,RiskName(B229&C229&H229))	2117.36	2372.23	$2,705.52
41Copco 1Riprap Protection on Cofferdam	U230		RiskPert(S230,R230,T230,RiskName(B230&C230&H230))	36869.28	43737.08	$52,050.74
41Copco 1Provide Dewatering behind Tailrace Cofferdam	U231		RiskPert(S231,R231,T231,RiskName(B231&C231&H231))	90995.34	102791	$121,327.10
41Copco 1Remove Current Diversion Tunnel Plug	U232		RiskPert(S232,R232,T232,RiskName(B232&C232&H232))	274485	310066.4	$365,980.00
41Copco 1Construct Embankment Cofferdam in Tailrace	U233		RiskPert(S233,R233,T233,RiskName(B233&C233&H233))	269201	319346.3	$380,048.50
41Copco 1Installation of 3 each 72" Blind Flanges	U234		RiskPert(S234,R234,T234,RiskName(B234&C234&H234))	1259357	1518637	$1,926,076.00
41Copco 1Installation of 16.5 X 18.5 Roller Gate and Gate Structure	U235		RiskPert(S235,R235,T235,RiskName(B235&C235&H235))	3918386	4725112	$5,992,825.00
41Copco 1Removal of 16.5 X 18.5 Roller Gate and Gate Structure	U236		RiskPert(S236,R236,T236,RiskName(B236&C236&H236))	259671.6	313133.4	$397,144.80
41Copco 1Remove Concrete Dam down to Elev. 2476	U237		RiskPert(S237,R237,T237,RiskName(B237&C237&H237))	8286845	9361065	$11,049,130.00
41Copco 1Remove Concrete Intake Structure on Right Abutment	U238		RiskPert(S238,R238,T238,RiskName(B238&C238&H238))	6957508	8253515	$9,822,364.00
41Copco 1Remove Structural Steel from Spillway	U239		RiskPert(S239,R239,T239,RiskName(B239&C239&H239))	66603.52	79663.04	$97,946.36
41Copco 1Install Diversion Tunnel Plugs	U240		RiskPert(S240,R240,T240,RiskName(B240&C240&H240))	40401.06	45264.15	$51,623.58
41Copco 1Remove Diversion Tunnel Control Structure Concrete	U241		RiskPert(S241,R241,T241,RiskName(B241&C241&H241))	81895.9	92512.03	$109,194.50
41Copco 1Remove & Dispose of Hand Rails	U242		RiskPert(S242,R242,T242,RiskName(B242&C242&H242))	14264.8	16921.96	$20,138.54
41Copco 1Remove & Dispose of Radial Gates	U243		RiskPert(S243,R243,T243,RiskName(B243&C243&H243))	158049.3	180000.6	$219,513.00
41Copco 1Remove & Dispose Radial Gate Stop logs	U244		RiskPert(S244,R244,T244,RiskName(B244&C244&H244))	19363.19	22052.53	$26,893.32
41Copco 1Remove & Dispose Stop log hoist, track and supports	U245		RiskPert(S245,R245,T245,RiskName(B245&C245&H245))	27174.14	30948.32	$37,741.86
41Copco 1Remove & Dispose of 3 sections of 23' of 72" Dia. steel lining (embedded)	U246		RiskPert(S246,R246,T246,RiskName(B246&C246&H246))	53888.25	63926.26	$76,077.53
41Copco 1Remove & Dispose of 3 - 72" butterfly valves (embedded)	U247		RiskPert(S247,R247,T247,RiskName(B247&C247&H247))	61039.71	68387.09	$77,995.19
41Copco 1Remove & Dispose of 3 - 72" flapper valves with remote mechanical	U248		RiskPert(S248,R248,T248,RiskName(B248&C248&H248))	437452.6	490108.9	$558,967.10
41Copco 1Remove & Dispose of Spillway gate motor & control panel	U249		RiskPert(S249,R249,T249,RiskName(B249&C249&H249))	1334.95	1495.64	$1,705.77

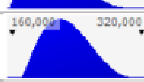
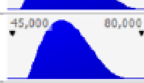
Name	Cell	Graph	Function	Min	Mean	Max
41Copco 1Remove & Dispose Distribution equipment, panelboards	U250		RiskPert(S250,R250,T250,RiskName(B250&C250&H250))	5950.3	6721.64	$7,933.73
41Copco 1Remove Powerhouse Concrete down to top of rock under the Powerhouse	U251		RiskPert(S251,R251,T251,RiskName(B251&C251&H251))	1148636	1373859	$1,689,171.00
41Copco 1Remove Powerhouse Structural Steel	U252		RiskPert(S252,R252,T252,RiskName(B252&C252&H252))	107266.7	127247.8	$151,435.30
41Copco 1Remove & Dispose of 2 - Governor Oil Systems	U253		RiskPert(S253,R253,T253,RiskName(B253&C253&H253))	41022.27	46719.81	$56,975.38
41Copco 1Remove & Dispose of Cooling water and bearing oil systems	U254		RiskPert(S254,R254,T254,RiskName(B254&C254&H254))	35139.87	39695.04	$46,853.15
41Copco 1Remove & Dispose of 4 - Horizontal Tandem Francis Turbines	U255		RiskPert(S255,R255,T255,RiskName(B255&C255&H255))	366617.7	414142.2	$488,823.60
41Copco 1Remove & Dispose of 2 - 40 Ton indoor cranes	U256		RiskPert(S256,R256,T256,RiskName(B256&C256&H256))	99381.76	117894	$140,303.70
41Copco 1Remove & Dispose of Compressed Air System	U257		RiskPert(S257,R257,T257,RiskName(B257&C257&H257))	1009.42	1130.93	$1,289.82
41Copco 1Remove & Dispose of 2 - CO2 Systems	U258		RiskPert(S258,R258,T258,RiskName(B258&C258&H258))	3291.93	3688.18	$4,206.35
41Copco 1Remove & Dispose of Plant Water and Fire Protection	U259		RiskPert(S259,R259,T259,RiskName(B259&C259&H259))	3554.73	4015.53	$4,739.65
41Copco 1Remove & Dispose of Transformer Oil Fire Protection	U260		RiskPert(S260,R260,T260,RiskName(B260&C260&H260))	6667.14	7531.4	$8,889.52
41Copco 1Remove & Dispose of Unwatering Piping	U261		RiskPert(S261,R261,T261,RiskName(B261&C261&H261))	18872.04	22572.44	$27,753.00
41Copco 1Remove & Dispose of Drainage Piping	U262		RiskPert(S262,R262,T262,RiskName(B262&C262&H262))	4973.82	5949.08	$7,314.45
41Copco 1Remove petroleum products from mechanical equipment	U263		RiskPert(S263,R263,T263,RiskName(B263&C263&H263))	5557.58	6226.54	$7,101.35
41Copco 1Remove & Dispose of Horizontal AC Generator, Indoor Open Frame	U264		RiskPert(S264,R264,T264,RiskName(B264&C264&H264))	73989.06	87771.34	$104,455.10
41Copco 1Remove & Dispose of Excitation equipment for 12.5 MVA Generator	U265		RiskPert(S265,R265,T265,RiskName(B265&C265&H265))	12151.23	14533.82	$17,869.45
41Copco 1Remove & Dispose of Surge protection equip. for 12.5 MVA Generator	U266		RiskPert(S266,R266,T266,RiskName(B266&C266&H266))	4789.2	5775.21	$7,324.66
41Copco 1Remove & Dispose of Neutral grounding equip. for 12.5 MVA Generator	U267		RiskPert(S267,R267,T267,RiskName(B267&C267&H267))	4722.21	5290.62	$6,033.93
41Copco 1Remove & Dispose of Generator Switchgear, 5kV-includes unit breakers	U268		RiskPert(S268,R268,T268,RiskName(B268&C268&H268))	20921.89	23440.27	$26,733.53
41Copco 1Remove & Dispose of Station Service Switchgear, 600 volt - (5 sections)	U269		RiskPert(S269,R269,T269,RiskName(B269&C269&H269))	11451.14	12829.52	$14,632.02
41Copco 1Remove & Dispose of Unit and plant control switchboard	U270		RiskPert(S270,R270,T270,RiskName(B270&C270&H270))	6185.95	6930.56	$7,904.27
41Copco 1Remove & Dispose of Battery System	U271		RiskPert(S271,R271,T271,RiskName(B271&C271&H271))	20894.08	23409.11	$26,697.99
41Copco 1Remove & Dispose of Raceways, Conduit and Cable	U272		RiskPert(S272,R272,T272,RiskName(B272&C272&H272))	17293.92	19375.6	$22,097.79
41Copco 1Remove & Dispose of Misc. power & control boards	U273		RiskPert(S273,R273,T273,RiskName(B273&C273&H273))	7031.91	7878.35	$8,985.22

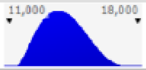
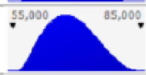
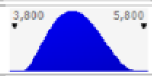
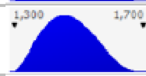
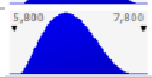
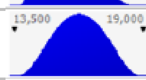
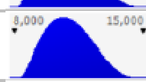
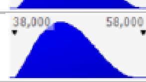
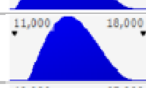
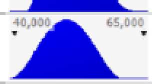
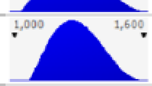
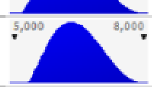
Name	Cell	Graph	Function	Min	Mean	Max
41Copco 1Remove & Dispose of Misc. power & control boards	U273		RiskPert(S273,R273,T273,RiskName(B273&C273&H273))	7031.91	7878.35	$8,985.22
41Copco 1Remove & Dispose of Step-up Transformers, indoor, oil-filled, 1-phase, 5000kVA	U274		RiskPert(S274,R274,T274,RiskName(B274&C274&H274))	195404.3	218925.1	$249,683.20
41Copco 1Remove & Dispose of Step-up Transformers, indoor, oil-filled, 1-phase, 4165kVA	U275		RiskPert(S275,R275,T275,RiskName(B275&C275&H275))	173884.2	194814.8	$222,185.40
41Copco 1Remove & Dispose of Seven 40-Ton Travelling Crane motors - hoist	U276		RiskPert(S276,R276,T276,RiskName(B276&C276&H276))	3347.62	3750.57	$4,277.51
41Copco 1Remove & Dispose of 40-Ton Travelling Crane control equipment	U277		RiskPert(S277,R277,T277,RiskName(B277&C277&H277))	4418.64	4950.51	$5,646.04
41Copco 1Remove & Dispose of 40-Ton Travelling Crane Festoon Cable	U278		RiskPert(S278,R278,T278,RiskName(B278&C278&H278))	1553.84	1755.26	$2,071.79
41Copco 1Remove & Dispose of Four 15-Ton Overhead Crane Motors - hoist	U279		RiskPert(S279,R279,T279,RiskName(B279&C279&H279))	971.41	1097.34	$1,295.22
41Copco 1Remove & Dispose of 15-Ton Overhead Crane control equipment	U280		RiskPert(S280,R280,T280,RiskName(B280&C280&H280))	439.57	492.48	$561.67
41Copco 1Remove & Dispose of 15-Ton Overhead Crane Festoon Cable	U281		RiskPert(S281,R281,T281,RiskName(B281&C281&H281))	645.38	723.07	$824.66
41Copco 1Remove petroleum products from mechanical equipment	U282		RiskPert(S282,R282,T282,RiskName(B282&C282&H282))	110466.2	123763.1	$141,151.30
41Copco 1Remove & Dispose of 69kV circuit breakers, oil0 filled, PCB	U283		RiskPert(S283,R283,T283,RiskName(B283&C283&H283))	1744.25	1938.05	$2,131.85
41Copco 1Remove & Dispose of 69kV disconnect switches, group-operated	U284		RiskPert(S284,R284,T284,RiskName(B284&C284&H284))	1744.25	1938.05	$2,131.85
41Copco 1Remove & Dispose of 60-foot wood poles	U285		RiskPert(S285,R285,T285,RiskName(B285&C285&H285))	14880.77	17652.67	$21,008.14
41Copco 1Remove & Dispose of 30-foot wood cross arms	U286		RiskPert(S286,R286,T286,RiskName(B286&C286&H286))	11115.97	13186.59	$15,693.13
41Copco 1Remove & Dispose of 69-kV insulator strings	U287		RiskPert(S287,R287,T287,RiskName(B287&C287&H287))	4278.72	5075.73	$6,040.54
41Copco 1Remove & Dispose of Transmission Line No. 3	U288		RiskPert(S288,R288,T288,RiskName(B288&C288&H288))	49856.34	59632.09	$73,318.15
41Copco 1Remove & Dispose of Transmission Line No. 15	U289		RiskPert(S289,R289,T289,RiskName(B289&C289&H289))	39951.8	47785.48	$58,752.64
41Copco 1Remove & Dispose of Transmission Line No. 26-1	U290		RiskPert(S290,R290,T290,RiskName(B290&C290&H290))	2243.82	2683.78	$3,299.73
41Copco 1Remove & Dispose of Transmission Line No. 26-2	U291		RiskPert(S291,R291,T291,RiskName(B291&C291&H291))	2243.82	2683.78	$3,299.73

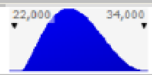
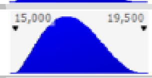
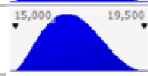
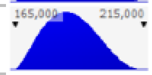
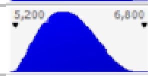
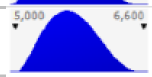
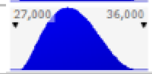
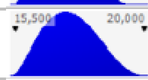
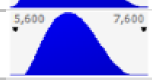
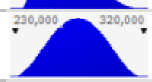
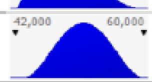
Name	Cell	Graph	Function	Min	Mean	Max
41Copco 1Remove gate house #1 from top of dam	U292		RiskPert(S292,R292,T292,RiskName(B292&C292&H292))	49603.99	59330.26	$72,947.04
41Copco 1Remove gate house #2 from top of dam	U293		RiskPert(S293,R293,T293,RiskName(B293&C293&H293))	49051.72	58669.7	$72,134.88
41Copco 1Remove Concrete Items associated with 10 ft. diam. Penstocks, reinf. Concrete	U294		RiskPert(S294,R294,T294,RiskName(B294&C294&H294))	301563.3	360693.4	$443,475.50
41Copco 1Plug 14-foot diameter penstock with concrete	U295		RiskPert(S295,R295,T295,RiskName(B295&C295&H295))	78546.57	88001.25	$100,365.10
41Copco 1Remove & Dispose of 8 screens	U296		RiskPert(S296,R296,T296,RiskName(B296&C296&H296))	21274.51	24032.32	$28,366.02
41Copco 1Remove & Dispose of 8 Water Gates	U297		RiskPert(S297,R297,T297,RiskName(B297&C297&H297))	20046.98	22645.66	$26,729.31
41Copco 1Remove & Dispose of 3 - 30" Dia. x 25' stand pipes	U298		RiskPert(S298,R298,T298,RiskName(B298&C298&H298))	5525.67	6241.96	$7,367.56
41Copco 1Remove & Dispose of 14' Dia. penstock pipe	U299		RiskPert(S299,R299,T299,RiskName(B299&C299&H299))	320503.2	383347	$471,328.30
41Copco 1Remove & Dispose of 10' Dia. penstock pipe	U300		RiskPert(S300,R300,T300,RiskName(B300&C300&H300))	354585.1	424111.6	$521,448.70
41Copco 1Site work - Clear and Grub Disposal Area	U301		RiskPert(S301,R301,T301,RiskName(B301&C301&H301))	52519.39	62302.41	$74,145.02
41Copco 1Site work - Soil Cover for Disposal Area	U302		RiskPert(S302,R302,T302,RiskName(B302&C302&H302))	78505.42	93128.98	$110,831.20
41Copco 1Mallard Cove - Concrete total	U303		RiskPert(S303,R303,T303,RiskName(B303&C303&H303))	34265.89	40312.82	$46,359.74
41Copco 1Mallard Cove - 25'x5' Dock made of composite decking and poly floats	U304		RiskPert(S304,R304,T304,RiskName(B304&C304&H304))	2877.15	3384.88	$3,892.61
41Copco 1Mallard Cove - Signs to be removed and hauled away	U306		RiskPert(S306,R306,T306,RiskName(B306&C306&H306))	925.67	1028.53	$1,131.38
41Copco 1Mallard Cove - Wood plank tables to be removed and hauled away	U307		RiskPert(S307,R307,T307,RiskName(B307&C307&H307))	925.67	1028.53	$1,131.38
41Copco 1Mallard Cove - Parking area to be regraded	U308		RiskPert(S308,R308,T308,RiskName(B308&C308&H308))	18858.25	21128.23	$24,096.66
41Copco 1Copco Cove - Concrete Total	U309		RiskPert(S309,R309,T309,RiskName(B309&C309&H309))	26651.25	31354.41	$36,057.57
41Copco 1Copco Cove - Dock abutment railing made of 2.5" dia. steel pipe	U310		RiskPert(S310,R310,T310,RiskName(B310&C310&H310))	1464.61	1627.35	$1,790.08
41Copco 1Copco Cove - Signs to be removed and hauled away	U311		RiskPert(S311,R311,T311,RiskName(B311&C311&H311))	2477.22	2752.47	$3,027.71
41Copco 1Copco Cove - Wood plank tables to be removed and hauled away	U312		RiskPert(S312,R312,T312,RiskName(B312&C312&H312))	308.56	342.84	$377.13
41Copco 1Copco Cove - Regrade	U313		RiskPert(S313,R313,T313,RiskName(B313&C313&H313))	15208.87	17039.56	$19,433.55

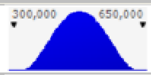
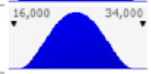
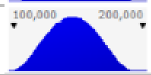
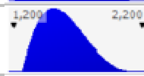
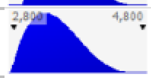
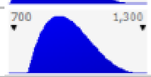
Name	Cell	Graph	Function	Min	Mean	Max
41Copco 1Diversion Tunnel Lining	U314		RiskPert(S314,R314,T314,RiskName(B314&C314&H314))	247874.9	277711.7	$316,729.10
41Copco 1Remove Frame Dead End Structures 60-80ft High @ Switch Yard	U315		RiskPert(S315,R315,T315,RiskName(B315&C315&H315))	24615.28	29683.13	$37,646.90
41Copco 1Remove Power Circuit Breakers 69KV @ Switch Yard	U316		RiskPert(S316,R316,T316,RiskName(B316&C316&H316))	11503.04	13100.69	$15,976.45
41Copco 1Remove Disconnect Switches @ Switch Yard	U317		RiskPert(S317,R317,T317,RiskName(B317&C317&H317))	39407.41	44880.66	$54,732.52
41Copco 1Remove All Associated AUX Equipment @ Switch Yard (allowance)	U318		RiskPert(S318,R318,T318,RiskName(B318&C318&H318))	49102.05	55921.78	$68,197.29
41Copco 1Remove Distribution Lines 69 KV Copco 1 Switch Yard and HE Plant (6 poles)	U319		RiskPert(S319,R319,T319,RiskName(B319&C319&H319))	8518.82	9701.98	$11,831.69
41Copco 1Remove Production Poles in General Area of Copco 1	U321		RiskPert(S321,R321,T321,RiskName(B321&C321&H321))	13097.16	15793.63	$20,030.95
41Copco 1Remove Village House Distribution Poles Near Dam (Est 10 each)	U322		RiskPert(S322,R322,T322,RiskName(B322&C322&H322))	12369.58	14916.26	$18,918.18
41Copco 1Remove 69 KV Distribution Line 1.6 Miles (30 Poles)	U323		RiskPert(S323,R323,T323,RiskName(B323&C323&H323))	60127.07	72506.17	$91,959.05
41Copco 1Remove Transmission Conductors 1.3 Miles Copco 1 to Copco 2	U325		RiskPert(S325,R325,T325,RiskName(B325&C325&H325))	46982.75	56655.67	$71,855.98

Copco 2

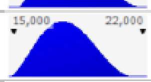
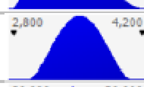
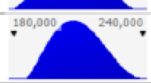
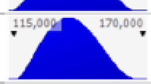
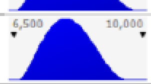
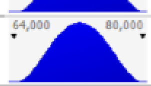
Name	Cell	Graph	Function	Min	Mean	Max
41Copco 2Construct and Remove Embankment Cofferdam-Right Side of Dam	U327		RiskPert(S327,R327,T327,RiskName(B327&C327&H327))	166544.1	215119.4	$291,452.20
41Copco 2Furnish, Install, and Remove RipRap	U328		RiskPert(S328,R328,T328,RiskName(B328&C328&H328))	54346.52	70197.59	$95,106.42
41Copco 2Provide Dewatering behind Cofferdams	U329		RiskPert(S329,R329,T329,RiskName(B329&C329&H329))	144983.6	166462.7	$209,420.80
41Copco 2Remove Water from behind Cofferdams	U330		RiskPert(S330,R330,T330,RiskName(B330&C330&H330))	5906.41	6781.43	$8,531.48
41Copco 2Construct and Remove Embankment Cofferdam-Left Side of Dam	U331		RiskPert(S331,R331,T331,RiskName(B331&C331&H331))	166296.6	218546.9	$291,019.10
41Copco 2Furnish, Install, and Remove RipRap	U332		RiskPert(S332,R332,T332,RiskName(B332&C332&H332))	41832.31	54033.4	$73,206.55
41Copco 2Provide Dewatering behind left Side Cofferdam	U333		RiskPert(S333,R333,T333,RiskName(B333&C333&H333))	80598.08	92538.54	$116,419.40
41Copco 2Remove Water from behind Cofferdams	U334		RiskPert(S334,R334,T334,RiskName(B334&C334&H334))	5418.49	6221.23	$7,826.71
41Copco 2Remove Water from behind Tailrace Cofferdam	U335		RiskPert(S335,R335,T335,RiskName(B335&C335&H335))	10414.19	11957.04	$15,042.72
41Copco 2Provide Dewatering behind Tailrace Cofferdam	U336		RiskPert(S336,R336,T336,RiskName(B336&C336&H336))	50556.99	58046.91	$73,026.76
41Copco 2Construct Embankment Cofferdam across Tailrace	U337		RiskPert(S337,R337,T337,RiskName(B337&C337&H337))	176448.3	227912.3	$308,784.40
41Copco 2Remove Concrete in Dam	U338		RiskPert(S338,R338,T338,RiskName(B338&C338&H338))	1071700	1323865	$1,828,195.00
41Copco 2Remove concrete equipment slab from top of embankment wing dam on right abutment	U339		RiskPert(S339,R339,T339,RiskName(B339&C339&H339))	1691.84	2040.16	$2,587.52
41Copco 2Remove Concrete Wing wall	U340		RiskPert(S340,R340,T340,RiskName(B340&C340&H340))	49897.74	60170.81	$76,314.20

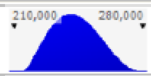
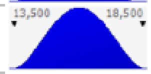
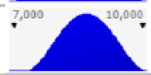
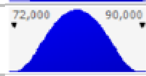
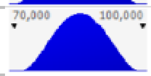
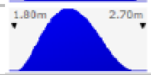
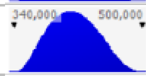
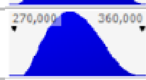
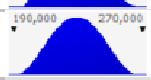
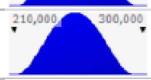
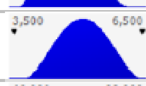
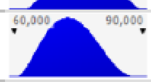
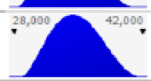
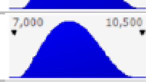
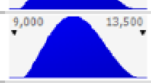
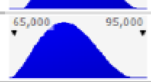
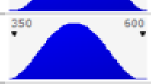
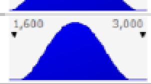
Name	Cell	Graph	Function	Min	Mean	Max
41Copco 2Right Abutment Removal - Random Fill	U341		RiskPert(S341,R341,T341,RiskName(B341&C341&H341))	75573.55	90391.89	$111,137.60
41Copco 2Right Abutment Removal - Remove Hand Placed Riprap	U342		RiskPert(S342,R342,T342,RiskName(B342&C342&H342))	11675.46	13964.77	$17,169.80
41Copco 2Right Abutment Removal - Gunite Curtain Wall	U343		RiskPert(S343,R343,T343,RiskName(B343&C343&H343))	57435.87	68697.8	$84,464.52
41Copco 2Remove & Dispose - Hand rails and Light Poles	U344		RiskPert(S344,R344,T344,RiskName(B344&C344&H344))	3999.98	4745.07	$5,647.03
41Copco 2Remove & Dispose - Radial Gates and Hoists	U345		RiskPert(S345,R345,T345,RiskName(B345&C345&H345))	51107.18	62130.3	$81,170.23
41Copco 2Remove & Dispose - 5-Radial Gate Stop logs & Slots (steel)	U346		RiskPert(S346,R346,T346,RiskName(B346&C346&H346))	85460.59	103893.3	$135,731.50
41Copco 2Remove & Dispose - Spillway intake gate motor & control panel	U347		RiskPert(S347,R347,T347,RiskName(B347&C347&H347))	1313.37	1471.46	$1,678.20
41Copco 2Remove & Dispose - Spillway radial gate motor & control panel	U348		RiskPert(S348,R348,T348,RiskName(B348&C348&H348))	1313.37	1471.46	$1,678.20
41Copco 2Remove & Dispose - Spillway trash rake motor, festoon cable & control panel	U349		RiskPert(S349,R349,T349,RiskName(B349&C349&H349))	558.13	625.32	$713.17
41Copco 2Remove & Dispose - Distribution equipment, panelboards	U350		RiskPert(S350,R350,T350,RiskName(B350&C350&H350))	5950.3	6666.54	$7,603.16
41Copco 2Remove Copper Shingles from Roof of Powerhouse	U351		RiskPert(S351,R351,T351,RiskName(B351&C351&H351))	13838.26	16280.31	$18,722.36
41Copco 2Remove Powerhouse Concrete down to spring-line of turbine	U352		RiskPert(S352,R352,T352,RiskName(B352&C352&H352))	545667.9	674060.4	$930,845.30
41Copco 2Remove Structural Steel items associated with Powerhouse	U353		RiskPert(S353,R353,T353,RiskName(B353&C353&H353))	190560.3	246140.4	$333,480.50
41Copco 2Remove Control House Concrete	U354		RiskPert(S354,R354,T354,RiskName(B354&C354&H354))	8579.07	10991.93	$14,477.18
41Copco 2Remove Control House Structural Steel Items	U355		RiskPert(S355,R355,T355,RiskName(B355&C355&H355))	2779.26	3589.88	$4,863.70
41Copco 2Remove Shop Building	U356		RiskPert(S356,R356,T356,RiskName(B356&C356&H356))	268728.1	341508.7	$436,683.20
41Copco 2Remove & Dispose - 2 - Governor oil systems	U357		RiskPert(S357,R357,T357,RiskName(B357&C357&H357))	38633.29	46208.44	$56,813.66
41Copco 2Remove & Dispose - Cooling water and bearing oil systems	U358		RiskPert(S358,R358,T358,RiskName(B358&C358&H358))	11869.83	14197.25	$17,455.64
41Copco 2Remove & Dispose - 12 - Cast Iron Columns	U360		RiskPert(S360,R360,T360,RiskName(B360&C360&H360))	40218.22	50272.77	$60,327.32
41Copco 2Remove & Dispose - 2 - Francis Turbines	U361		RiskPert(S361,R361,T361,RiskName(B361&C361&H361))	492692.5	626130	$800,625.30
41Copco 2Remove & Dispose - 2 - 40 Ton indoor cranes	U362		RiskPert(S362,R362,T362,RiskName(B362&C362&H362))	146926.3	186718.8	$238,755.30
41Copco 2Remove & Dispose - Compressed Air Systems	U363		RiskPert(S363,R363,T363,RiskName(B363&C363&H363))	1079.6	1291.28	$1,587.65
41Copco 2Remove & Dispose - 2 - CO2 Systems	U364		RiskPert(S364,R364,T364,RiskName(B364&C364&H364))	2460.27	2942.68	$3,618.05
41Copco 2Remove & Dispose - Plant Water and Fire Protection	U365		RiskPert(S365,R365,T365,RiskName(B365&C365&H365))	4181.19	5001.03	$6,148.81
41Copco 2Remove & Dispose - Transformer Oil Fire Protection	U366		RiskPert(S366,R366,T366,RiskName(B366&C366&H366))	5386.18	6442.3	$7,920.86

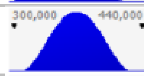
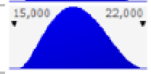
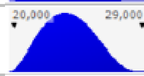
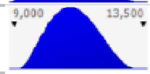
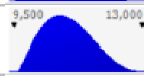
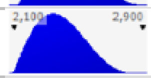
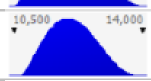
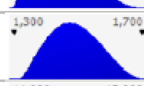
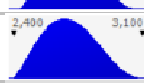
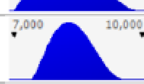
Name	Cell	Graph	Function	Min	Mean	Max
41Copco 2Remove & Dispose - Unwatering Piping	U367		RiskPert(S367,R367,T367,RiskName(B367&C367&H367))	23058.1	27579.29	$33,908.96
41Copco 2Remove & Dispose - Drainage Piping	U368		RiskPert(S368,R368,T368,RiskName(B368&C368&H368))	13267.99	15869.55	$19,511.75
41Copco 2Remove & Dispose - Petroleum Products from Mechanical Equip.	U369		RiskPert(S369,R369,T369,RiskName(B369&C369&H369))	15157.02	16981.48	$19,367.31
41Copco 2Remove & Dispose - Remove Petroleum Products at or near the Power House	U370		RiskPert(S370,R370,T370,RiskName(B370&C370&H370))	15157.02	16981.48	$19,367.31
41Copco 2Remove & Dispose - AC Generator, Indoor Vertical	U371		RiskPert(S371,R371,T371,RiskName(B371&C371&H371))	166628.1	186685.2	$212,913.60
41Copco 2Remove & Dispose - Excitation equipment for 15 MVA Generator	U372		RiskPert(S372,R372,T372,RiskName(B372&C372&H372))	16550.3	18542.47	$21,147.61
41Copco 2Remove & Dispose - Surge protection equip. for 15 MVA Generator	U373		RiskPert(S373,R373,T373,RiskName(B373&C373&H373))	5229.24	5858.68	$6,681.80
41Copco 2Remove & Dispose - Neutral grounding equip. for 15 MVA Generator	U374		RiskPert(S374,R374,T374,RiskName(B374&C374&H374))	5091.69	5704.58	$6,506.05
41Copco 2Remove & Dispose - Generator Switchgear, 7.2kV-includes unit breakers	U375		RiskPert(S375,R375,T375,RiskName(B375&C375&H375))	27678.62	31010.31	$35,367.13
41Copco 2Remove & Dispose - Station Service Switchgear, 600-volt (5 sections)	U376		RiskPert(S376,R376,T376,RiskName(B376&C376&H376))	24381.7	27316.54	$31,154.40
41Copco 2Remove & Dispose - Unit and plant control switchboard	U377		RiskPert(S377,R377,T377,RiskName(B377&C377&H377))	7645.41	8565.69	$9,769.13
41Copco 2Remove & Dispose - Battery system	U378		RiskPert(S378,R378,T378,RiskName(B378&C378&H378))	10602.84	11879.11	$13,548.08
41Copco 2Remove & Dispose - Raceways, Conduit and Cable	U379		RiskPert(S379,R379,T379,RiskName(B379&C379&H379))	15574.69	17449.42	$19,900.99
41Copco 2Remove & Dispose - Misc. Power & Control Boards	U380		RiskPert(S380,R380,T380,RiskName(B380&C380&H380))	5795.3	6492.88	$7,405.10
41Copco 2Remove & Dispose - 7 - 40-Ton Travelling Crane motors-hoist (2-30Hp)	U381		RiskPert(S381,R381,T381,RiskName(B381&C381&H381))	3592.84	4058.58	$4,790.46
41Copco 2Remove & Dispose - 40-Ton Travelling Crane control equipment	U382		RiskPert(S382,R382,T382,RiskName(B382&C382&H382))	11341.74	12811.97	$15,122.33
41Copco 2Remove & Dispose - 40-Ton Travelling Crane Festoon Cable	U383		RiskPert(S383,R383,T383,RiskName(B383&C383&H383))	2589.31	2924.97	$3,452.42
41Copco 2Remove Oil from Oil-Filled Step-up Transformers	U384		RiskPert(S384,R384,T384,RiskName(B384&C384&H384))	232965.2	274076.8	$315,188.30
41Copco 2Remove Intake Structure Concrete	U385		RiskPert(S385,R385,T385,RiskName(B385&C385&H385))	472788.1	588667.6	$834,331.90
41Copco 2Remove Concrete Items associated with 16-foot I.D. Wood Stave Pipe	U386		RiskPert(S386,R386,T386,RiskName(B386&C386&H386))	374992.7	463226.3	$639,693.50
41Copco 2Place Concrete Plugs for Tunnels	U387		RiskPert(S387,R387,T387,RiskName(B387&C387&H387))	174692.4	210658.5	$267,176.70
41Copco 2Remove & Dispose of Caterpillar Gate (steel)	U389		RiskPert(S389,R389,T389,RiskName(B389&C389&H389))	43861.63	51601.91	$59,342.20
41Copco 2Remove & Dispose of Trash rack and trash rake (steel)	U390		RiskPert(S390,R390,T390,RiskName(B390&C390&H390))	51989.57	62693.3	$79,513.45
41Copco 2Remove & Dispose of Stop Logs and slots for intake (steel)	U391		RiskPert(S391,R391,T391,RiskName(B391&C391&H391))	163303.2	196924.5	$249,757.90

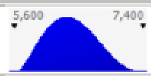
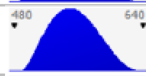
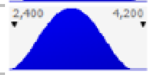
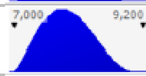
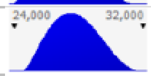
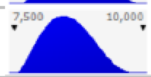
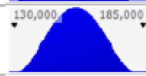
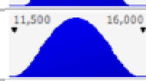
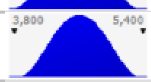
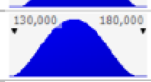
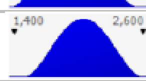
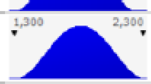
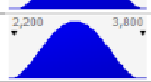
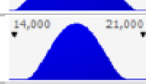
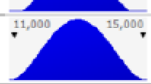
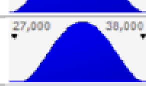
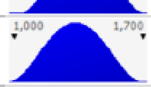
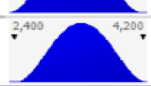
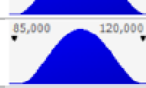
Name	Cell	Graph	Function	Min	Mean	Max
41Copco 2Remove & Dispose of Bands (steel)	U394		RiskPert(S394,R394,T394,RiskName(B394&C394&H394))	336046.6	480066.5	$624,086.40
41Copco 2Remove & Dispose of Penstock after bifurcation to butterfly valves	U395		RiskPert(S395,R395,T395,RiskName(B395&C395&H395))	728831.3	1041188	$1,353,544.00
41Copco 2Remove & Dispose of Bifurcated vent pipes and support structure	U396		RiskPert(S396,R396,T396,RiskName(B396&C396&H396))	17349.06	24784.37	$32,219.69
41Copco 2Remove & Dispose of 2 - 138" Butterfly Valves	U397		RiskPert(S397,R397,T397,RiskName(B397&C397&H397))	102288.9	146127	$189,965.10
41Copco 2Disconnect and Remove Medium Voltage Circuit Breakers 115KV @ Substation	U398		RiskPert(S398,R398,T398,RiskName(B398&C398&H398))	1297.18	1589.69	$2,136.54
41Copco 2Disconnect and Remove Medium Voltage Circuit Breakers 69KV @ Substation	U399		RiskPert(S399,R399,T399,RiskName(B399&C399&H399))	2824.62	3461.54	$4,652.31
41Copco 2Disconnect and Remove Transformers 12KV @ substation	U400		RiskPert(S400,R400,T400,RiskName(B400&C400&H400))	781	957.11	$1,286.35
41Copco 2Disconnect and Remove cable connection between Copco 2 and HE plant At substation	U401		RiskPert(S401,R401,T401,RiskName(B401&C401&H401))	9050.96	11091.86	$14,907.46
41Copco 2Remove All associated Aux Equipment @ substation (allowance)	U402		RiskPert(S402,R402,T402,RiskName(B402&C402&H402))	23123.96	28338.19	$38,086.52
41Copco 2Demolish overhead transmission line and structure 69KV Copco #1 to Iron Gate	U403		RiskPert(S403,R403,T403,RiskName(B403&C403&H403))	568821.4	697085.1	$936,882.40
41Copco 2Demolish transmission conductor from existing structure pole. Structures to Remain	U404		RiskPert(S404,R404,T404,RiskName(B404&C404&H404))	10144.44	12431.92	$16,708.50

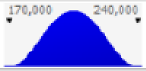
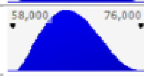
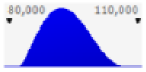
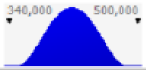
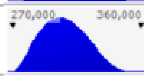
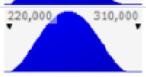
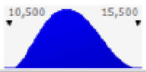
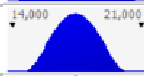
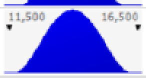
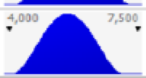
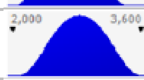
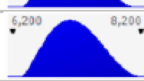
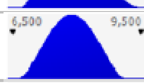
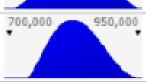
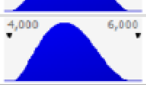
Iron Gate

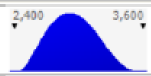
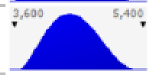
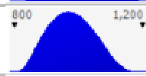
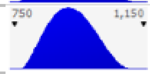
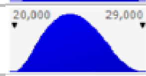
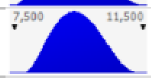
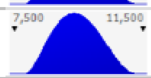
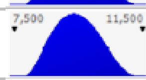
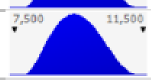
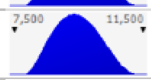
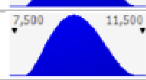
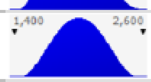
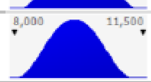
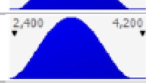
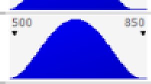
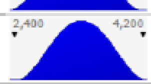
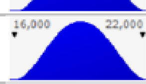
Name	Cell	Graph	Function	Min	Mean	Max
41Iron GateFurnish, Install, and Remove Barge-Mounted Crane in Reservoir	U407		RiskPert(S407,R407,T407,RiskName(B407&C407&H407))	194197.5	217573.1	$248,141.20
41Iron GateFurnish, Install, and Remove Temporary Air Vent Hose from Barge to Diversion Tunnel Intake Structure	U408		RiskPert(S408,R408,T408,RiskName(B408&C408&H408))	15080.74	17889.9	$21,290.46
41Iron GateRemove Reinforced Concrete Stoplog Structure	U410		RiskPert(S410,R410,T410,RiskName(B410&C410&H410))	10560.4	11831.56	$13,493.85
41Iron GateRemove Water from behind Tailrace Cofferdam	U411		RiskPert(S411,R411,T411,RiskName(B411&C411&H411))	2994.52	3522.97	$4,051.41
41Iron GateProvide Dewatering behind Tailrace Cofferdam for removal of Powerhouse in the dry	U412		RiskPert(S412,R412,T412,RiskName(B412&C412&H412))	28170.54	33141.8	$38,113.08
41Iron GateConstruct Embankment Cofferdam across Tailrace to remove Powerhouse in dry	U413		RiskPert(S413,R413,T413,RiskName(B413&C413&H413))	187234.8	209772.3	$239,244.40
41Iron GateUpstream Cofferdam to be Removed in the Wet	U414		RiskPert(S414,R414,T414,RiskName(B414&C414&H414))	281114.9	330723.4	$380,332.00
41Iron GateRemove 9' dia. hinged blind flange	U415		RiskPert(S415,R415,T415,RiskName(B415&C415&H415))	117959.6	139932.5	$166,531.20
41Iron GateRemove 18" plug valve and 7' of 18" drainage pipe	U416		RiskPert(S416,R416,T416,RiskName(B416&C416&H416))	6751.37	8008.98	$9,531.35
41Iron GateFurnish and Install 1-16.5'x18' roller gate, stem, and operator in Wet	U417		RiskPert(S417,R417,T417,RiskName(B417&C417&H417))	3804057	4226730	$4,649,403.00
41Iron GateRemove Existing sluice and diversion gates from shaft by divers	U418		RiskPert(S418,R418,T418,RiskName(B418&C418&H418))	488298.2	542553.5	$596,808.90
41Iron GateRemove 16.5'X 18' sluice and diversion gates from shaft in Dry	U419		RiskPert(S419,R419,T419,RiskName(B419&C419&H419))	65010.53	72233.92	$79,457.31
41Iron GateRemove Concrete in Observation Platform, Crest Wall and Wall Extension	U420		RiskPert(S420,R420,T420,RiskName(B420&C420&H420))	235956.9	262174.3	$288,391.80

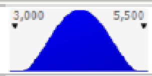
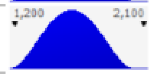
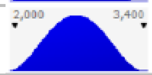
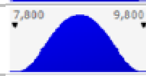
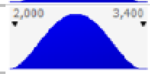
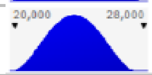
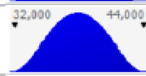
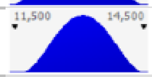
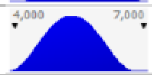
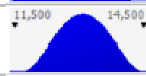
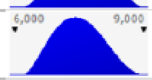
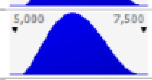
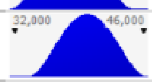
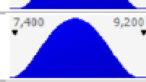
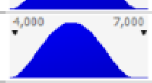
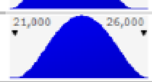
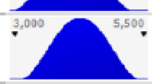
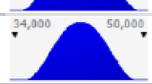
Name	Cell	Graph	Function	Min	Mean	Max
41Iron GateRemove Concrete in Diversion Tunnel Intake Structure	U421		RiskPert(S421,R421,T421,RiskName(B421&C421&H421))	217197.4	243341.5	$277,530.00
41Iron GateRemove Concrete in Diversion Tunnel Gate Tower	U422		RiskPert(S422,R422,T422,RiskName(B422&C422&H422))	122202.4	143767.5	$165,332.60
41Iron GateRemove Steel Footbridge to Gate Tower	U423		RiskPert(S423,R423,T423,RiskName(B423&C423&H423))	13633.44	16039.34	$18,445.24
41Iron GateRemove Concrete in Diversion Tunnel Footbridge Abutment	U424		RiskPert(S424,R424,T424,RiskName(B424&C424&H424))	7381.19	8683.75	$9,986.32
41Iron GatePlace Concrete Plugs for Diversion Tunnel	U425		RiskPert(S425,R425,T425,RiskName(B425&C425&H425))	72790.67	80878.53	$88,966.38
41Iron GateRemove Concrete Closure Gates in Gate Tower	U426		RiskPert(S426,R426,T426,RiskName(B426&C426&H426))	72664.06	85487.13	$98,310.20
41Iron GateRemove Upstream Riprap	U427		RiskPert(S427,R427,T427,RiskName(B427&C427&H427))	1859375	2205729	$2,625,000.00
41Iron GateRemove Downstream Riprap	U428		RiskPert(S428,R428,T428,RiskName(B428&C428&H428))	349829.1	414993.4	$493,876.40
41Iron GateMiscellaneous Excavation	U429		RiskPert(S429,R429,T429,RiskName(B429&C429&H429))	1735814	2059152	$2,450,561.00
41Iron GateMiscellaneous Excavation	U430		RiskPert(S430,R430,T430,RiskName(B430&C430&H430))	11317570	13425740	$15,977,740.00
41Iron GateCutoff Wall Concrete Demolition	U431		RiskPert(S431,R431,T431,RiskName(B431&C431&H431))	278744.4	312297	$356,173.40
41Iron GateEarth Fill Crest Raise	U432		RiskPert(S432,R432,T432,RiskName(B432&C432&H432))	194899	229293	$263,687.00
41Iron GateSheet pile Crest Raise	U433		RiskPert(S433,R433,T433,RiskName(B433&C433&H433))	215078.8	253033.8	$290,988.90
41Iron GateRemove 5 Monitoring Wells	U434		RiskPert(S434,R434,T434,RiskName(B434&C434&H434))	11808.42	13229.8	$15,088.53
41Iron GateRemove and Dispose of Trash Sluice Gate - 10 ft x 9 ft H	U435		RiskPert(S435,R435,T435,RiskName(B435&C435&H435))	3833.76	5111.68	$6,389.60
41Iron GateRemove and Dispose of Intake Structure	U436		RiskPert(S436,R436,T436,RiskName(B436&C436&H436))	61826.99	73343.78	$87,285.16
41Iron GateRemove and Dispose of Sluice and Diversion Tunnel Gate	U437		RiskPert(S437,R437,T437,RiskName(B437&C437&H437))	29304.43	34763.09	$41,370.96
41Iron GateRemove and Dispose of Hoist Stem - 6" Dia. Sch 160x150'	U438		RiskPert(S438,R438,T438,RiskName(B438&C438&H438))	7245.46	8595.1	$10,228.88
41Iron GateRemove and Dispose of Air Vent Pipe - 8" Dia. Sch 40 x160'	U439		RiskPert(S439,R439,T439,RiskName(B439&C439&H439))	9422.65	11177.85	$13,302.57
41Iron GateRemove and Dispose of Air Vent Pipe - 12" Dia. Sch 40 x560'	U440		RiskPert(S440,R440,T440,RiskName(B440&C440&H440))	65354.76	77528.69	$92,265.55
41Iron GateRemove and Dispose of Outlet Works Stop Logs	U441		RiskPert(S441,R441,T441,RiskName(B441&C441&H441))	2274.7	3032.93	$3,791.16
41Iron GateRemove and Dispose of Hydraulic Pump Motor (10 HP est) & control panel	U442		RiskPert(S442,R442,T442,RiskName(B442&C442&H442))	350.8	467.74	$584.67
41Iron GateRemove and Dispose of Distribution Equipment, Junction Boxes	U443		RiskPert(S443,R443,T443,RiskName(B443&C443&H443))	1703.89	2271.86	$2,839.82
41Iron GateRemove and Dispose of Power Cable and 4" Conduit from Penstock Structure	U444		RiskPert(S444,R444,T444,RiskName(B444&C444&H444))	38137.33	44867.45	$51,597.56

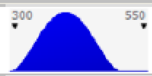
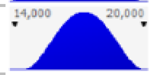
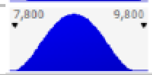
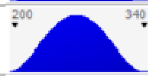
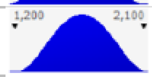
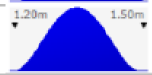
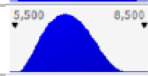
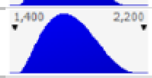
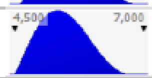
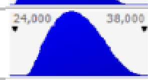
Name	Cell	Graph	Function	Min	Mean	Max
41Iron GateRemove Powerhouse Concrete	U445		RiskPert(S445,R445,T445,RiskName(B445&C445&H445))	2118164	2373128	$2,706,543.00
41Iron GateRemove and Dispose of Turbine Unit	U446		RiskPert(S446,R446,T446,RiskName(B446&C446&H446))	313213.6	368486.6	$423,759.50
41Iron GateRemove and Dispose of Draft Tube Bulkheads	U447		RiskPert(S447,R447,T447,RiskName(B447&C447&H447))	15523.22	18414.8	$21,915.13
41Iron GateRemove and Dispose of Crane	U448		RiskPert(S448,R448,T448,RiskName(B448&C448&H448))	24494.88	29297.8	$36,021.89
41Iron GateRemove and Dispose of Governor	U449		RiskPert(S449,R449,T449,RiskName(B449&C449&H449))	20110.76	23856.88	$28,391.66
41Iron GateRemove and Dispose of Bearing Oil System and Cooling Water System	U450		RiskPert(S450,R450,T450,RiskName(B450&C450&H450))	9332.82	11071.29	$13,175.75
41Iron GateRemove and Dispose of CO2 Systems	U451		RiskPert(S451,R451,T451,RiskName(B451&C451&H451))	2635.77	2977.44	$3,514.35
41Iron GateRemove and Dispose of Plant Water and Fire Protection System	U452		RiskPert(S452,R452,T452,RiskName(B452&C452&H452))	9714.38	10973.65	$12,952.51
41Iron GateRemove and Dispose of Sump Pumps	U453		RiskPert(S453,R453,T453,RiskName(B453&C453&H453))	2117.71	2392.23	$2,823.61
41Iron GateRemove and Dispose of Pumps	U454		RiskPert(S454,R454,T454,RiskName(B454&C454&H454))	24382.46	27543.15	$32,509.94
41Iron GateRemove and Dispose of Exposed Piping Around the Plant	U455		RiskPert(S455,R455,T455,RiskName(B455&C455&H455))	20536.19	23198.28	$27,381.58
41Iron GateRemove and Dispose of Unwatering Piping	U456		RiskPert(S456,R456,T456,RiskName(B456&C456&H456))	17176.54	19244.09	$21,947.80
41Iron GateRemove and Dispose of Drainage Piping	U457		RiskPert(S457,R457,T457,RiskName(B457&C457&H457))	10788.88	12087.55	$13,785.80
41Iron GateRemove and Dispose of Transformer Oil and Fire Protection	U458		RiskPert(S458,R458,T458,RiskName(B458&C458&H458))	9829.98	10433.57	$11,382.08
41Iron GateRemove and Dispose of Compressed Air System	U459		RiskPert(S459,R459,T459,RiskName(B459&C459&H459))	1329.06	1489.04	$1,698.25
41Iron GateRemove & Dispose - Petroleum Products from Mechanical Equip.	U460		RiskPert(S460,R460,T460,RiskName(B460&C460&H460))	11815.71	12541.24	$13,681.35
41Iron GateRemove and Dispose of AC Generator, Outdoor Horizontal	U461		RiskPert(S461,R461,T461,RiskName(B461&C461&H461))	92287.2	103395.9	$117,922.50
41Iron GateRemove and Dispose of Excitation equipment for 18.975 MVA Generator	U462		RiskPert(S462,R462,T462,RiskName(B462&C462&H462))	2414.25	2704.86	$3,084.88
41Iron GateRemove and Dispose of Surge protection equip. for 18.975 MVA Generator	U463		RiskPert(S463,R463,T463,RiskName(B463&C463&H463))	1914.46	2144.9	$2,446.25
41Iron GateRemove and Dispose of Neutral grounding equip. for 18.975 MVA Generator	U464		RiskPert(S464,R464,T464,RiskName(B464&C464&H464))	4029.6	4514.64	$5,148.93
41Iron GateRemove and Dispose of Station Service Switchgear, 600 volt - (5 sections)	U465		RiskPert(S465,R465,T465,RiskName(B465&C465&H465))	7470.29	8369.5	$9,545.38
41Iron GateRemove and Dispose of Unit and plant control switchboard	U466		RiskPert(S466,R466,T466,RiskName(B466&C466&H466))	24245.35	27163.77	$30,980.17
41Iron GateRemove and Dispose of Battery System - assume 60 batteries, charger	U467		RiskPert(S467,R467,T467,RiskName(B467&C467&H467))	15540.22	17410.81	$19,856.95
41Iron GateRemove and Dispose of Raceways, Bus, Conduit and Cable	U468		RiskPert(S468,R468,T468,RiskName(B468&C468&H468))	18579.86	20816.33	$23,740.94

Name	Cell	Graph	Function	Min	Mean	Max
41Iron GateRemove and Dispose of Misc. power & control boards	U469		RiskPert(S469,R469,T469,RiskName(B469&C469&H469))	5712.68	6400.32	$7,299.54
41Iron GateRemove and Dispose of Governor Oil Pump Motors (10 hp and 20 hp est.)	U471		RiskPert(S471,R471,T471,RiskName(B471&C471&H471))	495.05	554.64	$632.57
41Iron GateRemove and Dispose of Vertical Motors, outdoor, (480V, 100 HP est.)	U472		RiskPert(S472,R472,T472,RiskName(B472&C472&H472))	2405.5	3207.33	$4,009.16
41Iron GateRemove and Dispose of Step-up Transformer, outdoor, oil-filled, 3-phase	U474		RiskPert(S474,R474,T474,RiskName(B474&C474&H474))	86600.01	97024.09	$110,655.60
41Iron GateRemove and Dispose of Lattice steel structure, with 69-kV disconnect	U475		RiskPert(S475,R475,T475,RiskName(B475&C475&H475))	7060.15	7909.99	$9,021.31
41Iron GateRemove and Dispose of Generator Switchgear, outdoor, 7.2kV	U476		RiskPert(S476,R476,T476,RiskName(B476&C476&H476))	24790.72	27774.79	$31,677.03
41Iron GateRemove and Dispose of Single Phase Pole Transformers (25 kVA est.)	U477		RiskPert(S477,R477,T477,RiskName(B477&C477&H477))	7636.08	8555.24	$9,757.21
41Iron GateRemove Concrete in Penstock Intake Structure	U478		RiskPert(S478,R478,T478,RiskName(B478&C478&H478))	133064.3	156546.3	$180,028.20
41Iron GateRemove Concrete in Penstock Encasement	U479		RiskPert(S479,R479,T479,RiskName(B479&C479&H479))	215754.3	241724.8	$275,686.10
41Iron GateRemove Concrete in 3 Penstock Anchors and 7 Penstock Supports	U480		RiskPert(S480,R480,T480,RiskName(B480&C480&H480))	888667	1045491	$1,202,314.00
41Iron GateRemove Steel Footbridge to Intake Structure	U481		RiskPert(S481,R481,T481,RiskName(B481&C481&H481))	11627.99	13679.99	$15,731.99
41Iron GateRemove Concrete in Intake Structure Footbridge Abutment	U482		RiskPert(S482,R482,T482,RiskName(B482&C482&H482))	3922.92	4615.2	$5,307.48
41Iron GateRemove and Dispose of Intake Structure	U483		RiskPert(S483,R483,T483,RiskName(B483&C483&H483))	130418	153433	$176,447.90
41Iron GateRemove and Dispose of Gate Hoist Stem - 6" Sch160x40'	U484		RiskPert(S484,R484,T484,RiskName(B484&C484&H484))	1533.5	2044.67	$2,555.84
41Iron GateRemove and Dispose of Water Fill line- 12" Dia STD x 27'	U485		RiskPert(S485,R485,T485,RiskName(B485&C485&H485))	1150.13	1533.5	$1,916.88
41Iron GateRemove and Dispose of Air Vent - 12" Dia STD x 32'	U486		RiskPert(S486,R486,T486,RiskName(B486&C486&H486))	1363.11	1817.49	$2,271.86
41Iron GateRemove and Dispose of Gage Wells	U487		RiskPert(S487,R487,T487,RiskName(B487&C487&H487))	2225.28	2967.05	$3,708.81
41Iron GateRemove and Dispose of Penstock Vent - 46" Dia, 0.25" Thick x 60'	U488		RiskPert(S488,R488,T488,RiskName(B488&C488&H488))	14788.02	17397.67	$20,007.32
41Iron GateRemove and Dispose of Penstock - 12" Dia, 0.25" Thick x 698'	U489		RiskPert(S489,R489,T489,RiskName(B489&C489&H489))	414064.5	487134.8	$560,204.90
41Iron GateRemove and Dispose of Bypass Outlet - 96" Dia, 0.25" Thick x 50'	U490		RiskPert(S490,R490,T490,RiskName(B490&C490&H490))	11040.59	12988.93	$14,937.27
41Iron GateRemove and Dispose of Outlet Valve on bypass outlet - 66" Dia.	U491		RiskPert(S491,R491,T491,RiskName(B491&C491&H491))	27912.44	32838.16	$37,763.89
41Iron GateRemove and Dispose Overhead trolley Crane Motor (4hp est) & Controls	U492		RiskPert(S492,R492,T492,RiskName(B492&C492&H492))	1002.29	1336.39	$1,670.48
41Iron GateRemove and Dispose Distribution equipment, Junction Boxes	U493		RiskPert(S493,R493,T493,RiskName(B493&C493&H493))	2505.73	3340.97	$4,176.21
41Iron GateRemove and Dispose Power Cable and Conduit	U494		RiskPert(S494,R494,T494,RiskName(B494&C494&H494))	87710.75	103189.1	$118,667.50

Name	Cell	Graph	Function	Min	Mean	Max
41Iron GateClear and Grub Disposal Area	U495		RiskPert(S495,R495,T495,RiskName(B495&C495&H495))	174480.6	205271.3	$236,062.00
41Iron GateRemove Building No. 2	U496		RiskPert(S496,R496,T496,RiskName(B496&C496&H496))	59126.73	66243.84	$75,550.83
41Iron GateRemove Building No. 3	U497		RiskPert(S497,R497,T497,RiskName(B497&C497&H497))	83216.66	93233.48	$106,332.40
41Iron GateRemove Concrete in Fish Ladder	U498		RiskPert(S498,R498,T498,RiskName(B498&C498&H498))	355912.5	418720.6	$481,528.70
41Iron GateRemove Concrete in Holding Ponds #1 thru #6	U499		RiskPert(S499,R499,T499,RiskName(B499&C499&H499))	273877.9	306844.7	$349,955.00
41Iron GateRemove Concrete in Fish Facility Items	U500		RiskPert(S500,R500,T500,RiskName(B500&C500&H500))	222619.1	261904.8	$301,190.50
41Iron GateRemove Miscellaneous Metalwork in Fish Facilities	U501		RiskPert(S501,R501,T501,RiskName(B501&C501&H501))	10852.91	12874.53	$15,321.76
41Iron GateRemove Concrete Associated with 30" Dia. water supply line	U502		RiskPert(S502,R502,T502,RiskName(B502&C502&H502))	14841.27	17460.32	$20,079.37
41Iron GateRemove Concrete in Aerator Structure	U503		RiskPert(S503,R503,T503,RiskName(B503&C503&H503))	11884.4	13981.65	$16,078.89
41Iron GateRemove Wood in Aerator Structure	U504		RiskPert(S504,R504,T504,RiskName(B504&C504&H504))	4209.62	5612.82	$7,016.03
41Iron GateRemove Structural Steel in Aerator Structure	U505		RiskPert(S505,R505,T505,RiskName(B505&C505&H505))	2129.87	2839.82	$3,549.78
41Iron GateRemove Asphalt Pavement	U506		RiskPert(S506,R506,T506,RiskName(B506&C506&H506))	24370.47	28671.15	$32,971.82
41Iron GateRemove Restroom Building near Aerator Structure	U507		RiskPert(S507,R507,T507,RiskName(B507&C507&H507))	20782.32	23283.9	$26,555.19
41Iron GateRemove Storage Shed near Aerator Structure	U508		RiskPert(S508,R508,T508,RiskName(B508&C508&H508))	6397.93	7168.06	$8,175.14
41Iron GateRemove Toe Drain Pipe	U509		RiskPert(S509,R509,T509,RiskName(B509&C509&H509))	6712.8	7897.42	$9,082.03
41Iron GateRemove Toe Drain Manhole	U510		RiskPert(S510,R510,T510,RiskName(B510&C510&H510))	1252.86	1670.48	$2,088.10
41Iron GateBerm Removal	U511		RiskPert(S511,R511,T511,RiskName(B511&C511&H511))	741625.5	830895.3	$947,632.60
41Iron GateRemove and Dispose of Intake Structures Trashracks	U512		RiskPert(S512,R512,T512,RiskName(B512&C512&H512))	3758.59	5011.45	$6,264.31
41Iron GateRemove and Dispose of Pipe Conduit, 30" Dia. x 0.25" Thick x 960'	U513		RiskPert(S513,R513,T513,RiskName(B513&C513&H513))	75485.27	89546.25	$106,567.40
41Iron GateRemove and Dispose of Sluice Gate Valve, 30" Dia.	U514		RiskPert(S514,R514,T514,RiskName(B514&C514&H514))	2555.84	3407.79	$4,259.73
41Iron GateRemove and Dispose of Sluice Gate Stem, 2" Dia. Sch160x45'	U515		RiskPert(S515,R515,T515,RiskName(B515&C515&H515))	306.7	408.93	$511.17
41Iron GateRemove and Dispose of Butterfly Valve, 30" Dia.	U516		RiskPert(S516,R516,T516,RiskName(B516&C516&H516))	2074.49	2765.99	$3,457.48
41Iron GateRemove and Dispose of Piping- 30-in. Dia. x 0.25 Thickness x 90'	U517		RiskPert(S517,R517,T517,RiskName(B517&C517&H517))	4141.6	4913.08	$5,846.97
41Iron GateRemove and Dispose of Piping- 24-in. Dia. x 0.25 Thickness x 248'	U518		RiskPert(S518,R518,T518,RiskName(B518&C518&H518))	7653.69	9079.38	$10,805.21

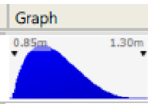
Name	Cell	Graph	Function	Min	Mean	Max
41Iron GateRemove and Dispose of Piping- 20-in. Dia. x 0.25 Thickness x 85'	U519		RiskPert(S519,R519,T519,RiskName(B519&C519&H519))	2484.96	2947.85	$3,508.18
41Iron GateRemove and Dispose of Piping- 18-in. Dia. x 0.25 Thickness x 432'	U520		RiskPert(S520,R520,T520,RiskName(B520&C520&H520))	10627.39	12607	$15,003.38
41Iron GateRemove and Dispose of Piping- 16-in. Dia. x 0.25 Thickness x 166'	U521		RiskPert(S521,R521,T521,RiskName(B521&C521&H521))	3727.44	4421.77	$5,262.27
41Iron GateRemove and Dispose of Piping- 12-in. Dia. x 0.25 Thickness x 64'	U522		RiskPert(S522,R522,T522,RiskName(B522&C522&H522))	948.43	1125.1	$1,338.96
41Iron GateRemove and Dispose of Piping- 10-in. Dia. x 0.25 Thickness x 69'	U523		RiskPert(S523,R523,T523,RiskName(B523&C523&H523))	825.83	979.66	$1,165.87
41Iron GateRemove and Dispose of Piping- 8-in. Dia. x 0.25 Thickness x 30'	U524		RiskPert(S524,R524,T524,RiskName(B524&C524&H524))	782.33	928.06	$1,104.46
41Iron GateRemove and Dispose of Piping- 3-in. Dia. x STD x 30'	U525		RiskPert(S525,R525,T525,RiskName(B525&C525&H525))	393.89	467.27	$556.08
41Iron GateRemove and Dispose of Gate Valves	U526		RiskPert(S526,R526,T526,RiskName(B526&C526&H526))	20377.55	24173.37	$28,768.31
41Iron GateRemove and Dispose of Basin #1	U527		RiskPert(S527,R527,T527,RiskName(B527&C527&H527))	7970.3	9454.96	$11,252.19
41Iron GateRemove and Dispose of Basin #2	U528		RiskPert(S528,R528,T528,RiskName(B528&C528&H528))	7970.3	9454.96	$11,252.19
41Iron GateRemove and Dispose of Basin #3	U529		RiskPert(S529,R529,T529,RiskName(B529&C529&H529))	7970.3	9454.96	$11,252.19
41Iron GateRemove and Dispose of Basin #4	U530		RiskPert(S530,R530,T530,RiskName(B530&C530&H530))	7970.3	9454.96	$11,252.19
41Iron GateRemove and Dispose of Basin #5	U531		RiskPert(S531,R531,T531,RiskName(B531&C531&H531))	7970.3	9454.96	$11,252.19
41Iron GateRemove and Dispose of Basin #6	U532		RiskPert(S532,R532,T532,RiskName(B532&C532&H532))	7970.3	9454.96	$11,252.19
41Iron GateRemove and Dispose of Holding Tank	U533		RiskPert(S533,R533,T533,RiskName(B533&C533&H533))	10857.38	12879.83	$15,328.06
41Iron GateRemove and Dispose of Misc.: Motors, control panels, cables, conduit	U534		RiskPert(S534,R534,T534,RiskName(B534&C534&H534))	1503.44	2004.58	$2,505.73
41Iron GateWanaka Springs - Concrete Total	U535		RiskPert(S535,R535,T535,RiskName(B535&C535&H535))	8199.73	9646.75	$11,093.76
41Iron GateWanaka Springs - Double Pipe Railings	U536		RiskPert(S536,R536,T536,RiskName(B536&C536&H536))	2405.5	3207.33	$4,009.16
41Iron GateWanaka Springs - Wood picnic tables to be removed and hauled	U537		RiskPert(S537,R537,T537,RiskName(B537&C537&H537))	501.15	668.19	$835.24
41Iron GateWanaka Springs - 25'x5' Wooden floating dock	U538		RiskPert(S538,R538,T538,RiskName(B538&C538&H538))	2505.73	3340.97	$4,176.21
41Iron GateWanaka Springs - Rip and reseed site and access road	U539		RiskPert(S539,R539,T539,RiskName(B539&C539&H539))	16249.75	19117.36	$21,984.96
41Iron GateWanaka Springs - Signs to be removed and hauled away	U540		RiskPert(S540,R540,T540,RiskName(B540&C540&H540))	902.06	1202.75	$1,503.44
41Iron GateWanaka Springs - 15'x5' Gangplank with Railings	U541		RiskPert(S541,R541,T541,RiskName(B541&C541&H541))	1503.44	2004.58	$2,505.73
41Iron GateJuniper Point - Concrete Total	U542		RiskPert(S542,R542,T542,RiskName(B542&C542&H542))	6535.16	7688.43	$8,841.69

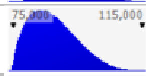
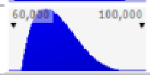
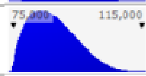
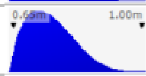
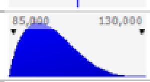
Name	Cell	Graph	Function	Min	Mean	Max
41Iron GateJuniper Point - 2, 4x4 Toilet Vaults	U543		RiskPert(S543,R543,T543,RiskName(B543&C543&H543))	3207.33	4276.44	$5,345.55
41Iron GateJuniper Point - Wood picnic tables to be removed and hauled	U544		RiskPert(S544,R544,T544,RiskName(B544&C544&H544))	801.83	1069.11	$1,336.39
41Iron GateJuniper Point - Signs to be removed and hauled away	U545		RiskPert(S545,R545,T545,RiskName(B545&C545&H545))	1202.75	1603.66	$2,004.58
41Iron GateJuniper Point - Dock pile railing	U546		RiskPert(S546,R546,T546,RiskName(B546&C546&H546))	2004.58	2672.77	$3,340.97
41Iron GateJuniper Point - 50'x5' Composite dock with poly floats	U547		RiskPert(S547,R547,T547,RiskName(B547&C547&H547))	7931.1	8812.33	$9,693.56
41Iron GateJuniper Point - 20'x5' Composite gangplank with railings	U548		RiskPert(S548,R548,T548,RiskName(B548&C548&H548))	2004.58	2672.77	$3,340.97
41Iron GateJuniper Point - Regrade to Natural Contour, rip, and reseed	U549		RiskPert(S549,R549,T549,RiskName(B549&C549&H549))	20167.11	23726.01	$27,284.91
41Iron GateCamp Creek - Concrete Total	U550		RiskPert(S550,R550,T550,RiskName(B550&C550&H550))	32242.6	37932.46	$43,622.34
41Iron GateCamp Creek - Well house 10'x16' concrete block building	U552		RiskPert(S552,R552,T552,RiskName(B552&C552&H552))	11782.53	13091.7	$14,400.88
41Iron GateCamp Creek - 2, 20'x5' Composite decking gangplanks	U553		RiskPert(S553,R553,T553,RiskName(B553&C553&H553))	4009.16	5345.55	$6,681.93
41Iron GateCamp Creek - Concrete block double toilet bldg 10'x16'	U555		RiskPert(S555,R555,T555,RiskName(B555&C555&H555))	11782.53	13091.7	$14,400.88
41Iron GateCamp Creek - Dump stations and approx. 2000 gal buried	U556		RiskPert(S556,R556,T556,RiskName(B556&C556&H556))	6307.25	7482.13	$8,904.35
41Iron GateCamp Creek - Power poles and lines	U557		RiskPert(S557,R557,T557,RiskName(B557&C557&H557))	5215.21	6186.67	$7,362.65
41Iron GateCamp Creek - Remove waterlines and 3 faucets and regrade	U558		RiskPert(S558,R558,T558,RiskName(B558&C558&H558))	3006.87	4009.16	$5,011.45
41Iron GateCamp Creek - Relocate concrete tables	U560		RiskPert(S560,R560,T560,RiskName(B560&C560&H560))	1202.75	1603.66	$2,004.58
41Iron GateCamp Creek - Regrade, rip, and reseed	U561		RiskPert(S561,R561,T561,RiskName(B561&C561&H561))	33890.32	39870.96	$45,851.61
41Iron GateCamp Creek - Signs to be removed and hauled away	U562		RiskPert(S562,R562,T562,RiskName(B562&C562&H562))	2104.81	2806.41	$3,508.02
41Iron GateDutch Creek - 50'4'3' Dock Concrete Abutment	U563		RiskPert(S563,R563,T563,RiskName(B563&C563&H563))	7424.93	8249.92	$9,074.91
41Iron GateDutch Creek - Double Pipe Railing	U564		RiskPert(S564,R564,T564,RiskName(B564&C564&H564))	4009.16	5345.55	$6,681.93
41Iron GateMirror Cove - Concrete Total	U565		RiskPert(S565,R565,T565,RiskName(B565&C565&H565))	21253.5	23615	$25,976.50
41Iron GateMirror Cove - 10'x16' Toilet Vault	U566		RiskPert(S566,R566,T566,RiskName(B566&C566&H566))	15587.74	17319.71	$19,051.68
41Iron GateMirror Cove - Double pipe railings on dock	U568		RiskPert(S568,R568,T568,RiskName(B568&C568&H568))	3207.33	4276.44	$5,345.55
41Iron GateMirror Cove - Regrade site	U569		RiskPert(S569,R569,T569,RiskName(B569&C569&H569))	35891.21	42224.96	$48,558.70
41Iron GateMirror Cove - Signs to be removed and hauled away	U570		RiskPert(S570,R570,T570,RiskName(B570&C570&H570))	2104.81	2806.41	$3,508.02

Name	Cell	Graph	Function	Min	Mean	Max
41Iron GateOverlook Point - 1 concrete picnic table base	U571		RiskPert(S571,R571,T571,RiskName(B571&C571&H571))	300.69	400.92	$501.15
41Iron GateOverlook Point - Steel frame table to be removed and hauled away	U572		RiskPert(S572,R572,T572,RiskName(B572&C572&H572))	100.23	133.64	$167.05
41Iron GateOverlook Point - Regrade steep access road and site to natural contours	U573		RiskPert(S573,R573,T573,RiskName(B573&C573&H573))	14643.54	17227.69	$19,811.84
41Iron GateLong Gulch - 80'x25x4" Concrete boat ramp to be removed	U574		RiskPert(S574,R574,T574,RiskName(B574&C574&H574))	7857.15	8730.16	$9,603.18
41Iron GateLong Gulch - Remove picnic tables (steel frames with planks) and haul away	U575		RiskPert(S575,R575,T575,RiskName(B575&C575&H575))	200.46	267.28	$334.10
41Iron GateLong Gulch - Regrade ramp area to natural contours, rip, reseed	U576		RiskPert(S576,R576,T576,RiskName(B576&C576&H576))	1252.86	1670.48	$2,088.10
41Iron GateConcrete Lining Installation for Diversion Tunnel	U577		RiskPert(S577,R577,T577,RiskName(B577&C577&H577))	1211059	1345621	$1,480,183.00
41Iron GateRemove Distribution Poles near Iron Gate Hydro Plant	U578		RiskPert(S578,R578,T578,RiskName(B578&C578&H578))	5690.16	6750.09	$8,033.16
41Iron GateRemove 6.6kV Power Circuit Breaker @Substation	U580		RiskPert(S580,R580,T580,RiskName(B580&C580&H580))	1457.44	1743.22	$2,143.30
41Iron GateRemove Generator @Substation	U581		RiskPert(S581,R581,T581,RiskName(B581&C581&H581))	4558.64	5452.49	$6,703.88
41Iron GateRemove all auxiliary equipment @Substation (Allowance)	U582		RiskPert(S582,R582,T582,RiskName(B582&C582&H582))	25687.01	30723.68	$37,775.02
41Iron GateNew Connection @Iron Gate Hatchery from PacifiCorp's Hornbrook Substation (Allowance)	U583		RiskPert(S583,R583,T583,RiskName(B583&C583&H583))	302507.5	336119.5	$369,731.40

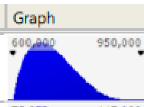
RESTORATION EARTHWORKS & HABITAT

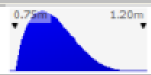
Copco 1 & 2

Name	Cell	Graph	Function	Min	Mean	Max
42Copco 1 & 2Removal of sediment and similar obstructions to ensure volitional fish passage + wood habitat structures	U586		RiskPert(S586,R586,T586,RiskName(B586&C586&H586))	860176.8	995574.9	$1,290,265.00
42Copco 1 & 2Equipment & road access into site	U587		RiskPert(S587,R587,T587,RiskName(B587&C587&H587))	75928.32	87880	$113,892.50
42Copco 1 & 2Grading and shaping of floodplain sediments (no export)	U588		RiskPert(S588,R588,T588,RiskName(B588&C588&H588))	658993	762723.4	$988,489.60
42Copco 1 & 2Floodplain roughness for 50% of area	U589		RiskPert(S589,R589,T589,RiskName(B589&C589&H589))	170079.4	196851.2	$255,119.20
42Copco 1 & 2Equipment & road access into site	U590		RiskPert(S590,R590,T590,RiskName(B590&C590&H590))	75928.32	87880	$113,892.50
42Copco 1 & 2Grading and shaping of floodplain sediments (no export)	U591		RiskPert(S591,R591,T591,RiskName(B591&C591&H591))	1330280	1539676	$1,995,421.00
42Copco 1 & 2Floodplain roughness for 50% of area	U592		RiskPert(S592,R592,T592,RiskName(B592&C592&H592))	387234.4	448188	$580,851.60
42Copco 1 & 2Equipment & road access into site	U593		RiskPert(S593,R593,T593,RiskName(B593&C593&H593))	75928.32	87880	$113,892.50
42Copco 1 & 2Grading and shaping of floodplain sediments (no export)	U594		RiskPert(S594,R594,T594,RiskName(B594&C594&H594))	636226.7	736373.5	$954,340.00
42Copco 1 & 2Floodplain roughness for 50% of area	U595		RiskPert(S595,R595,T595,RiskName(B595&C595&H595))	211080.7	244306.4	$316,621.10

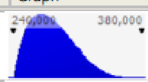
Name	Cell	Graph	Function	Min	Mean	Max
42Copco 1 & 2Equipment & road access into site	U596		RiskPert(S596,R596,T596,RiskName(B596&C596&H596))	75928.32	87880	$113,892.50
42Copco 1 & 2Grading and shaping of floodplain sediments (no export)	U597		RiskPert(S597,R597,T597,RiskName(B597&C597&H597))	409810.4	474317.7	$614,715.70
42Copco 1 & 2Floodplain roughness for 50% of area	U598		RiskPert(S598,R598,T598,RiskName(B598&C598&H598))	159449.5	184548	$239,174.20
42Copco 1 & 2Equipment & road access into site	U599		RiskPert(S599,R599,T599,RiskName(B599&C599&H599))	75928.32	87880	$113,892.50
42Copco 1 & 2Grading and shaping of floodplain sediments (no export)	U600		RiskPert(S600,R600,T600,RiskName(B600&C600&H600))	164142.9	189980.2	$246,214.30
42Copco 1 & 2Floodplain roughness for 50% of area	U601		RiskPert(S601,R601,T601,RiskName(B601&C601&H601))	63779.79	73819.2	$95,669.68
42Copco 1 & 2Equipment & road access into site	U602		RiskPert(S602,R602,T602,RiskName(B602&C602&H602))	75928.32	87880	$113,892.50
42Copco 1 & 2Grading and shaping of floodplain sediments (no export)	U603		RiskPert(S603,R603,T603,RiskName(B603&C603&H603))	138882	160743.1	$208,323.00
42Copco 1 & 2Floodplain roughness for 50% of area	U604		RiskPert(S604,R604,T604,RiskName(B604&C604&H604))	80484.02	93152.8	$120,726.00
Complexity Develop process-based restoration and velocity	U605		RiskPert(S605,R605,T605,RiskName(B605&C605&H605))	653135.4	755943.8	$979,703.10
42Copco 1 & 2Ground-Based Placement	U606		RiskPert(S606,R606,T606,RiskName(B606&C606&H606))	578063.6	669055.1	$867,095.30
42Copco 1 & 2Helicopter Placement (@ 50 members staged and placed per site)	U607		RiskPert(S607,R607,T607,RiskName(B607&C607&H607))	470877.1	544996.6	$706,315.60
42Copco 1 & 2Contractor overhead	U608		RiskPert(S608,R608,T608,RiskName(B608&C608&H608))	1110728	1285565	$1,666,092.00
42Copco 1 & 2Contractor profit (included in rates & prices)	U609		RiskPert(S609,R609,T609,RiskName(B609&C609&H609))	0	0	$0.00
42Copco 1 & 2Insurance	U610		RiskPert(S610,R610,T610,RiskName(B610&C610&H610))	85155.83	98559.99	$127,733.80
42Copco 1 & 2Bond	U611		RiskPert(S611,R611,T611,RiskName(B611&C611&H611))	85155.83	98559.99	$127,733.80

Iron Gate

Name	Cell	Graph	Function	Min	Mean	Max
42Iron GateRemoval of sediment and similar obstructions to ensure volitional fish passage + wood habitat structures	U613		RiskPert(S613,R613,T613,RiskName(B613&C613&H613))	614411.9	711124.9	$921,617.90
42Iron GateEquipment & road access into site	U614		RiskPert(S614,R614,T614,RiskName(B614&C614&H614))	75928.32	87880	$113,892.50
42Iron GateGrading and shaping of floodplain sediments (no export)	U615		RiskPert(S615,R615,T615,RiskName(B615&C615&H615))	485941.3	562432	$728,911.90
42Iron GateFloodplain roughness for 50% of area	U616		RiskPert(S616,R616,T616,RiskName(B616&C616&H616))	215636.4	249579.2	$323,454.70
42Iron GateEquipment & road access into site	U617		RiskPert(S617,R617,T617,RiskName(B617&C617&H617))	75928.32	87880	$113,892.50
42Iron GateGrading and shaping of floodplain sediments (no export)	U618		RiskPert(S618,R618,T618,RiskName(B618&C618&H618))	153881.4	178103.5	$230,822.10
42Iron GateFloodplain roughness for 50% of area	U619		RiskPert(S619,R619,T619,RiskName(B619&C619&H619))	88076.85	101940.8	$132,115.30
42Iron GateEquipment & road access into site	U620		RiskPert(S620,R620,T620,RiskName(B620&C620&H620))	50618.88	58586.67	$75,928.32

Name	Cell	Graph	Function	Min	Mean	Max
42Iron GateGrading and shaping of floodplain sediments (no export)	U621		RiskPert(S621,R621,T621,RiskName(B621&C621&H621))	769407	890517.3	$1,154,111.00
42Iron GateFloodplain roughness for 75% of area	U622		RiskPert(S622,R622,T622,RiskName(B622&C622&H622))	525424	608129.6	$788,135.90
42Iron GateDevelop process-based restoration and velocity variations along bankline by adding large wood complexity for resting zone, feeding seams, cover and velocity refugia	U623		RiskPert(S623,R623,T623,RiskName(B623&C623&H623))	261254.2	302377.5	$391,881.30
42Iron GateGround-Based Placement	U624		RiskPert(S624,R624,T624,RiskName(B624&C624&H624))	578063.6	669055.1	$867,095.30
42Iron GateHelicopter Placement (@ 50 members staged and placed per site)	U625		RiskPert(S625,R625,T625,RiskName(B625&C625&H625))	235438.5	272498.3	$353,157.80
42Iron GateContractor overhead	U626		RiskPert(S626,R626,T626,RiskName(B626&C626&H626))	618315.2	715642.6	$927,472.80
42Iron GateContractor profit (included in rates & prices)	U627		RiskPert(S627,R627,T627,RiskName(B627&C627&H627))	0	0	$0.00
42Iron GateInsurance	U628		RiskPert(S628,R628,T628,RiskName(B628&C628&H628))	47404.16	54865.93	$71,106.25
42Iron GateBond	U629		RiskPert(S629,R629,T629,RiskName(B629&C629&H629))	47404.16	54865.93	$71,106.25

JC Boyle

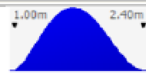
Name	Cell	Graph	Function	Min	Mean	Max
42JC BoyleRemoval of sediment and similar obstructions to ensure volitional fish passage + wood habitat structures	U631		RiskPert(S631,R631,T631,RiskName(B631&C631&H631))	245764.8	284450	$368,647.20
42JC BoyleEquipment & road access into site	U632		RiskPert(S632,R632,T632,RiskName(B632&C632&H632))	12654.72	14646.67	$18,982.08
42JC BoyleGrading and shaping of floodplain sediments (no export)	U633		RiskPert(S633,R633,T633,RiskName(B633&C633&H633))	299663.8	346833.1	$449,495.70
42JC BoyleFloodplain roughness for 50% of area	U634		RiskPert(S634,R634,T634,RiskName(B634&C634&H634))	50112.69	58000.8	$75,169.04
42JC BoyleEquipment & road access into site	U635		RiskPert(S635,R635,T635,RiskName(B635&C635&H635))	12654.72	14646.67	$18,982.08
42JC BoyleGrading and shaping of floodplain sediments (no export)	U636		RiskPert(S636,R636,T636,RiskName(B636&C636&H636))	283465.7	328085.3	$425,198.60
42JC BoyleFloodplain roughness for 50% of area	U637		RiskPert(S637,R637,T637,RiskName(B637&C637&H637))	665132.1	769828.8	$997,698.10
42JC BoyleEquipment & road access into site	U638		RiskPert(S638,R638,T638,RiskName(B638&C638&H638))	12654.72	14646.67	$18,982.08
42JC BoyleGrading and shaping of floodplain sediments (no export)	U639		RiskPert(S639,R639,T639,RiskName(B639&C639&H639))	429248.1	496814.9	$643,872.10
42JC BoyleFloodplain roughness for 30% of area	U640		RiskPert(S640,R640,T640,RiskName(B640&C640&H640))	607426.6	703040	$911,139.80
42JC BoyleEquipment & road access into site	U641		RiskPert(S641,R641,T641,RiskName(B641&C641&H641))	12654.72	14646.67	$18,982.08
42JC BoyleGrading and shaping of floodplain sediments (no export)	U642		RiskPert(S642,R642,T642,RiskName(B642&C642&H642))	137683.4	159355.7	$206,525.00
42JC BoyleFloodplain roughness for 50% of area	U643		RiskPert(S643,R643,T643,RiskName(B643&C643&H643))	323454.7	374368.8	$485,182.00
42JC BoyleDevelop process-based restoration and velocity variations along bankline by adding large wood complexity for resting zone, feeding seams, cover and velocity refugia	U644		RiskPert(S644,R644,T644,RiskName(B644&C644&H644))	522508.3	604755	$783,762.50
42JC BoyleGround-Based Placement	U645		RiskPert(S645,R645,T645,RiskName(B645&C645&H645))	867095.3	1003583	$1,300,643.00

Name	Cell	Graph	Function	Min	Mean	Max
42JC BoyleContractor profit (included in rates & prices)	U648	-0.60 – 0.60	RiskPert(S648,R648,T648,RiskName(B648&C648&H648))	0	0	$0.00
42JC BoyleInsurance	U649	50,000 – 80,000	RiskPert(S649,R649,T649,RiskName(B649&C649&H649))	52765.99	61071.75	$79,148.98
42JC BoyleBond	U650	50,000 – 80,000	RiskPert(S650,R650,T650,RiskName(B650&C650&H650))	52765.99	61071.75	$79,148.98

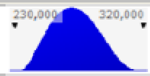
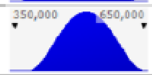
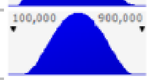
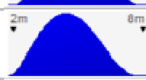
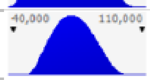
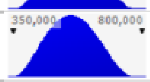
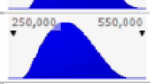
RESTORATION OF VEGETATION

JC Boyle

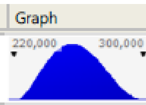
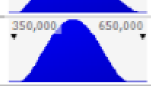
Name	Cell	Graph	Function	Min	Mean	Max
42JC BoyleContractor profit (included in rates & prices)	U648	-0.60 – 0.60	RiskPert(S648,R648,T648,RiskName(B648&C648&H648))	0	0	$0.00
42JC BoyleInsurance	U649	50,000 – 80,000	RiskPert(S649,R649,T649,RiskName(B649&C649&H649))	52765.99	61071.75	$79,148.98
42JC BoyleBond	U650	50,000 – 80,000	RiskPert(S650,R650,T650,RiskName(B650&C650&H650))	52765.99	61071.75	$79,148.98
43JC BoyleOn-Site Pilot Growing Experiment	U653	100,000 – 135,000	RiskPert(S653,R653,T653,RiskName(B653&C653&H653))	101733.8	116567.2	$134,281.90
43JC BoyleSeed Collection	U654	160,000 – 200,000	RiskPert(S654,R654,T654,RiskName(B654&C654&H654))	167775.5	221301.2	$275,180.60
43JC BoyleSeed Propagation	U655	200,000 – 800,000	RiskPert(S655,R655,T655,RiskName(B655&C655&H655))	208731.7	523944.9	$713,733.00
43JC BoyleWeed Eradication	U656	450,000 – 750,000	RiskPert(S656,R656,T656,RiskName(B656&C656&H656))	478981.8	606616.8	$734,251.80
43JC BoylePioneer Seeding	U657	250,000 – 700,000	RiskPert(S657,R657,T657,RiskName(B657&C657&H657))	283465.7	448820.8	$668,169.20
43JC BoyleContainer Plant Growing	U658	50,000 – 400,000	RiskPert(S658,R658,T658,RiskName(B658&C658&H658))	79389.05	217088.1	$354,787.10
43JC BoyleEstabl. Prd. Maint. & Monitor'g	U659	0.80m – 2.80m	RiskPert(S659,R659,T659,RiskName(B659&C659&H659))	944557.2	1777640	$2,675,395.00
43JC BoyleLong-Term Maint. & Monitor'g	U660	0.50m – 3.50m	RiskPert(S660,R660,T660,RiskName(B660&C660&H660))	872285.8	1969922	$3,253,352.00
43JC BoyleEmergent Wetland	U661	20,000 – 50,000	RiskPert(S661,R661,T661,RiskName(B661&C661&H661))	23651.35	34702.09	$47,519.24
43JC BoyleBank Wetland	U662	60,000 – 140,000	RiskPert(S662,R662,T662,RiskName(B662&C662&H662))	62033.59	101403.6	$133,596.50
43JC BoyleBank Riparian	U663	0.70m – 1.60m	RiskPert(S663,R663,T663,RiskName(B663&C663&H663))	741466.4	1147879	$1,569,618.00
43JC BoyleFloodplain Riparian	U664	0.50m – 1.30m	RiskPert(S664,R664,T664,RiskName(B664&C664&H664))	583878.6	881705.6	$1,201,866.00
43JC BoyleUplands below RW	U665	200,000 – 380,000	RiskPert(S665,R665,T665,RiskName(B665&C665&H665))	204169.5	277650.6	$369,607.50
43JC BoyleRocky Wake Zone	U666	120,000 – 260,000	RiskPert(S666,R666,T666,RiskName(B666&C666&H666))	138113.8	189017.7	$256,825.10
43JC BoyleDisturbed Uplands above RWZ	U667	350,000 – 700,000	RiskPert(S667,R667,T667,RiskName(B667&C667&H667))	350982.4	477886.6	$650,192.10
43JC BoyleUplands Stockpiles	U668	45,000 – 95,000	RiskPert(S668,R668,T668,RiskName(B668&C668&H668))	48826.25	66416.49	$90,343.84
43JC BoyleUndisturbed Uplands	U669	40,000 – 70,000	RiskPert(S669,R669,T669,RiskName(B669&C669&H669))	43015.37	56288.13	$69,173.37

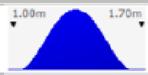
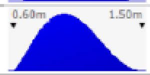
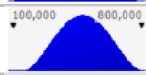
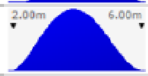
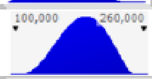
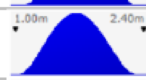
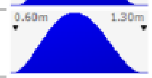
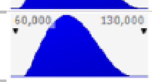
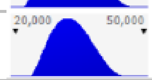
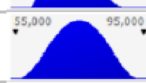
Name	Cell	Graph	Function	Min	Mean	Max
43JC BoyleContractor overhead	U670		RiskPert(S670,R670,T670,RiskName(B670&C670&H670))	1030506	1663701	$2,379,157.00

Iron Gate

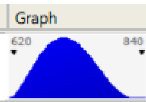
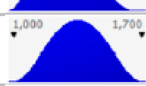
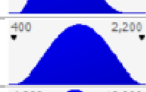
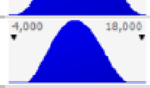
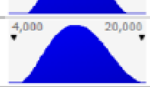
Name	Cell	Graph	Function	Min	Mean	Max
43Iron GateOn-Site Pilot Growing Experiment	U672		RiskPert(S672,R672,T672,RiskName(B672&C672&H672))	237491.8	272119.7	$313,473.50
43Iron GateSeed Collection	U673		RiskPert(S673,R673,T673,RiskName(B673&C673&H673))	391662.5	516615.4	$642,393.70
43Iron GateSeed Propagation	U674		RiskPert(S674,R674,T674,RiskName(B674&C674&H674))	487272.5	1223120	$1,666,170.00
43Iron GateWeed Eradication	U675		RiskPert(S675,R675,T675,RiskName(B675&C675&H675))	1118156	1416113	$1,714,070.00
43Iron GatePioneer Seeding	U676		RiskPert(S676,R676,T676,RiskName(B676&C676&H676))	661735	1047747	$1,559,804.00
43Iron GateContainer Plant Growing	U677		RiskPert(S677,R677,T677,RiskName(B677&C677&H677))	185329.3	506780	$828,230.70
43Iron GateEstabl. Prd. Maint. & Monitor'g	U678		RiskPert(S678,R678,T678,RiskName(B678&C678&H678))	2205016	4149801	$6,245,560.00
43Iron GateLong-Term Maint. & Monitor'g	U679		RiskPert(S679,R679,T679,RiskName(B679&C679&H679))	2036303	4598673	$7,594,770.00
43Iron GateEmergent Wetland	U680		RiskPert(S680,R680,T680,RiskName(B680&C680&H680))	49772.4	73027.82	$100,000.50
43Iron GateBank Wetland	U681		RiskPert(S681,R681,T681,RiskName(B681&C681&H681))	111888.4	182899	$240,964.50
43Iron GateBank Riparian	U682		RiskPert(S682,R682,T682,RiskName(B682&C682&H682))	537537.8	832172.8	$1,137,920.00
43Iron GateFloodplain Riparian	U683		RiskPert(S683,R683,T683,RiskName(B683&C683&H683))	369143.2	557437.2	$759,851.10
43Iron GateUplands below RW	U684		RiskPert(S684,R684,T684,RiskName(B684&C684&H684))	2806068	3815979	$5,079,817.00
43Iron GateRocky Wake Zone	U685		RiskPert(S685,R685,T685,RiskName(B685&C685&H685))	94494.99	129322.5	$175,715.20
43Iron GateDisturbed Uplands above RWZ	U686		RiskPert(S686,R686,T686,RiskName(B686&C686&H686))	585424.3	797095.4	$1,084,494.00
43Iron GateUplands Stockpiles	U687		RiskPert(S687,R687,T687,RiskName(B687&C687&H687))	281252	382576.3	$520,404.10
43Iron GateUndisturbed Uplands	U688		RiskPert(S688,R688,T688,RiskName(B688&C688&H688))	89687.52	117361.4	$144,227.20
43Iron GateContractor overhead	U689		RiskPert(S689,R689,T689,RiskName(B689&C689&H689))	2354359	3715968	$5,298,931.00

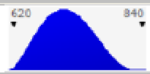
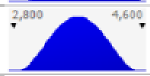
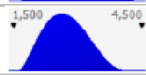
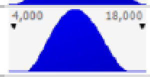
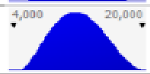
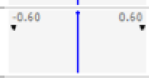
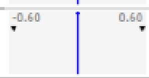
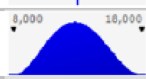
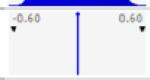
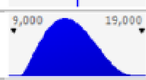
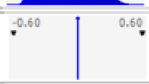
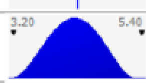
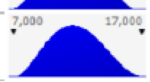
Copco 1

Name	Cell	Graph	Function	Min	Mean	Max
43Copco 1On-Site Pilot Growing Experiment	U691		RiskPert(S691,R691,T691,RiskName(B691&C691&H691))	225340.3	258196.4	$297,434.30
43Copco 1Seed Collection	U692		RiskPert(S692,R692,T692,RiskName(B692&C692&H692))	371622.7	490182.2	$609,524.90
43Copco 1Seed Propagation	U693		RiskPert(S693,R693,T693,RiskName(B693&C693&H693))	462340.7	1160538	$1,580,919.00

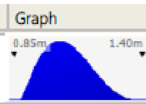
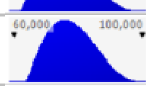
Name	Cell	Graph	Function	Min	Mean	Max
43Copco 1Weed Eradication	U694		RiskPert(S694,R694,T694,RiskName(B694&C694&H694))	1060945	1343656	$1,626,368.00
43Copco 1Pioneer Seeding	U695		RiskPert(S695,R695,T695,RiskName(B695&C695&H695))	627876.6	994137.9	$1,479,995.00
43Copco 1Container Plant Growing	U696		RiskPert(S696,R696,T696,RiskName(B696&C696&H696))	175846.8	480850.1	$785,853.40
43Copco 1Establ. Prd. Maint. & Monitor'g	U697		RiskPert(S697,R697,T697,RiskName(B697&C697&H697))	2092194	3937472	$5,925,999.00
43Copco 1Long-Term Maint. & Monitor'g	U698		RiskPert(S698,R698,T698,RiskName(B698&C698&H698))	1932113	4363377	$7,206,175.00
43Copco 1Emergent Wetland	U699		RiskPert(S699,R699,T699,RiskName(B699&C699&H699))	50057.63	73446.31	$100,573.60
43Copco 1Bank Wetland	U700		RiskPert(S700,R700,T700,RiskName(B700&C700&H700))	112892.6	184540.6	$243,127.30
43Copco 1Bank Riparian	U701		RiskPert(S701,R701,T701,RiskName(B701&C701&H701))	1081229	1673872	$2,288,865.00
43Copco 1Floodplain Riparian	U702		RiskPert(S702,R702,T702,RiskName(B702&C702&H702))	617264	932120.4	$1,270,588.00
43Copco 1Uplands below RW	U703		RiskPert(S703,R703,T703,RiskName(B703&C703&H703))	2577989	3505815	$4,666,927.00
43Copco 1Rocky Wake Zone	U704		RiskPert(S704,R704,T704,RiskName(B704&C704&H704))	127052.8	173880	$236,256.90
43Copco 1Disturbed Uplands above RWZ	U705		RiskPert(S705,R705,T705,RiskName(B705&C705&H705))	66582.32	90656.4	$123,343.20
43Copco 1Uplands Stockpiles	U706		RiskPert(S706,R706,T706,RiskName(B706&C706&H706))	24450.96	33259.71	$45,241.93
43Copco 1Undisturbed Uplands	U707		RiskPert(S707,R707,T707,RiskName(B707&C707&H707))	57222.34	74878.79	$92,019.71
43Copco 1Contractor overhead	U708		RiskPert(S708,R708,T708,RiskName(B708&C708&H708))	2244456	3578544	$5,103,293.00

Copco 2

Name	Cell	Graph	Function	Min	Mean	Max
43Copco 2On-Site Pilot Growing Experiment	U710		RiskPert(S710,R710,T710,RiskName(B710&C710&H710))	621.71	712.36	$820.61
43Copco 2Seed Collection	U711		RiskPert(S711,R711,T711,RiskName(B711&C711&H711))	1025.29	1352.4	$1,681.66
43Copco 2Seed Propagation	U712		RiskPert(S712,R712,T712,RiskName(B712&C712&H712))	1275.58	3201.89	$4,361.70
43Copco 2Weed Eradication	U713		RiskPert(S713,R713,T713,RiskName(B713&C713&H713))	2927.11	3707.1	$4,487.09
43Copco 2Pioneer Seeding	U714		RiskPert(S714,R714,T714,RiskName(B714&C714&H714))	1732.29	2742.79	$4,083.26
43Copco 2Container Plant Growing	U715		RiskPert(S715,R715,T715,RiskName(B715&C715&H715))	485.16	1326.65	$2,168.14
43Copco 2Establ. Prd. Maint. & Monitor'g	U716		RiskPert(S716,R716,T716,RiskName(B716&C716&H716))	5772.29	10863.35	$16,349.63
43Copco 2Long-Term Maint. & Monitor'g	U717		RiskPert(S717,R717,T717,RiskName(B717&C717&H717))	5330.64	12038.41	$19,881.60
43Copco 2Emergent Wetland	U718		RiskPert(S718,R718,T718,RiskName(B718&C718&H718))	0	0	$0.00

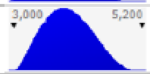
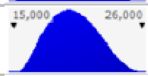
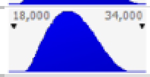
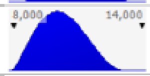
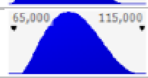
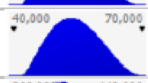
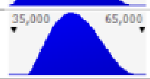
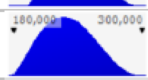
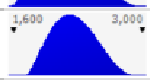
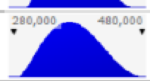
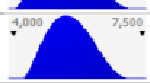
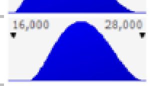
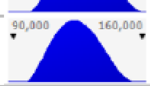
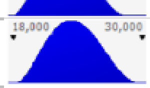
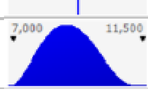
Name	Cell	Graph	Function	Min	Mean	Max
43Copco 2On-Site Pilot Growing Experiment	U710		RiskPert(S710,R710,T710,RiskName(B710&C710&H710))	621.71	712.36	$820.61
43Copco 2Seed Collection	U711		RiskPert(S711,R711,T711,RiskName(B711&C711&H711))	1025.29	1352.4	$1,681.66
43Copco 2Seed Propagation	U712		RiskPert(S712,R712,T712,RiskName(B712&C712&H712))	1275.58	3201.89	$4,361.70
43Copco 2Weed Eradication	U713		RiskPert(S713,R713,T713,RiskName(B713&C713&H713))	2927.11	3707.1	$4,487.09
43Copco 2Pioneer Seeding	U714		RiskPert(S714,R714,T714,RiskName(B714&C714&H714))	1732.29	2742.79	$4,083.26
43Copco 2Container Plant Growing	U715		RiskPert(S715,R715,T715,RiskName(B715&C715&H715))	485.16	1326.65	$2,168.14
43Copco 2Establ. Prd. Maint. & Monitor'g	U716		RiskPert(S716,R716,T716,RiskName(B716&C716&H716))	5772.29	10863.35	$16,349.63
43Copco 2Long-Term Maint. & Monitor'g	U717		RiskPert(S717,R717,T717,RiskName(B717&C717&H717))	5330.64	12038.41	$19,881.60
43Copco 2Emergent Wetland	U718		RiskPert(S718,R718,T718,RiskName(B718&C718&H718))	0	0	$0.00
43Copco 2Bank Wetland	U719		RiskPert(S719,R719,T719,RiskName(B719&C719&H719))	0	0	$0.00
43Copco 2Bank Riparian	U720		RiskPert(S720,R720,T720,RiskName(B720&C720&H720))	0	0	$0.00
43Copco 2Floodplain Riparian	U721		RiskPert(S721,R721,T721,RiskName(B721&C721&H721))	8559.58	12925.68	$17,619.19
43Copco 2Uplands below RW	U722		RiskPert(S722,R722,T722,RiskName(B722&C722&H722))	0	0	$0.00
43Copco 2Rocky Wake Zone	U723		RiskPert(S723,R723,T723,RiskName(B723&C723&H723))	0	0	$0.00
43Copco 2Disturbed Uplands above RWZ	U724		RiskPert(S724,R724,T724,RiskName(B724&C724&H724))	9853.08	13415.64	$18,252.75
43Copco 2Uplands Stockpiles	U725		RiskPert(S725,R725,T725,RiskName(B725&C725&H725))	0	0	$0.00
43Copco 2Undisturbed Uplands	U726		RiskPert(S726,R726,T726,RiskName(B726&C726&H726))	3.25	4.25	$5.23
43Copco 2Contractor overhead	U727		RiskPert(S727,R727,T727,RiskName(B727&C727&H727))	7569.28	11844.54	$16,845.22

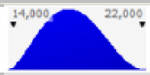
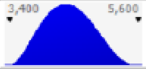
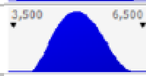
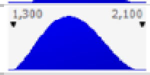
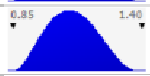
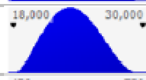
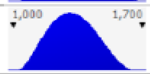
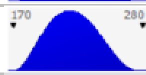
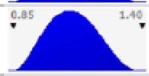
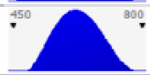
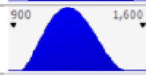
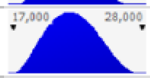
YREKA WATER LINE REPLACEMENT

Name	Cell	Graph	Function	Min	Mean	Max
44ProjectMicrotunneling	U730		RiskPert(S730,R730,T730,RiskName(B730&C730&H730))	894330.8	1078458	$1,367,800.00
44ProjectPile and Lagging Pre Drilling	U731		RiskPert(S731,R731,T731,RiskName(B731&C731&H731))	64713.55	78036.92	$98,973.66
44ProjectPile and Lagging Wall InstallatioN	U732		RiskPert(S732,R732,T732,RiskName(B732&C732&H732))	938963.4	1132279	$1,436,062.00
44ProjectPipe Installation	U733		RiskPert(S733,R733,T733,RiskName(B733&C733&H733))	264161.5	318547.7	$404,011.70
44ProjectExcavation and Backfill	U734		RiskPert(S734,R734,T734,RiskName(B734&C734&H734))	302983	365361.9	$463,385.80

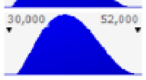
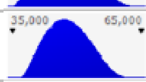
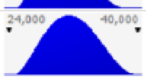
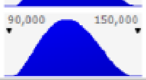
TRANSPORTATION (BRIDGES, CULVERTS, ROADS)

Lakeview Bridge

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectSheet Pile Coffer Dam For Center Footer	U737		RiskPert(S737,R737,T737,RiskName(B737&C737&H737))	80702.01	102558.8	$131,140.80
45ProjectBackfill, structural, common earth, 105 H.P. dozer, 50' haul, from existing stockpile, excludes compaction	U738		RiskPert(S738,R738,T738,RiskName(B738&C738&H738))	3099.77	3939.29	$5,037.13
45ProjectEarth Work Coffer Dam Construction for side footers	U739		RiskPert(S739,R739,T739,RiskName(B739&C739&H739))	15847.14	20139.08	$25,751.61
45ProjectStructure Excavation (Type D)	U741		RiskPert(S741,R741,T741,RiskName(B741&C741&H741))	19913.47	25306.7	$32,359.39
45ProjectStructure Excavation (Bridge)	U742		RiskPert(S742,R742,T742,RiskName(B742&C742&H742))	8085.96	10275.91	$13,139.69
45ProjectPrestressed concrete piles, square, 40' long, 24" square, priced using 200 piles, excludes pile caps or mobilization	U743		RiskPert(S743,R743,T743,RiskName(B743&C743&H743))	69425.02	88227.63	$112,815.60
45Project18" Diameter 40' Long Tie Down Anchor Installation	U744		RiskPert(S744,R744,T744,RiskName(B744&C744&H744))	42851.99	54457.73	$69,634.48
45ProjectPiling special costs, pre-augering for Pile and Tie Down Anchor	U745		RiskPert(S745,R745,T745,RiskName(B745&C745&H745))	261911.7	332846.1	$425,606.40
45ProjectMobilization, 150 ton, set up and remove crane, with pile leads and pile hammer	U746		RiskPert(S746,R746,T746,RiskName(B746&C746&H746))	38928.68	49471.87	$63,259.11
45ProjectA736 Barrier Wall	U747		RiskPert(S747,R747,T747,RiskName(B747&C747&H747))	182108.3	231429.3	$295,925.90
45ProjectExpansion joint, neoprene, liquid, 1" x 2", cold applied	U748		RiskPert(S748,R748,T748,RiskName(B748&C748&H748))	1776.1	2257.13	$2,886.16
45ProjectColumns Structural Concrete includes forms, Grade 60 rebar, concrete, placing and finishing	U749		RiskPert(S749,R749,T749,RiskName(B749&C749&H749))	294160.5	373829	$478,010.80
45ProjectDeck Structural concrete, in place, includes forms, Grade 60 rebar, concrete, placing and finishing	U750		RiskPert(S750,R750,T750,RiskName(B750&C750&H750))	168204.1	213759.4	$273,331.70
45ProjectFooter Structural concrete,footing, reinforced, includes forms(4 uses), Grade 60 rebar, concrete, placing and finishing	U751		RiskPert(S751,R751,T751,RiskName(B751&C751&H751))	165438.5	210244.7	$268,837.50
45ProjectApproach Slab Structural concrete, in place, 6" thick, includes forms, Grade 60 rebar, concrete, and placing, excludes finishing	U752		RiskPert(S752,R752,T752,RiskName(B752&C752&H752))	4369.04	5552.32	$7,099.68
45ProjectPrecast 36" I-Girder 65'	U753		RiskPert(S753,R753,T753,RiskName(B753&C753&H753))	209949.7	266811	$341,168.20
45ProjectPrecast 36" I-Girder 48'	U754		RiskPert(S754,R754,T754,RiskName(B754&C754&H754))	250864.2	318806.5	$407,654.30
45ProjectBridge Demolition	U755		RiskPert(S755,R755,T755,RiskName(B755&C755&H755))	205798.4	261535.5	$334,422.40
45ProjectRoadway Excavation	U757		RiskPert(S757,R757,T757,RiskName(B757&C757&H757))	17863.53	22515.49	$27,911.77
45ProjectImported Borrow	U758		RiskPert(S758,R758,T758,RiskName(B758&C758&H758))	98906.18	124663	$154,540.90
45ProjectHot Mix Asphalt (Type A)	U759		RiskPert(S759,R759,T759,RiskName(B759&C759&H759))	51226.3	64566.49	$80,041.10
45ProjectClass 2 Aggregate Base	U760		RiskPert(S760,R760,T760,RiskName(B760&C760&H760))	18782.98	23674.38	$29,348.40
45ProjectRemove Base and Surfacing	U761		RiskPert(S761,R761,T761,RiskName(B761&C761&H761))	0	0	$0.00
45ProjectMidwest Guardrail System	U762		RiskPert(S762,R762,T762,RiskName(B762&C762&H762))	7112.14	8964.26	$11,112.71

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectTransition Railing (Type WB-31)	U763		RiskPert(S763,R763,T763,RiskName(B763&C763&H763))	14010.61	17659.21	$21,891.58
45ProjectAlternative Flared Terminal System	U764		RiskPert(S764,R764,T764,RiskName(B764&C764&H764))	3502.65	4414.8	$5,472.90
45ProjectTemporary Reinforced Silt Fence	U765		RiskPert(S765,R765,T765,RiskName(B765&C765&H765))	3982.52	5019.63	$6,222.68
45ProjectTemporary Fence (Type ESA)	U766		RiskPert(S766,R766,T766,RiskName(B766&C766&H766))	1321.38	1665.48	$2,064.65
45ProjectTemporary Concrete Washout	U767		RiskPert(S767,R767,T767,RiskName(B767&C767&H767))	0.88	1.1	$1.37
45ProjectTemporary Construction Entrance	U768		RiskPert(S768,R768,T768,RiskName(B768&C768&H768))	7536.4	9499	$11,775.62
45ProjectWater Pollution Control	U769		RiskPert(S769,R769,T769,RiskName(B769&C769&H769))	18677.9	23541.94	$29,184.22
45ProjectRoadside Sign - One Post	U770		RiskPert(S770,R770,T770,RiskName(B770&C770&H770))	472.86	596	$738.84
45ProjectReset Roadside Sign	U771		RiskPert(S771,R771,T771,RiskName(B771&C771&H771))	1050.8	1324.44	$1,641.87
45ProjectRelocate Roadside Sign	U772		RiskPert(S772,R772,T772,RiskName(B772&C772&H772))	175.13	220.74	$273.64
45ProjectConstruction Area Signs	U773		RiskPert(S773,R773,T773,RiskName(B773&C773&H773))	0.88	1.1	$1.37
45ProjectThermoplastic Traffic Stripe	U774		RiskPert(S774,R774,T774,RiskName(B774&C774&H774))	497.03	626.46	$776.60
45ProjectType III Barricade	U775		RiskPert(S775,R775,T775,RiskName(B775&C775&H775))	960.74	1210.94	$1,501.16
45ProjectTraffic Control System	U776		RiskPert(S776,R776,T776,RiskName(B776&C776&H776))	17513.27	22074.01	$27,364.48
45ProjectTemporary Railing (Type K)	U777		RiskPert(S777,R777,T777,RiskName(B777&C777&H777))	12346.85	15562.18	$19,291.96

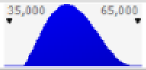
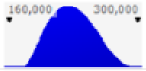
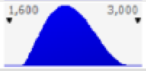
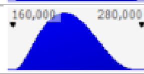
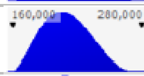
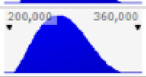
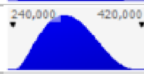
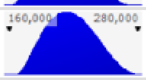
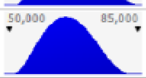
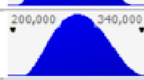
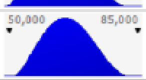
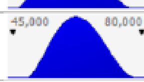
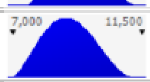
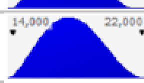
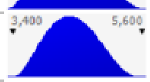
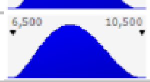
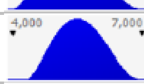
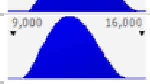
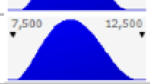
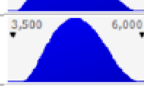
Fall Creek Bridge

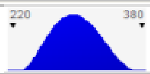
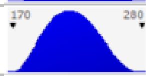
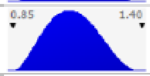
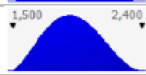
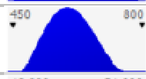
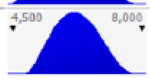
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectStructure Excavation (Bridge)	U779		RiskPert(S779,R779,T779,RiskName(B779&C779&H779))	25376.7	32249.55	$41,237.13
45ProjectA736 Barrier Wall	U780		RiskPert(S780,R780,T780,RiskName(B780&C780&H780))	33975.42	43177.1	$55,210.06
45ProjectDeck Structural concrete, in place, includes forms, Grade 60 rebar, concrete, placing and finishing	U782		RiskPert(S782,R782,T782,RiskName(B782&C782&H782))	31037.66	39443.69	$50,436.20
45ProjectFooter Structural concrete,footing, reinforced, includes forms(4 uses), Grade 60 rebar, concrete, placing and finishing	U783		RiskPert(S783,R783,T783,RiskName(B783&C783&H783))	31758.28	40359.48	$51,607.20
45ProjectApproach Slab Structural concrete, in place, 6" thick, includes forms, Grade 60 rebar, concrete, and placing, excludes finishing	U784		RiskPert(S784,R784,T784,RiskName(B784&C784&H784))	5654.05	7185.36	$9,187.84
45ProjectBridge Demolition	U785		RiskPert(S785,R785,T785,RiskName(B785&C785&H785))	37828.66	48073.92	$61,471.57
45ProjectRoadway Excavation	U787		RiskPert(S787,R787,T787,RiskName(B787&C787&H787))	25219.11	31786.58	$39,404.85
45ProjectImported Borrow	U788		RiskPert(S788,R788,T788,RiskName(B788&C788&H788))	93783.55	118206.3	$146,536.80
45ProjectHot Mix Asphalt (Type A)	U789		RiskPert(S789,R789,T789,RiskName(B789&C789&H789))	26182.33	33000.65	$40,909.90

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectClass 2 Aggregate Base	U790	9,000 16,000	RiskPert(S790,R790,T790,RiskName(B790&C790&H790))	9676.08	12195.89	$15,118.88
45ProjectMidwest Guardrail System	U791	3,500 6,000	RiskPert(S791,R791,T791,RiskName(B791&C791&H791))	3556.07	4482.13	$5,556.36
45ProjectTransition Railing (Type WB-31)	U792	14,000 22,000	RiskPert(S792,R792,T792,RiskName(B792&C792&H792))	14010.61	17659.21	$21,891.58
45ProjectAlternative Flared Terminal System	U793	3,400 5,600	RiskPert(S793,R793,T793,RiskName(B793&C793&H793))	3502.65	4414.8	$5,472.90
45ProjectRelocate Gate	U794	85 140	RiskPert(S794,R794,T794,RiskName(B794&C794&H794))	87.57	110.37	$136.82
45ProjectTemporary Reinforced Silt Fence	U795	2,600 4,200	RiskPert(S795,R795,T795,RiskName(B795&C795&H795))	2655.01	3346.42	$4,148.46
45ProjectTemporary Fence (Type ESA)	U796	1,700 2,800	RiskPert(S796,R796,T796,RiskName(B796&C796&H796))	1761.84	2220.65	$2,752.87
45ProjectTemporary Hydroseed	U797	2,200 3,600	RiskPert(S797,R797,T797,RiskName(B797&C797&H797))	2260.61	2849.31	$3,532.21
45ProjectTemporary Fiber Roll	U799	2,600 4,200	RiskPert(S799,R799,T799,RiskName(B799&C799&H799))	2659.83	3352.49	$4,155.98
45ProjectTemporary Concrete Washout	U800	0.85 1.40	RiskPert(S800,R800,T800,RiskName(B800&C800&H800))	0.88	1.1	$1.37
45ProjectTemporary Construction Entrance	U801	7,500 12,000	RiskPert(S801,R801,T801,RiskName(B801&C801&H801))	7536.4	9499	$11,775.62
45ProjectWater Pollution Control	U802	15,000 25,000	RiskPert(S802,R802,T802,RiskName(B802&C802&H802))	15486.11	19518.95	$24,197.04
45ProjectConstruction Area Signs	U803	0.85 1.40	RiskPert(S803,R803,T803,RiskName(B803&C803&H803))	0.88	1.1	$1.37
45ProjectTemporary Traffic Stripe	U804	500 850	RiskPert(S804,R804,T804,RiskName(B804&C804&H804))	525.4	662.22	$820.93
45ProjectThermoplastic Traffic Stripe	U805	200 340	RiskPert(S805,R805,T805,RiskName(B805&C805&H805))	207.09	261.03	$323.59
45ProjectType III Barricade	U806	450 800	RiskPert(S806,R806,T806,RiskName(B806&C806&H806))	480.37	605.47	$750.58
45ProjectTraffic Control System	U807	40,000 70,000	RiskPert(S807,R807,T807,RiskName(B807&C807&H807))	43783.17	55185.04	$68,411.20
45ProjectTemporary Railing (Type K)	U808	8,000 13,000	RiskPert(S808,R808,T808,RiskName(B808&C808&H808))	8231.24	10374.79	$12,861.31

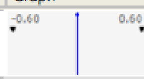
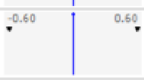
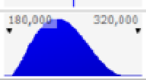
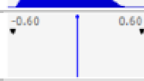
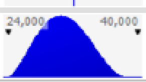
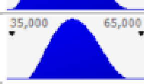
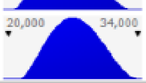
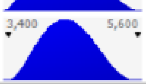
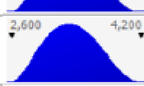
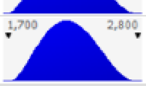
Daggett Road Bridge

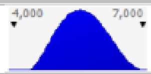
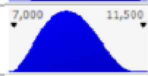
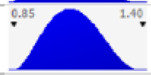
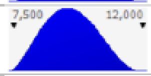
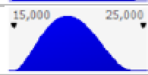
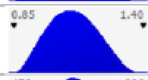
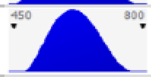
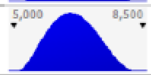
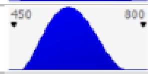
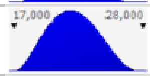
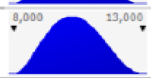
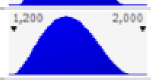
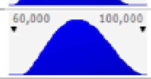
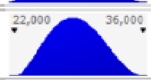
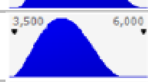
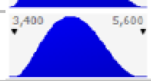
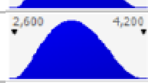
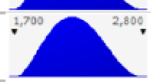
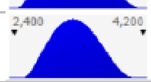
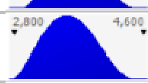
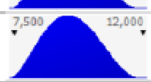
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectSheet Pile Coffer Dam For Footers	U810	240,000 400,000	RiskPert(S810,R810,T810,RiskName(B810&C810&H810))	242106	307676.4	$393,422.30
45ProjectBackfill, structural, common earth, 105 H.P. dozer, 50' haul, from existing stockpile, excludes compaction	U811	3,000 5,200	RiskPert(S811,R811,T811,RiskName(B811&C811&H811))	3169.43	4027.82	$5,150.32
45ProjectStructure Excavation (Type D)	U813	26,000 46,000	RiskPert(S813,R813,T813,RiskName(B813&C813&H813))	27243.47	34621.91	$44,270.64
45ProjectStructure Excavation (Bridge)	U814	8,000 15,000	RiskPert(S814,R814,T814,RiskName(B814&C814&H814))	8696.22	11051.45	$14,131.36
45ProjectPrestressed concrete piles, square, 40' long, 24" square, priced using 200 piles, excludes pile caps or mobilization	U815	65,000 115,000	RiskPert(S815,R815,T815,RiskName(B815&C815&H815))	69425.02	88227.63	$112,815.60
45Project18" Diameter 40' Long Tie Down Anchor Installation	U816	40,000 70,000	RiskPert(S816,R816,T816,RiskName(B816&C816&H816))	42851.99	54457.73	$69,634.48

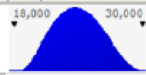
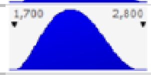
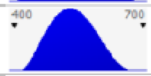
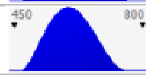
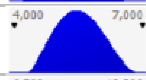
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectPiling special costs, pre-augering for Pile and Tie Down Anchor	U817		RiskPert(S817,R817,T817,RiskName(B817&C817&H817))	261911.7	332846.1	$425,606.40
45ProjectMobilization, 150 ton, set up and remove crane, with pile leads and pile hammer	U818		RiskPert(S818,R818,T818,RiskName(B818&C818&H818))	38928.68	49471.87	$63,259.11
45ProjectA736 Barrier Wall	U819		RiskPert(S819,R819,T819,RiskName(B819&C819&H819))	180069.8	228838.6	$292,613.30
45ProjectExpansion joint, neoprene, liquid, 1" x 2", cold applied	U820		RiskPert(S820,R820,T820,RiskName(B820&C820&H820))	1776.1	2257.13	$2,886.16
45ProjectColumns Structural Concrete includes forms, Grade 60 rebar, concrete, placing and finishing	U821		RiskPert(S821,R821,T821,RiskName(B821&C821&H821))	268507	341227.6	$436,323.80
45ProjectDeck Structural concrete, in place, includes forms, Grade 60 rebar, concrete, placing and finishing	U822		RiskPert(S822,R822,T822,RiskName(B822&C822&H822))	167202.9	212487	$271,704.70
45ProjectFooter Structural concrete,footing, reinforced, includes forms(4 uses), Grade 60 rebar, concrete, placing and finishing	U823		RiskPert(S823,R823,T823,RiskName(B823&C823&H823))	165438.5	210244.7	$268,837.50
45ProjectApproach Slab Structural concrete, in place, 6" thick, includes forms, Grade 60 rebar, concrete, and placing, excludes finishing	U824		RiskPert(S824,R824,T824,RiskName(B824&C824&H824))	4369.04	5552.32	$7,099.68
45ProjectPrecast 36" I-Girder 65'	U825		RiskPert(S825,R825,T825,RiskName(B825&C825&H825))	209949.7	266811	$341,168.20
45ProjectPrecast 36" I-Girder 48'	U826		RiskPert(S826,R826,T826,RiskName(B826&C826&H826))	250864.2	318806.5	$407,654.30
45ProjectBridge Demolition	U827		RiskPert(S827,R827,T827,RiskName(B827&C827&H827))	171384.8	217801.6	$278,500.30
45ProjectRoadway Excavation	U829		RiskPert(S829,R829,T829,RiskName(B829&C829&H829))	52539.8	66222.04	$82,093.44
45ProjectImported Borrow	U830		RiskPert(S830,R830,T830,RiskName(B830&C830&H830))	216726.7	273165.9	$338,635.40
45ProjectHot Mix Asphalt (Type A)	U831		RiskPert(S831,R831,T831,RiskName(B831&C831&H831))	141156.9	177916.5	$220,557.70
45ProjectClass 2 Aggregate Base	U832		RiskPert(S832,R832,T832,RiskName(B832&C832&H832))	52364.67	66001.3	$81,819.80
45ProjectRemove Base and Surfacing	U833		RiskPert(S833,R833,T833,RiskName(B833&C833&H833))	49834	62811.61	$77,865.63
45ProjectMidwest Guardrail System	U834		RiskPert(S834,R834,T834,RiskName(B834&C834&H834))	7112.14	8964.26	$11,112.71
45ProjectTransition Railing (Type WB-31)	U835		RiskPert(S835,R835,T835,RiskName(B835&C835&H835))	14010.61	17659.21	$21,891.58
45ProjectAlternative Flared Terminal System	U836		RiskPert(S836,R836,T836,RiskName(B836&C836&H836))	3502.65	4414.8	$5,472.90
45ProjectTemporary Reinforced Silt Fence	U837		RiskPert(S837,R837,T837,RiskName(B837&C837&H837))	6637.53	8366.05	$10,371.14
45ProjectTemporary Fence (Type ESA)	U838		RiskPert(S838,R838,T838,RiskName(B838&C838&H838))	4404.59	5551.61	$6,882.17
45ProjectTemporary Hydroseed	U839		RiskPert(S839,R839,T839,RiskName(B839&C839&H839))	9688.34	12211.34	$15,138.03
45ProjectTemporary Fiber Roll	U841		RiskPert(S841,R841,T841,RiskName(B841&C841&H841))	7802.16	9833.97	$12,190.88
45ProjectTemporary Construction Entrance	U842		RiskPert(S842,R842,T842,RiskName(B842&C842&H842))	3768.2	4749.5	$5,887.81
45ProjectWater Pollution Control	U843		RiskPert(S843,R843,T843,RiskName(B843&C843&H843))	51262.21	64611.74	$80,097.20

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectRoadside Sign - One Post	U844		RiskPert(S844,R844,T844,RiskName(B844&C844&H844))	236.43	298	$369.42
45ProjectRemove Roadside Sign	U845		RiskPert(S845,R845,T845,RiskName(B845&C845&H845))	175.13	220.74	$273.64
45ProjectReset Roadside Sign	U846		RiskPert(S846,R846,T846,RiskName(B846&C846&H846))	525.4	662.22	$820.93
45ProjectConstruction Area Signs	U847		RiskPert(S847,R847,T847,RiskName(B847&C847&H847))	0.88	1.1	$1.37
45ProjectThermoplastic Traffic Stripe	U848		RiskPert(S848,R848,T848,RiskName(B848&C848&H848))	1521.2	1917.35	$2,376.88
45ProjectType III Barricade	U849		RiskPert(S849,R849,T849,RiskName(B849&C849&H849))	480.37	605.47	$750.58
45ProjectTraffic Control System	U850		RiskPert(S850,R850,T850,RiskName(B850&C850&H850))	13134.95	16555.51	$20,523.36
45ProjectTemporary Railing (Type K)	U851		RiskPert(S851,R851,T851,RiskName(B851&C851&H851))	4938.74	6224.87	$7,716.78

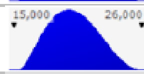
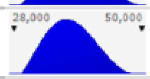
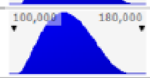
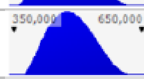
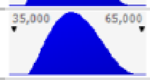
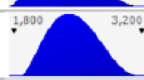
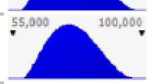
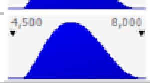
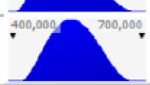
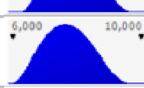
Dry Creek Bridge

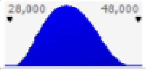
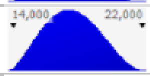
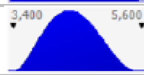
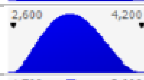
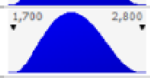
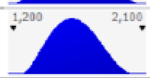
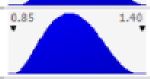
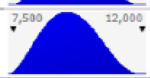
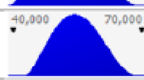
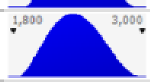
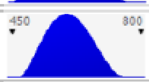
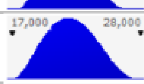
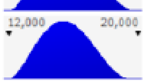
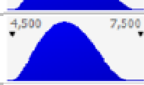
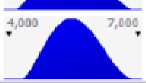
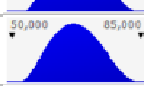
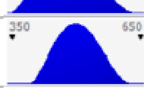
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectStructure Excavation (Bridge)	U853		RiskPert(S853,R853,T853,RiskName(B853&C853&H853))	0	0	$0.00
45ProjectA736 Barrier Wall	U854		RiskPert(S854,R854,T854,RiskName(B854&C854&H854))	0	0	$0.00
45ProjectDeck Structural concrete, in place, includes forms, Grade 60 rebar, concrete, placing and finishing	U856		RiskPert(S856,R856,T856,RiskName(B856&C856&H856))	0	0	$0.00
45ProjectFooter Structural concrete,footing, reinforced, includes forms(4 uses), Grade 60 rebar, concrete, placing and finishing	U857		RiskPert(S857,R857,T857,RiskName(B857&C857&H857))	0	0	$0.00
45ProjectApproach Slab Structural concrete, in place, 6" thick, includes forms, Grade 60 rebar, concrete, and placing, excludes finishing	U858		RiskPert(S858,R858,T858,RiskName(B858&C858&H858))	0	0	$0.00
45ProjectTemporary Bridge	U859		RiskPert(S859,R859,T859,RiskName(B859&C859&H859))	186647.6	237198	$303,302.40
45ProjectBridge Demolition	U860		RiskPert(S860,R860,T860,RiskName(B860&C860&H860))	0	0	$0.00
45ProjectRoadway Excavation	U862		RiskPert(S862,R862,T862,RiskName(B862&C862&H862))	24518.57	30903.62	$38,310.27
45ProjectImported Borrow	U863		RiskPert(S863,R863,T863,RiskName(B863&C863&H863))	39404.85	49666.53	$61,570.08
45ProjectHot Mix Asphalt (Type A)	U864		RiskPert(S864,R864,T864,RiskName(B864&C864&H864))	68301.74	86088.66	$106,721.50
45ProjectClass 2 Aggregate Base	U865		RiskPert(S865,R865,T865,RiskName(B865&C865&H865))	21628.88	27261.41	$33,795.13
45ProjectMidwest Guardrail System	U866		RiskPert(S866,R866,T866,RiskName(B866&C866&H866))	3556.07	4482.13	$5,556.36
45ProjectTransition Railing (Type WB-31)	U867		RiskPert(S867,R867,T867,RiskName(B867&C867&H867))	14010.61	17659.21	$21,891.58
45ProjectAlternative Flared Terminal System	U868		RiskPert(S868,R868,T868,RiskName(B868&C868&H868))	3502.65	4414.8	$5,472.90
45ProjectTemporary Reinforced Silt Fence	U869		RiskPert(S869,R869,T869,RiskName(B869&C869&H869))	2655.01	3346.42	$4,148.46
45ProjectTemporary Fence (Type ESA)	U870		RiskPert(S870,R870,T870,RiskName(B870&C870&H870))	1761.84	2220.65	$2,752.87

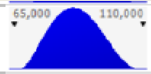
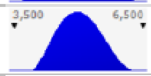
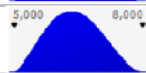
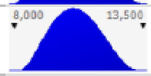
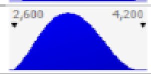
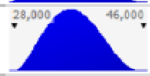
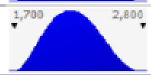
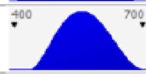
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectTemporary Hydroseed	U871		RiskPert(S871,R871,T871,RiskName(B871&C871&H871))	4440.49	5596.87	$6,938.26
45ProjectTemporary Fiber Roll	U873		RiskPert(S873,R873,T873,RiskName(B873&C873&H873))	7092.87	8939.98	$11,082.61
45ProjectTemporary Concrete Washout	U874		RiskPert(S874,R874,T874,RiskName(B874&C874&H874))	0.88	1.1	$1.37
45ProjectTemporary Construction Entrance	U875		RiskPert(S875,R875,T875,RiskName(B875&C875&H875))	7536.4	9499	$11,775.62
45ProjectWater Pollution Control	U876		RiskPert(S876,R876,T876,RiskName(B876&C876&H876))	15385.41	19392.02	$24,039.70
45ProjectConstruction Area Signs	U877		RiskPert(S877,R877,T877,RiskName(B877&C877&H877))	0.88	1.1	$1.37
45ProjectThermoplastic Traffic Stripe	U878		RiskPert(S878,R878,T878,RiskName(B878&C878&H878))	489.5	616.97	$764.84
45ProjectPortable Changeable Message Signs	U879		RiskPert(S879,R879,T879,RiskName(B879&C879&H879))	5253.98	6622.2	$8,209.34
45ProjectType III Barricade	U880		RiskPert(S880,R880,T880,RiskName(B880&C880&H880))	480.37	605.47	$750.58
45ProjectTraffic Control System	U881		RiskPert(S881,R881,T881,RiskName(B881&C881&H881))	17513.27	22074.01	$27,364.48
45ProjectTemporary Railing (Type K)	U882		RiskPert(S882,R882,T882,RiskName(B882&C882&H882))	8231.24	10374.79	$12,861.31
45ProjectRoadway Excavation	U884		RiskPert(S884,R884,T884,RiskName(B884&C884&H884))	42031.84	52977.63	$65,674.75
45ProjectDitch Excavation	U885		RiskPert(S885,R885,T885,RiskName(B885&C885&H885))	1225.93	1545.18	$1,915.51
45ProjectImported Borrow	U886		RiskPert(S886,R886,T886,RiskName(B886&C886&H886))	63835.86	80459.78	$99,743.53
45ProjectHot Mix Asphalt (Type A)	U887		RiskPert(S887,R887,T887,RiskName(B887&C887&H887))	60333.21	76044.98	$94,270.63
45ProjectClass 2 Aggregate Base	U888		RiskPert(S888,R888,T888,RiskName(B888&C888&H888))	22767.25	28696.22	$35,573.82
45ProjectMidwest Guardrail System	U889		RiskPert(S889,R889,T889,RiskName(B889&C889&H889))	3556.07	4482.13	$5,556.36
45ProjectTransition Railing (Type WB-31)	U890		RiskPert(S890,R890,T890,RiskName(B890&C890&H890))	14010.61	17659.21	$21,891.58
45ProjectAlternative Flared Terminal System	U891		RiskPert(S891,R891,T891,RiskName(B891&C891&H891))	3502.65	4414.8	$5,472.90
45ProjectTemporary Reinforced Silt Fence	U892		RiskPert(S892,R892,T892,RiskName(B892&C892&H892))	2655.01	3346.42	$4,148.46
45ProjectTemporary Fence (Type ESA)	U893		RiskPert(S893,R893,T893,RiskName(B893&C893&H893))	1761.84	2220.65	$2,752.87
45ProjectTemporary Hydroseed	U894		RiskPert(S894,R894,T894,RiskName(B894&C894&H894))	2583.56	3256.36	$4,036.81
45ProjectTemporary Fiber Roll	U896		RiskPert(S896,R896,T896,RiskName(B896&C896&H896))	2837.15	3575.99	$4,433.05
45ProjectTemporary Concrete Washout	U897		RiskPert(S897,R897,T897,RiskName(B897&C897&H897))	1.31	1.66	$2.05
45ProjectTemporary Construction Entrance	U898		RiskPert(S898,R898,T898,RiskName(B898&C898&H898))	7536.4	9499	$11,775.62

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectWater Pollution Control	U899		RiskPert(S899,R899,T899,RiskName(B899&C899&H899))	19019.41	23972.38	$29,717.83
45ProjectConstruction Area Signs	U900		RiskPert(S900,R900,T900,RiskName(B900&C900&H900))	1751.33	2207.4	$2,736.45
45ProjectTemporary Traffic Stripe	U901		RiskPert(S901,R901,T901,RiskName(B901&C901&H901))	425.84	536.73	$665.37
45ProjectType III Barricade	U902		RiskPert(S902,R902,T902,RiskName(B902&C902&H902))	480.37	605.47	$750.58
45ProjectTraffic Control System	U903		RiskPert(S903,R903,T903,RiskName(B903&C903&H903))	4378.32	5518.5	$6,841.12
45ProjectTemporary Railing (Type K)	U904		RiskPert(S904,R904,T904,RiskName(B904&C904&H904))	6584.99	8299.83	$10,289.04

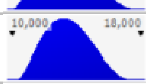
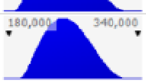
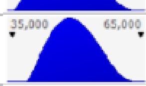
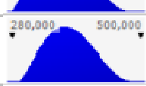
Camp Creek Bridge

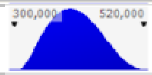
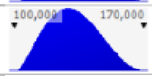
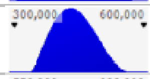
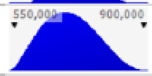
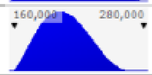
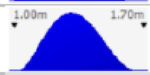
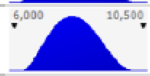
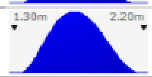
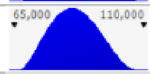
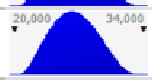
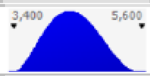
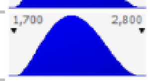
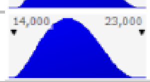
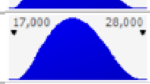
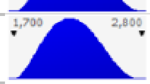
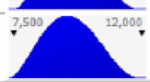
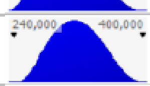
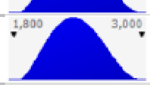
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectBackfill, structural, common earth, 105 H.P. dozer, 50' haul, from existing stockpile, excludes compaction	U906		RiskPert(S906,R906,T906,RiskName(B906&C906&H906))	14628.13	18589.92	$23,770.71
45ProjectEarth Work Coffer Dam Construction for side footers	U907		RiskPert(S907,R907,T907,RiskName(B907&C907&H907))	15847.14	20139.08	$25,751.61
45ProjectStructure Excavation (Bridge)	U908		RiskPert(S908,R908,T908,RiskName(B908&C908&H908))	29750.24	37807.6	$48,344.14
45ProjectSteel piles, "H" Sections, 50' long, HP14 X 89, excludes mobilization or demobilization	U909		RiskPert(S909,R909,T909,RiskName(B909&C909&H909))	105579.5	134174	$171,566.80
45ProjectPiling special costs, pre-augering for Pile	U910		RiskPert(S910,R910,T910,RiskName(B910&C910&H910))	381954.5	485400.5	$620,676.10
45ProjectMobilization, 150 ton, set up and remove crane, with pile leads and pile hammer	U911		RiskPert(S911,R911,T911,RiskName(B911&C911&H911))	38928.68	49471.87	$63,259.11
45ProjectA736 Barrier Wall	U912		RiskPert(S912,R912,T912,RiskName(B912&C912&H912))	150850.9	191706.3	$245,132.70
45ProjectExpansion joint, neoprene, liquid, 1" x 2", cold applied	U913		RiskPert(S913,R913,T913,RiskName(B913&C913&H913))	1930.55	2453.41	$3,137.14
45ProjectColumns Structural Concrete includes forms, Grade 60 rebar, concrete, placing and finishing	U914		RiskPert(S914,R914,T914,RiskName(B914&C914&H914))	225751.1	286892	$366,845.50
45ProjectDeck Structural concrete, in place, includes forms, Grade 60 rebar, concrete, placing and finishing	U915		RiskPert(S915,R915,T915,RiskName(B915&C915&H915))	139168.9	176860.4	$226,149.40
45ProjectFooter Structural concrete,footing, reinforced, includes forms(4 uses), Grade 60 rebar, concrete, placing and finishing	U916		RiskPert(S916,R916,T916,RiskName(B916&C916&H916))	59823.73	76025.98	$97,213.55
45ProjectApproach Slab Structural concrete, in place, 6" thick, includes forms, Grade 60 rebar, concrete, and placing, excludes finishing	U917		RiskPert(S917,R917,T917,RiskName(B917&C917&H917))	4883.04	6205.53	$7,934.94
45ProjectPrecast 36" I-Girder 67'	U918		RiskPert(S918,R918,T918,RiskName(B918&C918&H918))	104974.8	133405.5	$170,584.10
45ProjectPrecast 36" I-Girder 53'	U919		RiskPert(S919,R919,T919,RiskName(B919&C919&H919))	250864.2	318806.5	$407,654.30
45ProjectRoadway Excavation	U921		RiskPert(S921,R921,T921,RiskName(B921&C921&H921))	429775.6	541696.3	$671,524.30
45ProjectDitch Excavation	U922		RiskPert(S922,R922,T922,RiskName(B922&C922&H922))	6129.64	7725.91	$9,577.57
45ProjectImported Borrow	U923		RiskPert(S923,R923,T923,RiskName(B923&C923&H923))	494530.9	623314.9	$772,704.50
45ProjectHot Mix Asphalt (Type A)	U924		RiskPert(S924,R924,T924,RiskName(B924&C924&H924))	80823.73	101871.6	$126,287.10

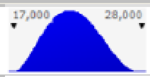
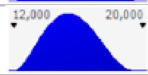
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectClass 2 Aggregate Base	U925		RiskPert(S925,R925,T925,RiskName(B925&C925&H925))	29597.42	37305.08	$46,245.97
45ProjectMidwest Guardrail System	U926		RiskPert(S926,R926,T926,RiskName(B926&C926&H926))	14224.28	17928.51	$22,225.43
45ProjectTransition Railing (Type WB-31)	U927		RiskPert(S927,R927,T927,RiskName(B927&C927&H927))	14010.61	17659.21	$21,891.58
45ProjectAlternative Flared Terminal System	U928		RiskPert(S928,R928,T928,RiskName(B928&C928&H928))	3502.65	4414.8	$5,472.90
45ProjectTemporary Reinforced Silt Fence	U929		RiskPert(S929,R929,T929,RiskName(B929&C929&H929))	2655.01	3346.42	$4,148.46
45ProjectTemporary Fence (Type ESA)	U930		RiskPert(S930,R930,T930,RiskName(B930&C930&H930))	1761.84	2220.65	$2,752.87
45ProjectTemporary Hydroseed	U931		RiskPert(S931,R931,T931,RiskName(B931&C931&H931))	1291.78	1628.18	$2,018.40
45ProjectTemporary Fiber Roll	U933		RiskPert(S933,R933,T933,RiskName(B933&C933&H933))	1595.9	2011.5	$2,493.59
45ProjectTemporary Concrete Washout	U934		RiskPert(S934,R934,T934,RiskName(B934&C934&H934))	0.88	1.1	$1.37
45ProjectTemporary Construction Entrance	U935		RiskPert(S935,R935,T935,RiskName(B935&C935&H935))	7536.4	9499	$11,775.62
45ProjectWater Pollution Control	U936		RiskPert(S936,R936,T936,RiskName(B936&C936&H936))	43590.52	54942.22	$68,110.19
45ProjectRoadside Sign - One Post	U937		RiskPert(S937,R937,T937,RiskName(B937&C937&H937))	1891.43	2383.99	$2,955.36
45ProjectConstruction Area Signs	U938		RiskPert(S938,R938,T938,RiskName(B938&C938&H938))	0.88	1.1	$1.37
45ProjectThermoplastic Traffic Stripe	U939		RiskPert(S939,R939,T939,RiskName(B939&C939&H939))	609.99	768.84	$953.10
45ProjectType III Barricade	U940		RiskPert(S940,R940,T940,RiskName(B940&C940&H940))	480.37	605.47	$750.58
45ProjectTraffic Control System	U941		RiskPert(S941,R941,T941,RiskName(B941&C941&H941))	17513.27	22074.01	$27,364.48
45ProjectTemporary Railing (Type K)	U942		RiskPert(S942,R942,T942,RiskName(B942&C942&H942))	12346.85	15562.18	$19,291.96
45ProjectRoadway Excavation	U944		RiskPert(S944,R944,T944,RiskName(B944&C944&H944))	3502.65	4414.8	$5,472.90
45ProjectDitch Excavation	U945		RiskPert(S945,R945,T945,RiskName(B945&C945&H945))	4597.23	5794.43	$7,183.18
45ProjectImported Borrow	U946		RiskPert(S946,R946,T946,RiskName(B946&C946&H946))	137917	173832.9	$215,495.30
45ProjectClearing & Grubbing	U947		RiskPert(S947,R947,T947,RiskName(B947&C947&H947))	4378.32	5518.5	$6,841.12
45ProjectHot Mix Asphalt (Type A)	U948		RiskPert(S948,R948,T948,RiskName(B948&C948&H948))	53503.03	67436.11	$83,598.48
45ProjectClass 2 Aggregate Base	U949		RiskPert(S949,R949,T949,RiskName(B949&C949&H949))	13375.76	16859.03	$20,899.62
45ProjectRock Slope Protection (Class?) Method B	U950		RiskPert(S950,R950,T950,RiskName(B950&C950&H950))	1313.5	1655.55	$2,052.34
45ProjectRock Slope Protection Fabric Class 8	U951		RiskPert(S951,R951,T951,RiskName(B951&C951&H951))	399.17	503.12	$623.70

Name	Cell	Graph	Function	Min	Mean	Max
45Project36" Alternative Pipe Culvert	U952		RiskPert(S952,R952,T952,RiskName(B952&C952&H952))	68674.77	86558.83	$107,304.30
45ProjectTemporary Reinforced Silt Fence	U953		RiskPert(S953,R953,T953,RiskName(B953&C953&H953))	3982.52	5019.63	$6,222.68
45ProjectTemporary Fence (Type ESA)	U954		RiskPert(S954,R954,T954,RiskName(B954&C954&H954))	2642.75	3330.97	$4,129.30
45ProjectTemporary Hydroseed	U955		RiskPert(S955,R955,T955,RiskName(B955&C955&H955))	5086.38	6410.96	$7,947.47
45ProjectTemporary Fiber Roll	U957		RiskPert(S957,R957,T957,RiskName(B957&C957&H957))	8440.52	10638.57	$13,188.31
45ProjectTemporary Concrete Washout	U958		RiskPert(S958,R958,T958,RiskName(B958&C958&H958))	2626.33	3310.27	$4,103.65
45ProjectTemporary Construction Entrance	U959		RiskPert(S959,R959,T959,RiskName(B959&C959&H959))	7536.4	9499	$11,775.62
45ProjectWater Pollution Control	U960		RiskPert(S960,R960,T960,RiskName(B960&C960&H960))	28766.14	36257.32	$44,947.09
45ProjectConstruction Area Signs	U961		RiskPert(S961,R961,T961,RiskName(B961&C961&H961))	1751.33	2207.4	$2,736.45
45ProjectTemporary Traffic Stripe	U962		RiskPert(S962,R962,T962,RiskName(B962&C962&H962))	446.44	562.7	$697.56
45ProjectType III Barricade	U963		RiskPert(S963,R963,T963,RiskName(B963&C963&H963))	480.37	605.47	$750.58
45ProjectTraffic Control System	U964		RiskPert(S964,R964,T964,RiskName(B964&C964&H964))	8756.63	11037.01	$13,682.24
45ProjectTemporary Railing (Type K)	U965		RiskPert(S965,R965,T965,RiskName(B965&C965&H965))	24693.71	31124.36	$38,583.92

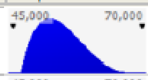
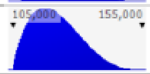
Jenny Creek Bridge

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectSheet Pile Coffer Dam For Center Footer	U967		RiskPert(S967,R967,T967,RiskName(B967&C967&H967))	80702.01	102558.8	$131,140.80
45ProjectEarth Work Coffer Dam Construction for side footers	U968		RiskPert(S968,R968,T968,RiskName(B968&C968&H968))	15847.14	20139.08	$25,751.61
45ProjectBackfill, structural, common earth, 105 H.P. dozer, 50' haul, from existing stockpile, excludes compaction	U969		RiskPert(S969,R969,T969,RiskName(B969&C969&H969))	4945.7	6285.16	$8,036.77
45ProjectStructure Excavation (Type D)	U970		RiskPert(S970,R970,T970,RiskName(B970&C970&H970))	5679.42	7217.6	$9,229.06
45ProjectStructure Excavation (Bridge)	U971		RiskPert(S971,R971,T971,RiskName(B971&C971&H971))	10628.72	13507.34	$17,271.68
45ProjectSteel piles, "H" Sections, 50' long, HP14 X 89, excludes mobilization or demobilization	U972		RiskPert(S972,R972,T972,RiskName(B972&C972&H972))	199092.8	253013.8	$323,525.80
45ProjectPiling special costs, pre-augering for Pile and Tie Down Anchor	U973		RiskPert(S973,R973,T973,RiskName(B973&C973&H973))	720257.1	915326.7	$1,170,418.00
45ProjectMobilization, 150 ton, set up and remove crane, with pile leads and pile hammer	U974		RiskPert(S974,R974,T974,RiskName(B974&C974&H974))	38928.68	49471.87	$63,259.11
45ProjectA736 Barrier Wall	U975		RiskPert(S975,R975,T975,RiskName(B975&C975&H975))	263649.3	335054.3	$428,430.10
45ProjectExpansion joint, neoprene, liquid, 1" x 2", cold applied	U976		RiskPert(S976,R976,T976,RiskName(B976&C976&H976))	2239.43	2845.94	$3,639.07
45ProjectColumns Structural Concrete includes forms, Grade 60 rebar, concrete, placing and finishing	U977		RiskPert(S977,R977,T977,RiskName(B977&C977&H977))	297581	378175.8	$483,569.10

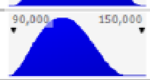
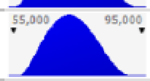
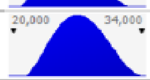
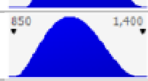
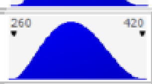
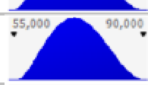
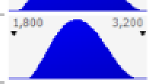
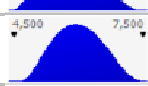
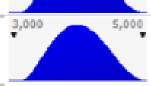
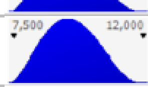
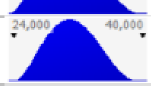
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectDeck Structural concrete, in place, includes forms, Grade 60 rebar, concrete, placing and finishing	U978		RiskPert(S978,R978,T978,RiskName(B978&C978&H978))	317385.1	403343.6	$515,750.80
45ProjectFooter Structural concrete,footing, reinforced, includes forms(4 uses), Grade 60 rebar, concrete, placing and finishing	U979		RiskPert(S979,R979,T979,RiskName(B979&C979&H979))	103768.3	131872.2	$168,623.50
45ProjectApproach Slab Structural concrete, in place, 6" thick, includes forms, Grade 60 rebar, concrete, and placing, excludes finishing	U980		RiskPert(S980,R980,T980,RiskName(B980&C980&H980))	5654.05	7185.36	$9,187.84
45ProjectPrecast 61" Bulb Tee 73'	U981		RiskPert(S981,R981,T981,RiskName(B981&C981&H981))	345877.8	439553.1	$562,051.50
45ProjectPrecast 61" Bulb Tee 100'	U982		RiskPert(S982,R982,T982,RiskName(B982&C982&H982))	552130.7	701666.1	$897,212.40
45ProjectBridge Demolition	U983		RiskPert(S983,R983,T983,RiskName(B983&C983&H983))	162978.5	207118.5	$264,840.00
45ProjectRoadway Excavation	U985		RiskPert(S985,R985,T985,RiskName(B985&C985&H985))	1050796	1324441	$1,641,869.00
45ProjectDitch Excavation	U986		RiskPert(S986,R986,T986,RiskName(B986&C986&H986))	6436.13	8112.2	$10,056.45
45ProjectImported Borrow	U987		RiskPert(S987,R987,T987,RiskName(B987&C987&H987))	1379170	1738329	$2,154,953.00
45ProjectHot Mix Asphalt (Type A)	U988		RiskPert(S988,R988,T988,RiskName(B988&C988&H988))	68301.74	86088.66	$106,721.50
45ProjectClass 2 Aggregate Base	U989		RiskPert(S989,R989,T989,RiskName(B989&C989&H989))	21059.7	26544	$32,905.79
45ProjectMidwest Guardrail System	U990		RiskPert(S990,R990,T990,RiskName(B990&C990&H990))	7112.14	8964.26	$11,112.71
45ProjectTransition Railing (Type WB-31)	U991		RiskPert(S991,R991,T991,RiskName(B991&C991&H991))	14010.61	17659.21	$21,891.58
45ProjectAlternative Flared Terminal System	U992		RiskPert(S992,R992,T992,RiskName(B992&C992&H992))	3502.65	4414.8	$5,472.90
45ProjectTemporary Reinforced Silt Fence	U993		RiskPert(S993,R993,T993,RiskName(B993&C993&H993))	2655.01	3346.42	$4,148.46
45ProjectTemporary Fence (Type ESA)	U994		RiskPert(S994,R994,T994,RiskName(B994&C994&H994))	1761.84	2220.65	$2,752.87
45ProjectTemporary Hydroseed	U995		RiskPert(S995,R995,T995,RiskName(B995&C995&H995))	14290.3	18011.73	$22,328.60
45ProjectTemporary Fiber Roll	U997		RiskPert(S997,R997,T997,RiskName(B997&C997&H997))	17661.25	22260.54	$27,595.71
45ProjectTemporary Concrete Washout	U998		RiskPert(S998,R998,T998,RiskName(B998&C998&H998))	1751.33	2207.4	$2,736.45
45ProjectTemporary Construction Entrance	U999		RiskPert(S999,R999,T999,RiskName(B999&C999&H999))	7536.4	9499	$11,775.62
45ProjectWater Pollution Control	U1000		RiskPert(S1000,R1000,T1000,RiskName(B1000&C1000&H1000))	252576.3	318351.4	$394,650.50
45ProjectRoadside Sign - One Post	U1001		RiskPert(S1001,R1001,T1001,RiskName(B1001&C1001&H1001))	1891.43	2383.99	$2,955.36
45ProjectConstruction Area Signs	U1002		RiskPert(S1002,R1002,T1002,RiskName(B1002&C1002&H1002))	1751.33	2207.4	$2,736.45
45ProjectThermoplastic Traffic Stripe	U1003		RiskPert(S1003,R1003,T1003,RiskName(B1003&C1003&H1003))	753.07	949.18	$1,176.67
45ProjectType III Barricade	U1004		RiskPert(S1004,R1004,T1004,RiskName(B1004&C1004&H1004))	480.37	605.47	$750.58

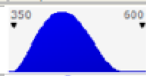
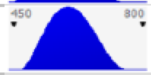
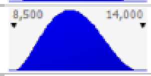
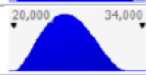
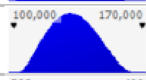
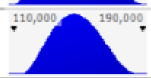
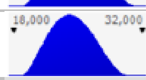
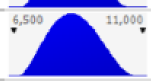
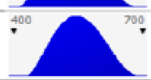
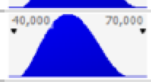
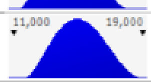
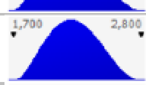
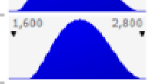
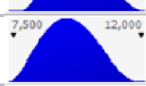
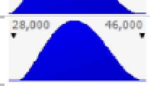
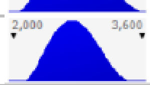
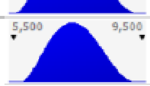
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectTraffic Control System	U1005		RiskPert(S1005,R1005,T1005,RiskName(B1005&C1005&H1005))	17513.27	22074.01	$27,364.48
45ProjectTemporary Railing (Type K)	U1006		RiskPert(S1006,R1006,T1006,RiskName(B1006&C1006&H1006))	12346.85	15562.18	$19,291.96

Other Structures

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectPedestrian Bridge Total	U1008		RiskPert(S1008,R1008,T1008,RiskName(B1008&C1008&H1008))	47285.82	54291.13	$68,301.74
45ProjectBridge Demolition Ped Bridge Campground	U1009		RiskPert(S1009,R1009,T1009,RiskName(B1009&C1009&H1009))	47285.82	54291.13	$68,301.74
45ProjectBridge Demolition Timber JC Boyle	U1010		RiskPert(S1010,R1010,T1010,RiskName(B1010&C1010&H1010))	106393.1	122155	$153,678.90

Scotch Creek

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectRoadway Excavation	U1012		RiskPert(S1012,R1012,T1012,RiskName(B1012&C1012&H1012))	19264.59	24281.42	$30,100.93
45ProjectDitch Excavation	U1013		RiskPert(S1013,R1013,T1013,RiskName(B1013&C1013&H1013))	306.48	386.3	$478.88
45ProjectImported Borrow	U1014		RiskPert(S1014,R1014,T1014,RiskName(B1014&C1014&H1014))	90631.16	114233	$141,611.20
45ProjectClearing & Grubbing	U1015		RiskPert(S1015,R1015,T1015,RiskName(B1015&C1015&H1015))	0.88	1.1	$1.37
45ProjectHot Mix Asphalt (Type A)	U1016		RiskPert(S1016,R1016,T1016,RiskName(B1016&C1016&H1016))	58056.48	73175.36	$90,713.25
45ProjectClass 2 Aggregate Base	U1017		RiskPert(S1017,R1017,T1017,RiskName(B1017&C1017&H1017))	21628.88	27261.41	$33,795.13
45ProjectRock Slope Protection (Class?) Method B	U1018		RiskPert(S1018,R1018,T1018,RiskName(B1018&C1018&H1018))	875.66	1103.7	$1,368.22
45ProjectRock Slope Protection Fabric Class 8	U1019		RiskPert(S1019,R1019,T1019,RiskName(B1019&C1019&H1019))	266.11	335.41	$415.80
45Project36" Alternative Pipe Culvert	U1020		RiskPert(S1020,R1020,T1020,RiskName(B1020&C1020&H1020))	57228.98	72132.36	$89,420.28
45ProjectTemporary Reinforced Silt Fence	U1021		RiskPert(S1021,R1021,T1021,RiskName(B1021&C1021&H1021))	1991.26	2509.82	$3,111.34
45ProjectTemporary Fence (Type ESA)	U1022		RiskPert(S1022,R1022,T1022,RiskName(B1022&C1022&H1022))	1321.38	1665.48	$2,064.65
45ProjectTemporary Hydroseed	U1023		RiskPert(S1023,R1023,T1023,RiskName(B1023&C1023&H1023))	4763.43	6003.91	$7,442.87
45ProjectTemporary Fiber Roll	U1025		RiskPert(S1025,R1025,T1025,RiskName(B1025&C1025&H1025))	3191.79	4022.99	$4,987.18
45ProjectTemporary Concrete Washout	U1026		RiskPert(S1026,R1026,T1026,RiskName(B1026&C1026&H1026))	2626.33	3310.27	$4,103.65
45ProjectTemporary Construction Entrance	U1027		RiskPert(S1027,R1027,T1027,RiskName(B1027&C1027&H1027))	7536.4	9499	$11,775.62
45ProjectWater Pollution Control	U1028		RiskPert(S1028,R1028,T1028,RiskName(B1028&C1028&H1028))	24825.92	31291.01	$38,790.50
45ProjectConstruction Area Signs	U1029		RiskPert(S1029,R1029,T1029,RiskName(B1029&C1029&H1029))	1751.33	2207.4	$2,736.45

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectTemporary Traffic Stripe	U1030		RiskPert(S1030,R1030,T1030,RiskName(B1030&C1030&H1030))	357.15	450.16	$558.05
45ProjectType III Barricade	U1031		RiskPert(S1031,R1031,T1031,RiskName(B1031&C1031&H1031))	480.37	605.47	$750.58
45ProjectTraffic Control System	U1032		RiskPert(S1032,R1032,T1032,RiskName(B1032&C1032&H1032))	8756.63	11037.01	$13,682.24
45ProjectTemporary Railing (Type K)	U1033		RiskPert(S1033,R1033,T1033,RiskName(B1033&C1033&H1033))	20578.09	25936.97	$32,153.26
45ProjectRoadway Excavation	U1035		RiskPert(S1035,R1035,T1035,RiskName(B1035&C1035&H1035))	105079.6	132444.1	$164,186.90
45ProjectDitch Excavation	U1036		RiskPert(S1036,R1036,T1036,RiskName(B1036&C1036&H1036))	306.48	386.3	$478.88
45ProjectImported Borrow	U1037		RiskPert(S1037,R1037,T1037,RiskName(B1037&C1037&H1037))	118214.6	148999.6	$184,710.20
45ProjectHot Mix Asphalt (Type A)	U1038		RiskPert(S1038,R1038,T1038,RiskName(B1038&C1038&H1038))	19352.16	24391.79	$30,237.75
45ProjectClass 2 Aggregate Base	U1039		RiskPert(S1039,R1039,T1039,RiskName(B1039&C1039&H1039))	6830.17	8608.87	$10,672.15
45ProjectRock Slope Protection Class III, Method B	U1040		RiskPert(S1040,R1040,T1040,RiskName(B1040&C1040&H1040))	437.83	551.85	$684.11
45ProjectRock Slope Protection Fabric Class 8	U1041		RiskPert(S1041,R1041,T1041,RiskName(B1041&C1041&H1041))	106.45	134.17	$166.32
45ProjectStructural Concrete, Box Culvert	U1042		RiskPert(S1042,R1042,T1042,RiskName(B1042&C1042&H1042))	42338.32	53363.93	$66,153.63
45ProjectMidwest Guardrail System	U1043		RiskPert(S1043,R1043,T1043,RiskName(B1043&C1043&H1043))	11975.57	15094.21	$18,711.83
45ProjectAlternative Flared Terminal System	U1044		RiskPert(S1044,R1044,T1044,RiskName(B1044&C1044&H1044))	3502.65	4414.8	$5,472.90
45ProjectTemporary Reinforced Silt Fence	U1045		RiskPert(S1045,R1045,T1045,RiskName(B1045&C1045&H1045))	2655.01	3346.42	$4,148.46
45ProjectTemporary Fence (Type ESA)	U1046		RiskPert(S1046,R1046,T1046,RiskName(B1046&C1046&H1046))	1761.84	2220.65	$2,752.87
45ProjectTemporary Hydroseed	U1047		RiskPert(S1047,R1047,T1047,RiskName(B1047&C1047&H1047))	1776.2	2238.75	$2,775.31
45ProjectTemporary Fiber Roll	U1049		RiskPert(S1049,R1049,T1049,RiskName(B1049&C1049&H1049))	3191.79	4022.99	$4,987.18
45ProjectTemporary Construction Entrance	U1050		RiskPert(S1050,R1050,T1050,RiskName(B1050&C1050&H1050))	7536.4	9499	$11,775.62
45ProjectWater Pollution Control	U1051		RiskPert(S1051,R1051,T1051,RiskName(B1051&C1051&H1051))	29266.56	36888.06	$45,729.00
45ProjectConstruction Area Signs	U1052		RiskPert(S1052,R1052,T1052,RiskName(B1052&C1052&H1052))	2189.16	2759.25	$3,420.56
45ProjectThermoplastic Traffic Stripe	U1053		RiskPert(S1053,R1053,T1053,RiskName(B1053&C1053&H1053))	150.61	189.84	$235.33
45ProjectTraffic Control System	U1054		RiskPert(S1054,R1054,T1054,RiskName(B1054&C1054&H1054))	8756.63	11037.01	$13,682.24
45ProjectTemporary Railing (Type K)	U1055		RiskPert(S1055,R1055,T1055,RiskName(B1055&C1055&H1055))	5879.45	7410.56	$9,186.65

Copco Rd at Beaver Creek

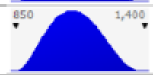
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectRoadway Excavation	U1057	100,000 170,000	RiskPert(S1057,R1057,T1057,RiskName(B1057&C1057&H1057))	105079.6	132444.1	$164,186.90
45ProjectImported Borrow	U1058	90,000 160,000	RiskPert(S1058,R1058,T1058,RiskName(B1058&C1058&H1058))	98512.13	124166.3	$153,925.20
45ProjectRock Slope Protection Class III, Method B	U1059	20,000 36,000	RiskPert(S1059,R1059,T1059,RiskName(B1059&C1059&H1059))	21891.58	27592.52	$34,205.60
45ProjectRock Slope Protection Fabric Class 8	U1060	6,000 10,000	RiskPert(S1060,R1060,T1060,RiskName(B1060&C1060&H1060))	6209.33	7826.34	$9,702.08
45Project60" CORRUGATED STEEL PIPE (.138" THICK)	U1061	18,000 30,000	RiskPert(S1061,R1061,T1061,RiskName(B1061&C1061&H1061))	18914.33	23839.94	$29,553.64
45ProjectTemporary Reinforced Silt Fence	U1062	3,500 6,500	RiskPert(S1062,R1062,T1062,RiskName(B1062&C1062&H1062))	3982.52	5019.63	$6,222.68
45ProjectTemporary Fence (Type ESA)	U1063	2,600 4,200	RiskPert(S1063,R1063,T1063,RiskName(B1063&C1063&H1063))	2642.75	3330.97	$4,129.30
45ProjectWater Pollution Control	U1064	24,000 40,000	RiskPert(S1064,R1064,T1064,RiskName(B1064&C1064&H1064))	25060.7	31586.92	$39,157.34
45ProjectConstruction Area Signs	U1065	500 850	RiskPert(S1065,R1065,T1065,RiskName(B1065&C1065&H1065))	525.4	662.22	$820.93
45ProjectTraffic Control System	U1066	8,500 14,000	RiskPert(S1066,R1066,T1066,RiskName(B1066&C1066&H1066))	8756.63	11037.01	$13,682.24
45ProjectTemporary Railing (Type K)	U1067	2,200 3,800	RiskPert(S1067,R1067,T1067,RiskName(B1067&C1067&H1067))	2351.78	2964.23	$3,674.66
45ProjectReplace and Reconstruct 60-inch Culvert No.1 at Beaver Creek	U1068	13,000 21,000	RiskPert(S1068,R1068,T1068,RiskName(B1068&C1068&H1068))	13134.95	16555.51	$20,523.36
45ProjectReplace and Reconstruct 60-inch Culvert No.2 at Beaver Creek	U1069	13,000 21,000	RiskPert(S1069,R1069,T1069,RiskName(B1069&C1069&H1069))	13134.95	16555.51	$20,523.36

Copco Rd at Raymond Gulch

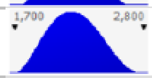
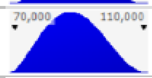
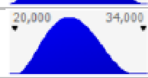
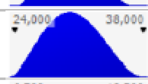
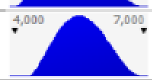
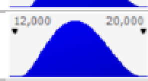
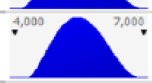
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectRock Slope Protection Class III, Method B	U1071	13,000 21,000	RiskPert(S1071,R1071,T1071,RiskName(B1071&C1071&H1071))	13134.95	16555.51	$20,523.36
45ProjectRock Slope Protection Fabric Class 8	U1072	3,400 5,600	RiskPert(S1072,R1072,T1072,RiskName(B1072&C1072&H1072))	3548.19	4472.2	$5,544.04
45ProjectTemporary Reinforced Silt Fence	U1073	3,500 6,500	RiskPert(S1073,R1073,T1073,RiskName(B1073&C1073&H1073))	3982.52	5019.63	$6,222.68
45ProjectTemporary Fence (Type ESA)	U1074	2,600 4,200	RiskPert(S1074,R1074,T1074,RiskName(B1074&C1074&H1074))	2642.75	3330.97	$4,129.30
45ProjectWater Pollution Control	U1075	16,000 27,000	RiskPert(S1075,R1075,T1075,RiskName(B1075&C1075&H1075))	16683.14	21027.71	$26,067.40
45ProjectTraffic Control System	U1076	850 1,400	RiskPert(S1076,R1076,T1076,RiskName(B1076&C1076&H1076))	875.66	1103.7	$1,368.22
45Project60-inch Culvert at Raymond Gulch	U1077	8,500 14,000	RiskPert(S1077,R1077,T1077,RiskName(B1077&C1077&H1077))	8756.63	11037.01	$13,682.24

Patricia Avenue Culverts

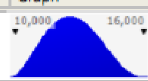
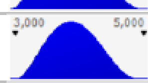
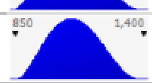
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectRock Slope Protection Class III, Method B	U1079	13,000 21,000	RiskPert(S1079,R1079,T1079,RiskName(B1079&C1079&H1079))	13134.95	16555.51	$20,523.36
45ProjectRock Slope Protection Fabric Class 8	U1080	3,400 5,600	RiskPert(S1080,R1080,T1080,RiskName(B1080&C1080&H1080))	3548.19	4472.2	$5,544.04

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectWater Pollution Control	U1081		RiskPert(S1081,R1081,T1081,RiskName(B1081&C1081&H1081))	1668.31	2102.77	$2,606.74
45ProjectTraffic Control System	U1082		RiskPert(S1082,R1082,T1082,RiskName(B1082&C1082&H1082))	875.66	1103.7	$1,368.22

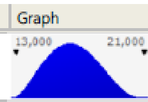
Topsy Grade Culverts

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectTrench Excavation	U1084		RiskPert(S1084,R1084,T1084,RiskName(B1084&C1084&H1084))	9632.3	12140.71	$15,050.46
45ProjectClearing & Grubbing	U1085		RiskPert(S1085,R1085,T1085,RiskName(B1085&C1085&H1085))	1751.33	2207.4	$2,736.45
45ProjectRock Slope Protection Class III, Method B	U1086		RiskPert(S1086,R1086,T1086,RiskName(B1086&C1086&H1086))	70053.07	88296.05	$109,457.90
45ProjectRock Slope Protection Fabric Class 8	U1087		RiskPert(S1087,R1087,T1087,RiskName(B1087&C1087&H1087))	20845.6	26274.15	$32,571.26
45Project24" corrugated steel pipe (.138" thick)	U1088		RiskPert(S1088,R1088,T1088,RiskName(B1088&C1088&H1088))	24080.74	30351.77	$37,626.16
45ProjectTemporary Reinforced Silt Fence	U1089		RiskPert(S1089,R1089,T1089,RiskName(B1089&C1089&H1089))	6637.53	8366.05	$10,371.14
45ProjectTemporary Fence (Type ESA)	U1090		RiskPert(S1090,R1090,T1090,RiskName(B1090&C1090&H1090))	4404.59	5551.61	$6,882.17
45ProjectWater Pollution Control	U1091		RiskPert(S1091,R1091,T1091,RiskName(B1091&C1091&H1091))	12636.3	15927.01	$19,744.22
45ProjectTraffic Control System	U1092		RiskPert(S1092,R1092,T1092,RiskName(B1092&C1092&H1092))	4378.32	5518.5	$6,841.12

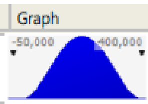
JC Boyle Unnamed Culverts

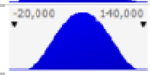
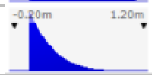
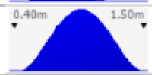
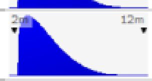
Name	Cell	Graph	Function	Min	Mean	Max
45ProjectRock Slope Protection Class III, Method B	U1094		RiskPert(S1094,R1094,T1094,RiskName(B1094&C1094&H1094))	10070.13	12692.56	$15,734.58
45ProjectRock Slope Protection Fabric Class 8	U1095		RiskPert(S1095,R1095,T1095,RiskName(B1095&C1095&H1095))	3104.67	3913.17	$4,851.04
45ProjectWater Pollution Control %	U1096		RiskPert(S1096,R1096,T1096,RiskName(B1096&C1096&H1096))	1317.48	1660.57	$2,058.56
45ProjectTraffic Control System	U1097		RiskPert(S1097,R1097,T1097,RiskName(B1097&C1097&H1097))	875.66	1103.7	$1,368.22

Other Structures

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectCopco Road at Unnamed Creek Culvert No. 1	U1099		RiskPert(S1099,R1099,T1099,RiskName(B1099&C1099&H1099))	13134.95	16555.51	$20,523.36
45ProjectCopco Road at Unnamed Creek Culvert No. 2	U1100		RiskPert(S1100,R1100,T1100,RiskName(B1100&C1100&H1100))	13134.95	16555.51	$20,523.36
45Project6'x6'x34' Box Culvert installation	U1101		RiskPert(S1101,R1101,T1101,RiskName(B1101&C1101&H1101))	13134.95	16555.51	$20,523.36

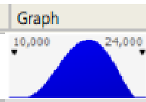
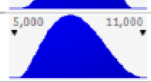
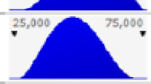
Paving

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectPre: none; Post: 0.7 miles 6" AB overlay (no drainage improvements, but some BMPs)	U1103		RiskPert(S1103,R1103,T1103,RiskName(B1103&C1103&H1103))	0	191226.9	$382,453.80
45ProjectPre: 2500CY roadway excavation, 0.9 miles 9" AB overlay (no drainage improvements, but some BMPs); Post: none	U1104		RiskPert(S1104,R1104,T1104,RiskName(B1104&C1104&H1104))	205504	281216	$400,192.00

Name	Cell	Graph	Function	Min	Mean	Max
45ProjectPre: 1 mile 9" AB repair; Post: 1 mile 9" AB repair, 0.2 mile HMA overlay, RSP	U1105		RiskPert(S1105,R1105,T1105,RiskName(B1105 &C1105&H1105))	230372.1	381184.7	$647,921.70
45ProjectPre: minor excavation and 9"' AB section; Post: none	U1106		RiskPert(S1106,R1106,T1106,RiskName(B1106 &C1106&H1106))	0	64896	$129,792.00
45ProjectPre: none; Post: none	U1107		RiskPert(S1107,R1107,T1107,RiskName(B1107 &C1107&H1107))	0	181103.1	$1,086,619.00
45ProjectPre: none; Post: none	U1108		RiskPert(S1108,R1108,T1108,RiskName(B1108 &C1108&H1108))	0	185227.6	$1,111,366.00
45ProjectPre: none; Post: none	U1109		RiskPert(S1109,R1109,T1109,RiskName(B1109 &C1109&H1109))	0	185227.6	$1,111,366.00
45ProjectPre: 0.9 mile 9" AB repair; Post: 0.9 mile 9" AB repair	U1110		RiskPert(S1110,R1110,T1110,RiskName(B1110 &C1110&H1110))	485422.1	970844.2	$1,456,266.00
45ProjectPre: minor excavation; 0.25 mile new 9" AB, 0.7 mile 9" AB repair; post: no excavation; 0.6 mile 9" AB repair	U1111		RiskPert(S1111,R1111,T1111,RiskName(B1111 &C1111&H1111))	232968	352748.7	$410,990.70
45ProjectPre: 1.5 mile 9" AB repair; post: 1.5 mile 9" AB repair; no guardrail	U1112		RiskPert(S1112,R1112,T1112,RiskName(B1112 &C1112&H1112))	238298.1	494247.9	$820,804.60
45ProjectPre: none; Post: none	U1113		RiskPert(S1113,R1113,T1113,RiskName(B1113 &C1113&H1113))	0	40495.11	$242,970.60
45ProjectPre: none; Post: 1 mile new asphalt overlay	U1114		RiskPert(S1114,R1114,T1114,RiskName(B1114 &C1114&H1114))	613050.9	1313279	$2,362,215.00
45ProjectPre: 0.5 miles crack sealer, 0.75 miles new asphalt; Post: 1 miles new asphalt overlay	U1115		RiskPert(S1115,R1115,T1115,RiskName(B1115 &C1115&H1115))	1312457	2384943	$5,798,068.00
45ProjectPre: 1 mile crack sealer, 1.5 miles new asphalt; Post: 2 miles new asphalt overlay	U1116		RiskPert(S1116,R1116,T1116,RiskName(B1116 &C1116&H1116))	2624914	4570525	$11,596,140.00
45ProjectPre: 1.5 mile 9" AB repair; Post: 1.5 mile 9" AB repair, no guardrail	U1117		RiskPert(S1117,R1117,T1117,RiskName(B1117 &C1117&H1117))	238298.1	494247.9	$820,804.60

RECREATION

Campground - Jenny Creek

Name	Cell	Graph	Function	Min	Mean	Max
46ProjectPicnic table	U1120		RiskPert(S1120,R1120,T1120,RiskName(B1120 &C1120&H1120))	11493.08	17820.94	$22,986.16
46ProjectFire grate	U1121		RiskPert(S1121,R1121,T1121,RiskName(B1121 &C1121&H1121))	3283.74	5091.7	$6,567.48
46ProjectTrash bins	U1122		RiskPert(S1122,R1122,T1122,RiskName(B1122 &C1122&H1122))	5472.9	7844.48	$10,945.79
46ProjectParking	U1123		RiskPert(S1123,R1123,T1123,RiskName(B1123 &C1123&H1123))	2736.45	4243.08	$5,472.90
46ProjectShade structure	U1124		RiskPert(S1124,R1124,T1124,RiskName(B1124 &C1124&H1124))	28459.06	48635.23	$71,147.65
46ProjectRestroom (single vault toilet)	U1125		RiskPert(S1125,R1125,T1125,RiskName(B1125 &C1125&H1125))	111647.1	139605.1	$223,294.20
46ProjectAssumed earthwork	U1126		RiskPert(S1126,R1126,T1126,RiskName(B1126 &C1126&H1126))	2626.99	4270.49	$5,253.98
46ProjectSignage	U1127		RiskPert(S1127,R1127,T1127,RiskName(B1127 &C1127&H1127))	5472.9	10945.79	$16,418.69
46ProjectOperations and maintenance	U1128		RiskPert(S1128,R1128,T1128,RiskName(B1128 &C1128&H1128))	0	232666	$656,747.50

Campground - Topsy Upgrade

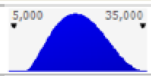
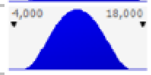
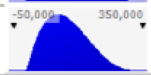
Name	Cell	Graph	Function	Min	Mean	Max
46Projectboat ramp	U1130	10,944.50 – 10,947.50	RiskPert(S1130,R1130,T1130,RiskName(B1130&C1130&H1130))	10945	10945.33	$10,947.00
46Projecttrash bins	U1131	950 – 1,200	RiskPert(S1131,R1131,T1131,RiskName(B1131&C1131&H1131))	1094.58	1094.58	$1,094.58
46ProjectOperations and maintenance	U1132	-50,000 – 250,000	RiskPert(S1132,R1132,T1132,RiskName(B1132&C1132&H1132))	0	77555.34	$218,915.80

Campground - New Campground

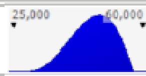
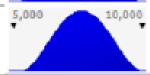
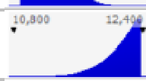
Name	Cell	Graph	Function	Min	Mean	Max
46Projectpicnic table	U1134	45,000 – 52,000	RiskPert(S1134,R1134,T1134,RiskName(B1134&C1134&H1134))	45972.33	50785	$51,748.00
46Projectfire grate	U1135	13,000 – 14,800	RiskPert(S1135,R1135,T1135,RiskName(B1135&C1135&H1135))	13134.95	14510.14	$14,786.00
46Projecttrash bins	U1136	19,500 – 24,000	RiskPert(S1136,R1136,T1136,RiskName(B1136&C1136&H1136))	21891.58	21891.58	$21,891.58
46Projectrestroom (single vault toilet)	U1137	330,000 – 390,000	RiskPert(S1137,R1137,T1137,RiskName(B1137&C1137&H1137))	334941.3	371670.9	$387,017.00
46Projectparking	U1138	10,800 – 12,400	RiskPert(S1138,R1138,T1138,RiskName(B1138&C1138&H1138))	10945.79	12091.84	$12,322.00
46Projectboat ramp	U1139	10,000 – 26,000	RiskPert(S1139,R1139,T1139,RiskName(B1139&C1139&H1139))	10945.79	22359.21	$24,643.00
46Projecttrash bins	U1140	1,000 – 2,600	RiskPert(S1140,R1140,T1140,RiskName(B1140&C1140&H1140))	1094.58	2056.7	$2,489.00
46Projectpicnic table	U1141	4,500 – 5,300	RiskPert(S1141,R1141,T1141,RiskName(B1141&C1141&H1141))	4597.23	5095.2	$5,275.00
46Projectfire grate	U1142	1,300 – 1,600	RiskPert(S1142,R1142,T1142,RiskName(B1142&C1142&H1142))	1313.5	1467.58	$1,578.00
46Projecttrash bins	U1143	1,950 – 2,400	RiskPert(S1143,R1143,T1143,RiskName(B1143&C1143&H1143))	2189.16	2189.16	$2,189.16
46Projectassumed earthwork	U1144	10,400 – 12,000	RiskPert(S1144,R1144,T1144,RiskName(B1144&C1144&H1144))	10507.96	11633.65	$11,982.00
46Projectsignage	U1145	10,000 – 35,000	RiskPert(S1145,R1145,T1145,RiskName(B1145&C1145&H1145))	10945.79	21891.58	$32,837.38
46ProjectOperations and maintenance	U1146	-0.20m – 1.40m	RiskPert(S1146,R1146,T1146,RiskName(B1146&C1146&H1146))	0	465332.1	$1,313,495.00

Recreation Area - Fall Creek

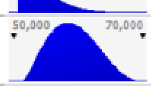
Name	Cell	Graph	Function	Min	Mean	Max
46Projectrestroom (single vault toilet)	U1148	50,000 – 120,000	RiskPert(S1148,R1148,T1148,RiskName(B1148&C1148&H1148))	55823.54	69802.53	$111,647.10
46Projectpicnic table	U1149	9,000 – 14,000	RiskPert(S1149,R1149,T1149,RiskName(B1149&C1149&H1149))	9194.47	12455.6	$13,791.70
46Projectshade structure	U1150	28,000 – 44,000	RiskPert(S1150,R1150,T1150,RiskName(B1150&C1150&H1150))	28459.06	33214.02	$42,688.59
46Projectfire grate	U1151	1,800 – 3,400	RiskPert(S1151,R1151,T1151,RiskName(B1151&C1151&H1151))	1970.24	2846.99	$3,283.74
46Projecttrash bins	U1152	4,000 – 7,000	RiskPert(S1152,R1152,T1152,RiskName(B1152&C1152&H1152))	4378.32	5472.9	$6,567.48
46Projectparking	U1153	2,000 – 4,500	RiskPert(S1153,R1153,T1153,RiskName(B1153&C1153&H1153))	2189.16	3558.74	$4,378.32

Name	Cell	Graph	Function	Min	Mean	Max
46Projectreconstructed trail	U1154		RiskPert(S1154,R1154,T1154,RiskName(B1154&C1154&H1154))	8669.07	20235	$34,676.27
46Projectassumed earthwork	U1155		RiskPert(S1155,R1155,T1155,RiskName(B1155&C1155&H1155))	1751.33	2846.99	$3,502.65
46Projectsignage	U1156		RiskPert(S1156,R1156,T1156,RiskName(B1156&C1156&H1156))	5472.9	10945.79	$16,418.69
46ProjectOperations and maintenance	U1157		RiskPert(S1157,R1157,T1157,RiskName(B1157&C1157&H1157))	0	116333	$328,373.80

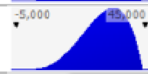
Recreation Area - Iron Gate

Name	Cell	Graph	Function	Min	Mean	Max
46Projectshade structure	U1159		RiskPert(S1159,R1159,T1159,RiskName(B1159&C1159&H1159))	28459.06	46263.64	$56,918.12
46Projectpicnic table	U1160		RiskPert(S1160,R1160,T1160,RiskName(B1160&C1160&H1160))	9194.47	14946.71	$18,388.93
46Projecttrash bins	U1161		RiskPert(S1161,R1161,T1161,RiskName(B1161&C1161&H1161))	5472.9	7662.05	$9,851.21
46Projectparking	U1162		RiskPert(S1162,R1162,T1162,RiskName(B1162&C1162&H1162))	2189.16	3558.74	$4,378.32
46Projectfire grate	U1163		RiskPert(S1163,R1163,T1163,RiskName(B1163&C1163&H1163))	2626.99	4270.49	$5,253.98
46Projectrestroom (single vault toilet)	U1164		RiskPert(S1164,R1164,T1164,RiskName(B1164&C1164&H1164))	111647.1	139605.1	$223,294.20
46Projectboat ramp	U1165		RiskPert(S1165,R1165,T1165,RiskName(B1165&C1165&H1165))	10945.79	12093.67	$12,333.00
46Projectassumed earthwork	U1166		RiskPert(S1166,R1166,T1166,RiskName(B1166&C1166&H1166))	2626.99	4270.49	$5,253.98
46Projectsignage	U1167		RiskPert(S1167,R1167,T1167,RiskName(B1167&C1167&H1167))	5472.9	10945.79	$16,418.69
46ProjectOperations and maintenance	U1168		RiskPert(S1168,R1168,T1168,RiskName(B1168&C1168&H1168))	0	116333	$328,373.80

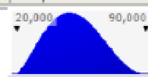
Recreation Area - River Fishing Access Sites

Name	Cell	Graph	Function	Min	Mean	Max
46Projectparking	U1170		RiskPert(S1170,R1170,T1170,RiskName(B1170&C1170&H1170))	0	9581.65	$13,134.95
46Projectportable toilet	U1171		RiskPert(S1171,R1171,T1171,RiskName(B1171&C1171&H1171))	4597.23	5237.64	$6,129.64
46Projecttrash bins	U1172		RiskPert(S1172,R1172,T1172,RiskName(B1172&C1172&H1172))	6567.48	6932.34	$8,756.63
46Projectsignage	U1173		RiskPert(S1173,R1173,T1173,RiskName(B1173&C1173&H1173))	32837.38	34661.68	$43,783.17
46Projecttrail refurbishment	U1174		RiskPert(S1174,R1174,T1174,RiskName(B1174&C1174&H1174))	52014.4	59260.16	$69,352.54
46ProjectOperations and maintenance	U1175		RiskPert(S1175,R1175,T1175,RiskName(B1175&C1175&H1175))	0	77555.34	$218,915.80

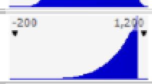
Recreation Area - New Day Use Sites

Name	Cell	Graph	Function	Min	Mean	Max
46Projectpicnic table	U1177		RiskPert(S1177,R1177,T1177,RiskName(B1177&C1177&H1177))	0	9198.27	$13,791.70
46Projectfire grate	U1178		RiskPert(S1178,R1178,T1178,RiskName(B1178&C1178&H1178))	0	2628.08	$3,940.49
46Projecttrash bins	U1179		RiskPert(S1179,R1179,T1179,RiskName(B1179&C1179&H1179))	0	4013.46	$6,567.48
46Projectshade structure	U1180		RiskPert(S1180,R1180,T1180,RiskName(B1180&C1180&H1180))	0	28470.84	$42,688.59
46Projectassumed earthwork	U1181		RiskPert(S1181,R1181,T1181,RiskName(B1181&C1181&H1181))	0	1752.05	$2,626.99
46Projectsignage	U1182		RiskPert(S1182,R1182,T1182,RiskName(B1182&C1182&H1182))	0	10033.64	$16,418.69
46ProjectOperations and maintenance	U1183		RiskPert(S1183,R1183,T1183,RiskName(B1183&C1183&H1183))	0	155110.7	$437,831.70

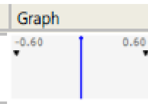
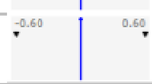
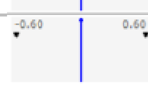
Recreation Area - New Boat Ramps

Name	Cell	Graph	Function	Min	Mean	Max
46ProjectNew boat ramps	U1185		RiskPert(S1185,R1185,T1185,RiskName(B1185&C1185&H1185))	21891.58	51098.48	$87,566.34

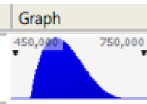
Non-motorized Recreation Trails

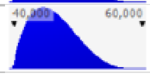
Name	Cell	Graph	Function	Min	Mean	Max
46ProjectTrail	U1207		RiskPert(S1207,R1207,T1207,RiskName(B1207&C1207&H1207))	0	751606.2	$1,387,051.00
46ProjectSignage	U1208		RiskPert(S1208,R1208,T1208,RiskName(B1208&C1208&H1208))	0	10033.64	$16,418.69
46ProjectWalking trails for recreation access to river	U1210		RiskPert(S1210,R1210,T1210,RiskName(B1210&C1210&H1210))	173381.3	268841.6	$346,762.70
46ProjectTrail Grading	U1212		RiskPert(S1212,R1212,T1212,RiskName(B1212&C1212&H1212))	0	187901.5	$346,762.70
46Projecttrash bins	U1213		RiskPert(S1213,R1213,T1213,RiskName(B1213&C1213&H1213))	0	912.15	$1,094.58
46ProjectSignage	U1214		RiskPert(S1214,R1214,T1214,RiskName(B1214&C1214&H1214))	0	10033.64	$16,418.69

Motorized Recreation Trails

Name	Cell	Graph	Function	Min	Mean	Max
46ProjectDirt Road Improvements	U1216		RiskPert(S1216,R1216,T1216,RiskName(B1216&C1216&H1216))	0	0	$0.00
46ProjectUpgrade Topsy Grade Road	U1217		RiskPert(S1217,R1217,T1217,RiskName(B1217&C1217&H1217))	0	0	$0.00
46ProjectNew Bridge over Klamath River at Frain Ranch	U1218		RiskPert(S1218,R1218,T1218,RiskName(B1218&C1218&H1218))	0	0	$0.00

Recreation, General Conditions

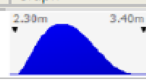
Name	Cell	Graph	Function	Min	Mean	Max
46ProjectContractor overhead	U1220		RiskPert(S1220,R1220,T1220,RiskName(B1220&C1220&H1220))	493405.1	566502.2	$712,696.30
46ProjectContractor profit	U1221		RiskPert(S1221,R1221,T1221,RiskName(B1221&C1221&H1221))	263149.4	302134.5	$380,104.70

Name	Cell	Graph	Function	Min	Mean	Max
46ProjectInsurance	U1222		RiskPert(S1222,R1222,T1222,RiskName(B1222&C1222&H1222))	40459.22	46453.18	$58,441.09
46ProjectBond	U1223		RiskPert(S1223,R1223,T1223,RiskName(B1223&C1223&H1223))	40459.22	46453.18	$58,441.09

FLOOD PROOFING

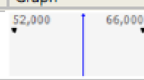
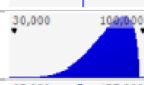
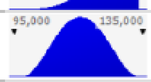
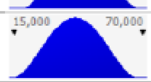
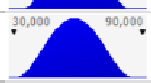
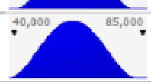
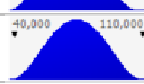
Name	Cell	Graph	Function	Min	Mean	Max
47ProjectCost to raise homes and add 2 stairs	U1226		RiskPert(S1226,R1226,T1226,RiskName(B1226&C1226&H1226))	1198946	1523660	$1,948,287.00

PUBLIC HEALTH AND SAFETY

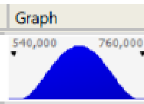
Name	Cell	Graph	Function	Min	Mean	Max
48ProjectCattle exclusion fencing	U1231		RiskPert(S1231,R1231,T1231,RiskName(B1231&C1231&H1231))	2363345	2755872	$3,316,825.00

MITIGATION MEASURES

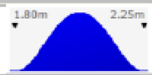
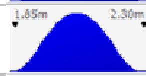
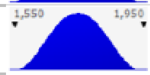
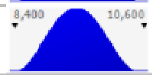
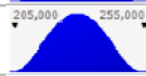
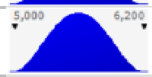
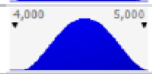
Groundwater Improvements

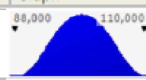
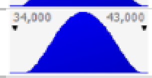
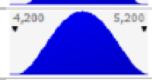
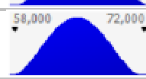
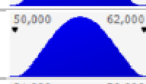
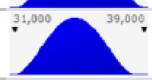
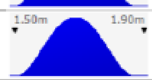
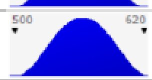
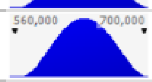
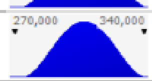
Name	Cell	Graph	Function	Min	Mean	Max
51ProjectOutreach to well owners	U1235		RiskPert(S1235,R1235,T1235,RiskName(B1235&C1235&H1235))	59488	59488	$59,488.00
51ProjectDrill and install new monitoring wells	U1236		RiskPert(S1236,R1236,T1236,RiskName(B1236&C1236&H1236))	35855	80790.7	$95,855.00
51ProjectSentinel water level monitoring of new wells and landowner for 3 years	U1237		RiskPert(S1237,R1237,T1237,RiskName(B1237&C1237&H1237))	99208.27	115743	$132,277.70
51ProjectWQ laboratory analytical testing	U1238		RiskPert(S1238,R1238,T1238,RiskName(B1238&C1238&H1238))	16548.48	41371.2	$66,193.92
51ProjectWell replacements	U1239		RiskPert(S1239,R1239,T1239,RiskName(B1239&C1239&H1239))	947949.9	1483366	$2,018,782.00
51ProjectWell abandonment	U1240		RiskPert(S1240,R1240,T1240,RiskName(B1240&C1240&H1240))	33421.44	58487.52	$83,553.60
51ProjectTemporary water supply	U1241		RiskPert(S1241,R1241,T1241,RiskName(B1241&C1241&H1241))	40105.73	60715.62	$81,325.51
51ProjectPermitting and Reporting	U1242		RiskPert(S1242,R1242,T1242,RiskName(B1242&C1242&H1242))	41219.78	74084.2	$106,948.60

Water Supply/Rights

Name	Cell	Graph	Function	Min	Mean	Max
52ProjectHay production	U1245		RiskPert(S1245,R1245,T1245,RiskName(B1245&C1245&H1245))	559202.9	652403.4	$745,603.90
52ProjectWater supply for domestic use for water rights	U1246		RiskPert(S1246,R1246,T1246,RiskName(B1246&C1246&H1246))	9306.48	9589.69	$9,988.07
52ProjectSediment removal at intakes	U1247		RiskPert(S1247,R1247,T1247,RiskName(B1247&C1247&H1247))	70054.8	140109.6	$210,164.40
52ProjectGroundwater wells - domestic	U1248		RiskPert(S1248,R1248,T1248,RiskName(B1248&C1248&H1248))	44129.28	91936	$110,323.20
52ProjectGroundwater wells - municipal	U1249		RiskPert(S1249,R1249,T1249,RiskName(B1249&C1249&H1249))	100323	110323.1	$120,323.00
52ProjectSediment basin	U1250		RiskPert(S1250,R1250,T1250,RiskName(B1250&C1250&H1250))	79677.87	79677.87	$79,677.87

CULTURAL RESOURCES

Name	Cell	Graph	Function	Min	Mean	Max
53ProjectGenerally	U1255		RiskPert(S1255,R1255,T1255,RiskName(B1255 &C1255&H1255))	1824750	2027500	$2,230,250.00
53ProjectGenerally	U1258		RiskPert(S1258,R1258,T1258,RiskName(B1258 &C1258&H1258))	1861245	2068050	$2,274,855.00
53ProjectTechnical Editor	U1266		RiskPert(S1266,R1266,T1266,RiskName(B1266 &C1266&H1266))	1572.48	1747.2	$1,921.92
53ProjectTechnical Editor	U1277		RiskPert(S1277,R1277,T1277,RiskName(B1277 &C1277&H1277))	8512.87	9458.74	$10,404.62
53ProjectCuration	U1282		RiskPert(S1282,R1282,T1282,RiskName(B1282 &C1282&H1282))	206404.6	229338.4	$252,272.30
53ProjectOther direct costs	U1283		RiskPert(S1283,R1283,T1283,RiskName(B1283 &C1283&H1283))	5034.26	5593.62	$6,152.98
53ProjectTechnical Editor	U1288		RiskPert(S1288,R1288,T1288,RiskName(B1288 &C1288&H1288))	4088.45	4542.72	$4,996.99

Name	Cell	Graph	Function	Min	Mean	Max
53ProjectTribal monitor subcontract	U1291		RiskPert(S1291,R1291,T1291,RiskName(B1291 &C1291&H1291))	89491.26	99434.73	$109,378.20
53ProjectTravel and perdiem	U1292		RiskPert(S1292,R1292,T1292,RiskName(B1292 &C1292&H1292))	34905.61	38784.01	$42,662.41
53ProjectTechnical Editor	U1296		RiskPert(S1296,R1296,T1296,RiskName(B1296 &C1296&H1296))	4251.99	4724.43	$5,196.87
53ProjectField Technician	U1299		RiskPert(S1299,R1299,T1299,RiskName(B1299 &C1299&H1299))	58312.95	64792.17	$71,271.38
53ProjectTribal monitor subcontract	U1300		RiskPert(S1300,R1300,T1300,RiskName(B1300 &C1300&H1300))	50501.9	56113.22	$61,724.54
53ProjectTravel and perdiem	U1301		RiskPert(S1301,R1301,T1301,RiskName(B1301 &C1301&H1301))	31282.47	34758.3	$38,234.13
53ProjectHuman remains	U1303		RiskPert(S1303,R1303,T1303,RiskName(B1303 &C1303&H1303))	1520155	1689062	$1,857,968.00
53ProjectOther direct costs	U1304		RiskPert(S1304,R1304,T1304,RiskName(B1304 &C1304&H1304))	506.72	563.02	$619.32
53ProjectArchaelogical unit cost	U1305		RiskPert(S1305,R1305,T1305,RiskName(B1305 &C1305&H1305))	1824186	2026874	$2,229,561.00
53ProjectOther direct costs	U1306		RiskPert(S1306,R1306,T1306,RiskName(B1306 &C1306&H1306))	506.72	563.02	$619.32
53ProjectTechnical Editor	U1311		RiskPert(S1311,R1311,T1311,RiskName(B1311 &C1311&H1311))	4170.22	4633.57	$5,096.93
53ProjectField Technician	U1314		RiskPert(S1314,R1314,T1314,RiskName(B1314 &C1314&H1314))	571915.5	635461.6	$699,007.80
53ProjectTribal monitor subcontract	U1315		RiskPert(S1315,R1315,T1315,RiskName(B1315 &C1315&H1315))	276906.4	307673.8	$338,441.10
53ProjectOther direct costs	U1316		RiskPert(S1316,R1316,T1316,RiskName(B1316 &C1316&H1316))	127076.4	141196	$155,315.70

Name	Cell	Graph	Function	Min	Mean	Max
53ProjectTechnical Editor	U1320	4,600 – 5,800	RiskPert(S1320,R1320,T1320,RiskName(B1320&C1320&H1320))	4601.31	5112.56	$5,623.82
53ProjectField Technician	U1323	620,000 – 780,000	RiskPert(S1323,R1323,T1323,RiskName(B1323&C1323&H1323))	631036.3	701151.4	$771,266.60
53ProjectTribal monitor subcontract	U1324	205,000 – 260,000	RiskPert(S1324,R1324,T1324,RiskName(B1324&C1324&H1324))	208666.9	231852.2	$255,037.40
53ProjectOther direct costs	U1325	62,000 – 78,000	RiskPert(S1325,R1325,T1325,RiskName(B1325&C1325&H1325))	62937.11	69930.12	$76,923.13
53ProjectTCP Project allowance	U1327	0.88m – 1.10m	RiskPert(S1327,R1327,T1327,RiskName(B1327&C1327&H1327))	1000000	1000000	$1,000,000.00
53ProjectAllowance for additional discoveries (reconciled with risk log)	U1328	0.88m – 1.10m	RiskPert(S1328,R1328,T1328,RiskName(B1328&C1328&H1328))	1000000	1000000	$1,000,000.00

GHG/Climate Change

Name	Cell	Graph	Function	Min	Mean	Max
54ProjectGenerated by construction work	U1331	110,000 – 200,000	RiskPert(S1331,R1331,T1331,RiskName(B1331&C1331&H1331))	110622.7	148726.1	$191,746.00

MONITORING AND OTHER COSTS

AQUATIC RESOURCES

Mainstem spawning (AR-1)

Name	Cell	Graph	Function	Min	Mean	Max
61ProjectTributary confluence monitoring (passage)	U1338	40,000 – 75,000	RiskPert(S1338,R1338,T1338,RiskName(B1338&C1338&H1338))	43979.53	52123.89	$73,299.22
61ProjectConfluence Area Maintenance (downstream tribs)	U1339	40,000 – 70,000	RiskPert(S1339,R1339,T1339,RiskName(B1339&C1339&H1339))	41230.81	48866.14	$68,718.02
61ProjectConfluence Area Maintenance (upstream tribs)	U1340	40,000 – 70,000	RiskPert(S1340,R1340,T1340,RiskName(B1340&C1340&H1340))	40721.79	48262.86	$67,869.65
61ProjectMainstem Spawning Gravel Survey (45.3 miles)	U1341	14,000 – 25,000	RiskPert(S1341,R1341,T1341,RiskName(B1341&C1341&H1341))	14761.65	17495.29	$24,602.75
61ProjectTributary Spawning Gravel Survey (13.9 miles)	U1342	20,000 – 34,000	RiskPert(S1342,R1342,T1342,RiskName(B1342&C1342&H1342))	20360.89	24131.43	$33,934.82
61ProjectReporting and Coordination	U1343	130,000 – 220,000	RiskPert(S1343,R1343,T1343,RiskName(B1343&C1343&H1343))	130309.7	154441.1	$217,182.90
61ProjectSpawning Gravel Augmentation	U1344	4.00m – 7.00m	RiskPert(S1344,R1344,T1344,RiskName(B1344&C1344&H1344))	4105774	4866103	$6,842,957.00
61ProjectLaborer (30 days)	U1345	8,000 – 15,000	RiskPert(S1345,R1345,T1345,RiskName(B1345&C1345&H1345))	8551.58	10135.2	$14,252.63
61Project200 Class Excavator (30 days)	U1346	60,000 – 105,000	RiskPert(S1346,R1346,T1346,RiskName(B1346&C1346&H1346))	61082.68	72394.29	$101,804.50

Juvenile outmigration (AR-2)

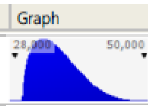
Name	Cell	Graph	Function	Min	Mean	Max
61ProjectTributary Confluence Monitoring (Passage)	U1348	40,000 – 75,000	RiskPert(S1348,R1348,T1348,RiskName(B1348&C1348&H1348))	43979.53	52123.89	$73,299.22
61ProjectTributary Confluence Monitoring (WQ)	U1349	40,000 – 75,000	RiskPert(S1349,R1349,T1349,RiskName(B1349&C1349&H1349))	43979.53	52123.89	$73,299.22
61Project2018 Mainstem Winter Seining Recon	U1350	40,000 – 75,000	RiskPert(S1350,R1350,T1350,RiskName(B1350&C1350&H1350))	42757.88	50676	$71,263.13

Name	Cell	Graph	Function	Min	Mean	Max
61Project2019 Mainstem Winter Seining	U1351		RiskPert(S1351,R1351,T1351,RiskName(B1351&C1351&H1351))	61082.68	72394.29	$101,804.50
61ProjectFish Transport (1 Truck)	U1352		RiskPert(S1352,R1352,T1352,RiskName(B1352&C1352&H1352))	18324.8	21718.29	$30,541.34
61ProjectFish Rescue and Relocation Crew	U1353		RiskPert(S1353,R1353,T1353,RiskName(B1353&C1353&H1353))	171031.5	202704	$285,052.50
61ProjectFish Transport (2 Trucks)	U1354		RiskPert(S1354,R1354,T1354,RiskName(B1354&C1354&H1354))	153928.4	182433.6	$256,547.30
61ProjectReporting and Coordination	U1355		RiskPert(S1355,R1355,T1355,RiskName(B1355&C1355&H1355))	130309.7	154441.1	$217,182.90
61ProjectMiscellaneous Equipment	U1356		RiskPert(S1356,R1356,T1356,RiskName(B1356&C1356&H1356))	30541.34	36197.14	$50,902.23
61ProjectH2O Monitoring Equipment	U1357		RiskPert(S1357,R1357,T1357,RiskName(B1357&C1357&H1357))	152706.7	180985.7	$254,511.20
61ProjectH2O Monitoring Equipment	U1358		RiskPert(S1358,R1358,T1358,RiskName(B1358&C1358&H1358))	7940.75	9411.26	$13,234.58
61ProjectTechnician Equipment	U1359		RiskPert(S1359,R1359,T1359,RiskName(B1359&C1359&H1359))	17103.15	20270.4	$28,505.25

Sucker rescue and relocation plan (AR-6)

Name	Cell	Graph	Function	Min	Mean	Max
61ProjectSucker Recapture Study (Spring and Fall)	U1363		RiskPert(S1363,R1363,T1363,RiskName(B1363&C1363&H1363))	85515.75	101352	$142,526.30
61ProjectSucker Salvage	U1364		RiskPert(S1364,R1364,T1364,RiskName(B1364&C1364&H1364))	85515.75	101352	$142,526.30
61ProjectSucker Transport (1 Truck)	U1365		RiskPert(S1365,R1365,T1365,RiskName(B1365&C1365&H1365))	6413.68	7601.4	$10,689.47
61ProjectReporting and Coordination	U1366		RiskPert(S1366,R1366,T1366,RiskName(B1366&C1366&H1366))	97732.29	115830.9	$162,887.10
61ProjectBoat Electrofisher	U1367		RiskPert(S1367,R1367,T1367,RiskName(B1367&C1367&H1367))	10994.88	13030.97	$18,324.80
61ProjectBoats (2 boats)	U1368		RiskPert(S1368,R1368,T1368,RiskName(B1368&C1368&H1368))	20523.78	24324.48	$34,206.30
61ProjectTechnician Equipment	U1369		RiskPert(S1369,R1369,T1369,RiskName(B1369&C1369&H1369))	14659.84	17374.63	$24,433.07
61ProjectTagging Equipment	U1370		RiskPert(S1370,R1370,T1370,RiskName(B1370&C1370&H1370))	12216.54	14478.86	$20,360.89

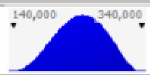
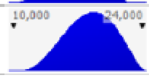
Freshwater mussel relocation (AR-7)

Name	Cell	Graph	Function	Min	Mean	Max
61ProjectFreshwater Mussel Reconnaissance	U1374		RiskPert(S1374,R1374,T1374,RiskName(B1374&C1374&H1374))	29930.51	35473.2	$49,884.19
61ProjectMussel Salvage and Relocation	U1375		RiskPert(S1375,R1375,T1375,RiskName(B1375&C1375&H1375))	74826.28	88683	$124,710.50
61ProjectMussel Transport (1 Truck)	U1376		RiskPert(S1376,R1376,T1376,RiskName(B1376&C1376&H1376))	6413.68	7601.4	$10,689.47
61ProjectReporting and Coordination	U1377		RiskPert(S1377,R1377,T1377,RiskName(B1377&C1377&H1377))	97732.29	115830.9	$162,887.10
61ProjectMiscellaneous Equipment	U1378		RiskPert(S1378,R1378,T1378,RiskName(B1378&C1378&H1378))	6108.27	7239.43	$10,180.45
61ProjectDiving Gear	U1379		RiskPert(S1379,R1379,T1379,RiskName(B1379&C1379&H1379))	6108.27	7239.43	$10,180.45

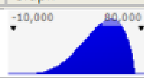
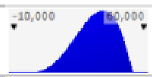
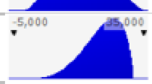
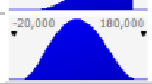
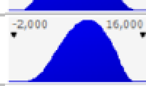
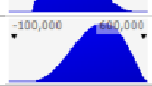
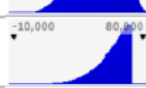
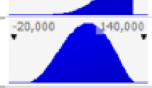
Name	Cell	Graph	Function	Min	Mean	Max
61ProjectTechnician Equipment	U1380		RiskPert(S1380,R1380,T1380,RiskName(B1380 &C1380&H1380))	12216.54	14478.86	$20,360.89

TERRESTRIAL RESOURCES MEASURES

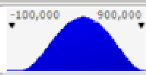
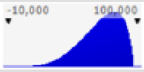
Habitat restoration plan (TER-1)

Name	Cell	Graph	Function	Min	Mean	Max
62ProjectAnnual maintenance and monitoring	U1385		RiskPert(S1385,R1385,T1385,RiskName(B1385 &C1385&H1385))	149036.3	245110.5	$328,051.30
62ProjectAnnual reporting	U1386		RiskPert(S1386,R1386,T1386,RiskName(B1386 &C1386&H1386))	21560.41	35218.25	$46,013.06
62ProjectPost construction regulatory compliance and reporting	U1387		RiskPert(S1387,R1387,T1387,RiskName(B1387 &C1387&H1387))	11205.67	18304.11	$23,914.53

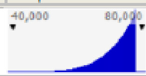
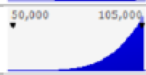
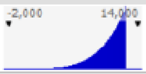
Nesting Bird Surveys (TER-2); Osprey nests

Name	Cell	Graph	Function	Min	Mean	Max
62ProjectRemove all nest platforms near construction, year 1	U1389		RiskPert(S1389,R1389,T1389,RiskName(B1389 &C1389&H1389))	0	50908.96	$73,384.40
62ProjectNest exclusion monitoring, year 1	U1390		RiskPert(S1390,R1390,T1390,RiskName(B1390 &C1390&H1390))	0	113862.8	$203,392.70
62ProjectRemove all nest platforms near construction, year 2	U1391		RiskPert(S1391,R1391,T1391,RiskName(B1391 &C1391&H1391))	0	33739.17	$52,454.66
62ProjectNest exclusion monitoring, year 2	U1392		RiskPert(S1392,R1392,T1392,RiskName(B1392 &C1392&H1392))	0	118417.3	$211,528.40
62ProjectRegulatory compliance and reporting, permitting	U1393		RiskPert(S1393,R1393,T1393,RiskName(B1393 &C1393&H1393))	0	9741.32	$14,173.29
62ProjectRemove nests near construction, year 1	U1394		RiskPert(S1394,R1394,T1394,RiskName(B1394 &C1394&H1394))	0	30127.18	$59,539.92
62ProjectNest exclusion monitoring, year 1	U1395		RiskPert(S1395,R1395,T1395,RiskName(B1395 &C1395&H1395))	0	76064.6	$158,562.60
62ProjectRemove nests near construction, year 2	U1396		RiskPert(S1396,R1396,T1396,RiskName(B1396 &C1396&H1396))	0	21967.77	$30,731.29
62ProjectNest exclusion monitoring, year 2	U1397		RiskPert(S1397,R1397,T1397,RiskName(B1397 &C1397&H1397))	0	79107.19	$164,905.10
62ProjectRegulatory compliance and reporting, permitting	U1398		RiskPert(S1398,R1398,T1398,RiskName(B1398 &C1398&H1398))	0	7896.55	$14,173.29
62ProjectNesting bird surveys prior to vegetation clearing	U1399		RiskPert(S1399,R1399,T1399,RiskName(B1399 &C1399&H1399))	0	83024.16	$234,511.80
62ProjectDaily biological monitoring throughout construction	U1400		RiskPert(S1400,R1400,T1400,RiskName(B1400 &C1400&H1400))	0	350110.1	$596,371.90
62ProjectRegulatory compliance and reporting during construction	U1401		RiskPert(S1401,R1401,T1401,RiskName(B1401 &C1401&H1401))	0	57633.33	$70,432.00
62ProjectSpecial status wildlife and habitat monitoring	U1402		RiskPert(S1402,R1402,T1402,RiskName(B1402 &C1402&H1402))	0	68544.35	$125,783.20
62ProjectConstruction timing and activity restrictions (if nest present)	U1403		RiskPert(S1403,R1403,T1403,RiskName(B1403 &C1403&H1403))	0	0	$0.00
62ProjectSecond year of protocol studies (if nest present)	U1404		RiskPert(S1404,R1404,T1404,RiskName(B1404 &C1404&H1404))	0	0	$0.00
62ProjectMonitoring nest during breeding season (if nest present)	U1405		RiskPert(S1405,R1405,T1405,RiskName(B1405 &C1405&H1405))	0	0	$0.00

Wetlands at Reservoirs (TER-5)

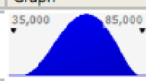
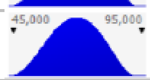
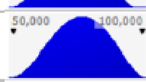
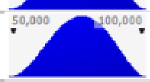
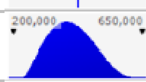
Name	Cell	Graph	Function	Min	Mean	Max
62ProjectWetland Project	U1414		RiskPert(S1414,R1414,T1414,RiskName(B1414 &C1414&H1414))	0	450935.6	$887,086.40
62ProjectMonitoring	U1415		RiskPert(S1415,R1415,T1415,RiskName(B1415 &C1415&H1415))	0	68159.49	$93,676.32

Special Status Bats (TER-6)

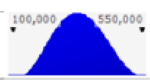
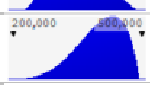
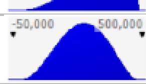
Name	Cell	Graph	Function	Min	Mean	Max
62ProjectPre-Demolition Exclusion	U1417		RiskPert(S1417,R1417,T1417,RiskName(B1417 &C1417&H1417))	43310.77	71501.52	$77,139.68
62ProjectBiological Monitoring During Demolition	U1420		RiskPert(S1420,R1420,T1420,RiskName(B1420 &C1420&H1420))	54925.15	95714.68	$103,872.60
62ProjectDesign Replacement Roosts	U1422		RiskPert(S1422,R1422,T1422,RiskName(B1422 &C1422&H1422))	0	10090.14	$12,108.17
62ProjectMonitor Replacement Roosts (3 years)	U1424		RiskPert(S1424,R1424,T1424,RiskName(B1424 &C1424&H1424))	0	233382	$280,058.30

WATER QUALITY MONITORING

Field installation & equipment

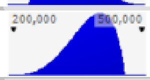
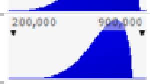
Name	Cell	Graph	Function	Min	Mean	Max
63ProjectKeno	U1427		RiskPert(S1427,R1427,T1427,RiskName(B1427 &C1427&H1427))	39520	62533.46	$82,336.80
63ProjectCopco	U1429		RiskPert(S1429,R1429,T1429,RiskName(B1429 &C1429&H1429))	0	86273.82	$126,969.00
63ProjectWalker Bridge	U1431		RiskPert(S1431,R1431,T1431,RiskName(B1431 &C1431&H1431))	83283.2	91125.7	$113,681.60
63ProjectSeiad Valley	U1432		RiskPert(S1432,R1432,T1432,RiskName(B1432 &C1432&H1432))	45427.2	69768.61	$91,535.80
63ProjectOrleans	U1433		RiskPert(S1433,R1433,T1433,RiskName(B1433 &C1433&H1433))	45760	69361.07	$90,854.40
63ProjectShasta	U1435		RiskPert(S1435,R1435,T1435,RiskName(B1435 &C1435&H1435))	50618.88	76251.72	$99,803.55
63ProjectScott	U1436		RiskPert(S1436,R1436,T1436,RiskName(B1436 &C1436&H1436))	50618.88	76251.72	$99,803.55
Trinity	U1438		RiskPert(S1438,R1438,T1438,RiskName(H143 8))	0	0	$0.00
63ProjectEquipment replacement	U1439		RiskPert(S1439,R1439,T1439,RiskName(B1439 &C1439&H1439))	246764.7	403048.9	$616,911.60

Operation & Maintenance

Name	Cell	Graph	Function	Min	Mean	Max
63ProjectKeno	U1441		RiskPert(S1441,R1441,T1441,RiskName(B1441 &C1441&H1441))	148444	330459.1	$529,830.80
63ProjectJC Boyle	U1442		RiskPert(S1442,R1442,T1442,RiskName(B1442 &C1442&H1442))	206040.8	400204.1	$484,802.00
63ProjectCopco	U1443		RiskPert(S1443,R1443,T1443,RiskName(B1443 &C1443&H1443))	0	246998.4	$465,449.30
63ProjectIron Gate	U1444		RiskPert(S1444,R1444,T1444,RiskName(B1444 &C1444&H1444))	109431.8	124498.5	$137,979.20

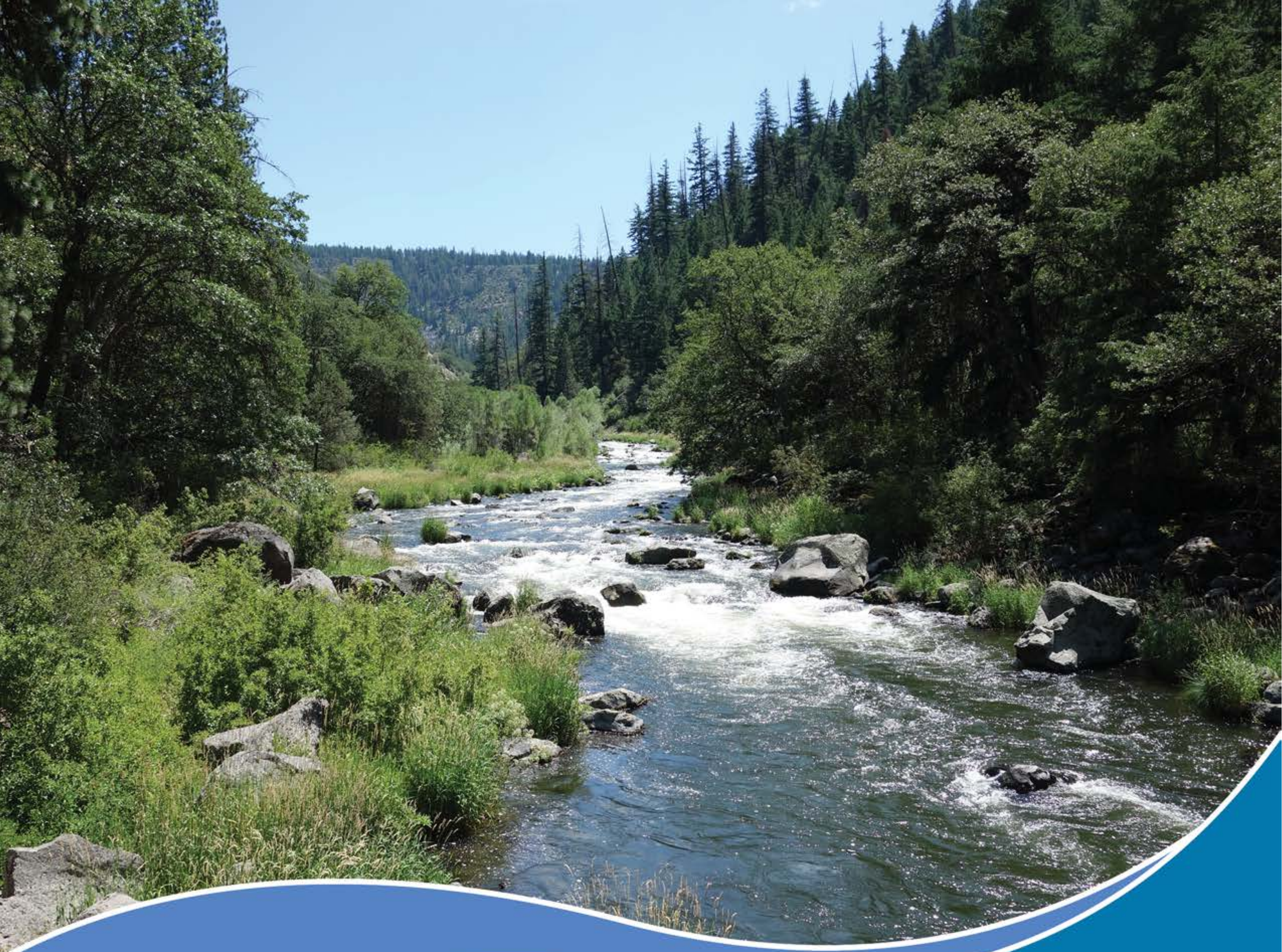
Name	Cell	Graph	Function	Min	Mean	Max
63ProjectWalker Bridge	U1445		RiskPert(S1445,R1445,T1445,RiskName(B1445&C1445&H1445))	153598.3	195411.1	$319,996.40
63ProjectSeiad Valley	U1446		RiskPert(S1446,R1446,T1446,RiskName(B1446&C1446&H1446))	43632.18	98738.01	$121,200.50
63ProjectOrleans	U1447		RiskPert(S1447,R1447,T1447,RiskName(B1447&C1447&H1447))	49958	114586.2	$137,979.20
63ProjectKlamath	U1448		RiskPert(S1448,R1448,T1448,RiskName(B1448&C1448&H1448))	42821.14	113396.7	$137,979.20
63ProjectShasta	U1449		RiskPert(S1449,R1449,T1449,RiskName(B1449&C1449&H1449))	32012.73	63432.63	$124,493.90
63ProjectScott	U1450		RiskPert(S1450,R1450,T1450,RiskName(B1450&C1450&H1450))	32012.73	63432.63	$124,493.90
63ProjectSalmon	U1451		RiskPert(S1451,R1451,T1451,RiskName(B1451&C1451&H1451))	0	8436.5	$50,619.00
63ProjectTrinity	U1452		RiskPert(S1452,R1452,T1452,RiskName(B1452&C1452&H1452))	0	8436.5	$50,619.00

Sediment, Sampling & Recording

Name	Cell	Graph	Function	Min	Mean	Max
63ProjectKeno	U1454		RiskPert(S1454,R1454,T1454,RiskName(B1454&C1454&H1454))	187552	260547.5	$397,373.10
63ProjectJC Boyle	U1455		RiskPert(S1455,R1455,T1455,RiskName(B1455&C1455&H1455))	206040.8	377337.6	$454,501.90
63ProjectCopco	U1456		RiskPert(S1456,R1456,T1456,RiskName(B1456&C1456&H1456))	0	231561	$436,358.70
63ProjectIron Gate	U1457		RiskPert(S1457,R1457,T1457,RiskName(B1457&C1457&H1457))	656590.9	746991.1	$827,875.40
63ProjectWalker Bridge	U1458		RiskPert(S1458,R1458,T1458,RiskName(B1458&C1458&H1458))	335123.5	426351.6	$698,173.90
63ProjectSeiad Valley	U1459		RiskPert(S1459,R1459,T1459,RiskName(B1459&C1459&H1459))	261793.1	592428.1	$727,203.00
63ProjectOrleans	U1460		RiskPert(S1460,R1460,T1460,RiskName(B1460&C1460&H1460))	299748	687517.3	$827,875.40
63ProjectKlamath	U1461		RiskPert(S1461,R1461,T1461,RiskName(B1461&C1461&H1461))	342569.2	482134.3	$551,916.90
63ProjectShasta	U1462		RiskPert(S1462,R1462,T1462,RiskName(B1462&C1462&H1462))	117380	275190.9	$547,773.40
63ProjectScott	U1463		RiskPert(S1463,R1463,T1463,RiskName(B1463&C1463&H1463))	117380	275190.9	$547,773.40
63ProjectSalmon	U1464		RiskPert(S1464,R1464,T1464,RiskName(B1464&C1464&H1464))	0	37120.5	$222,723.00
63ProjectTrinity	U1465		RiskPert(S1465,R1465,T1465,RiskName(B1465&C1465&H1465))	0	37120.5	$222,723.00
63ProjectData Management	U1466		RiskPert(S1466,R1466,T1466,RiskName(B1466&C1466&H1466))	360111.8	561594.1	$738,167.60
63ProjectODCs	U1467		RiskPert(S1467,R1467,T1467,RiskName(B1467&C1467&H1467))	133840	221553.7	$432,943.30
63ProjectEsturary and river sampling for toxins	U1468		RiskPert(S1468,R1468,T1468,RiskName(B1468&C1468&H1468))	222896.1	243885.5	$304,253.20
63ProjectTSS and NTU laboratory relationship study by USGS	U1469		RiskPert(S1469,R1469,T1469,RiskName(B1469&C1469&H1469))	167172.1	182914.1	$228,189.90

Other

Name	Cell	Graph	Function	Min	Mean	Max
63ProjectAnnual aircraft surveys + 1 after 5 year gap	U1471		RiskPert(S1471,R1471,T1471,RiskName(B1471&C1471&H1471))	341123.5	404294.5	$568,539.10
63ProjectAnnual field survey; 2 wk field survey + study.	U1472		RiskPert(S1472,R1472,T1472,RiskName(B1472&C1472&H1472))	142134.8	168456	$236,891.30
63ProjectDrone LiDAR in site specific locations, analysis & reporting	U1473		RiskPert(S1473,R1473,T1473,RiskName(B1473&C1473&H1473))	86807.23	102882.6	$144,678.70
63ProjectSurface comparison and analysis of sediment erosion	U1474		RiskPert(S1474,R1474,T1474,RiskName(B1474&C1474&H1474))	86807.23	102882.6	$144,678.70



Definite Plan for the Lower Klamath Project

Appendix Q – Draft Recreation Plan

KLAMATH RIVER RENEWAL CORPORATION

June 2018

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Prepared for:

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Acronyms

BLM Bureau of Land Management

CDFW California Fish and Wildlife

Chapter 1: Introduction

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1. INTRODUCTION

KRRC developed this Draft Recreation Plan to provide information on the changes to existing recreation sites that will occur as part of the decommissioning and removal of the Lower Klamath Project consistent with the terms of the KHSA (the Project) and to provide a programmatic level of detail on proposed recreation opportunities and facilities that are consistent with pre-hydropower development conditions. KRRC developed this Draft Recreation Plan with input from a variety of stakeholders including tribes, state and federal agencies, county agencies and chambers of commerce, local residents, and public interest groups.

1.1 Existing Recreation Sites

Recreation sites are located throughout the project area from J.C. Boyle Reservoir to the Iron Gate fish hatchery. The existing recreation facilities and their planned disposition as part of the Project is presented in Tables 1-1 and 1-2.

Table 1-1 Existing PacifiCorp Recreation Facilities in the Project Area and Proposed Actions

Site	Property Type[1]	Facilities	Proposed Action	Estimated Annual Use[2]
J.C. Boyle Reservoir Recreation				40 – 65%
Pioneer Park (East and West)	Parcel A	Picnic areas, boat launches, shoreline fishing, interpretive signs, restrooms	Remove	
Stateline Take-out	Parcel A	Boat put-in/take-out, shoreline fishing access, restrooms. Upstream of Copco Lake	Unknown	
Fishing Access Sites 1-6	Parcel A	Shoreline fishing access, parking. Upstream of Copco Lake	Unknown	
Copco Lake Recreation				5 – 15%
Mallard Cove	Parcel B	Day use/picnic area, restrooms, boat launch with boarding dock, interpretive signs	Remove	
Copco Cove	Parcel B	Picnic area, restrooms, boat launch with boarding dock, interpretive signs	Remove	
Iron Gate Reservoir Recreation				5 – 25%

Site	Property Type[1]	Facilities	Proposed Action	Estimated Annual Use[2]
Fall Creek Day Use Area and Fall Creek Trail	Parcel B	Picnic areas, boat launch, restroom, hiking trail	Retain / modify	
Overlook Point	Parcel B	Picnic area, restrooms	Remove	
Wanaka Springs Day Use Area	Parcel B	Day use/ camping areas, fishing dock, restrooms, interpretive signs	Remove	
Jenny Creek Day Use Area and Campground	Parcel B	Campsites/day use areas (6), hiking trails, shoreline fishing, restrooms	Retain / modify	
Camp Creek Day Use Area and Campground (including Dutch or Scotch Creek)	Parcel B	Campsites (22), boat launch, boarding and fishing docks (3), swimming area, a RV dump station, interpretive display, restrooms	Remove	
Juniper Point Day Use Area and Campground	Parcel B	Campsites (9), a fishing dock, interpretive signs, restroom	Remove	
Mirror Cove Day Use Area and Campground	Parcel B	Campsites (10), a boat launch, fishing dock, interpretive signs, restroom	Remove	
Long Gulch Day Use Area and Campground	Parcel B	Picnic sites, boat launch, restrooms	Remove	
Iron Gate Fish Hatchery Day Use Area	Parcel B	Picnic areas, picnic shelter, visitor center, interpretive kiosks, restrooms, trail to river, fishing dock, boat launch (3)	Retain / Modify	

Notes

1. Parcel A lands will remain with PacifiCorp because these parcels are not directly related to the hydroelectric facilities to be transferred to KRRC (J.C. Boyle, Copco 1&2, and Iron Gate). Parcel B lands are directly related to these four hydroelectric facilities. According to the 2016 Amended KHSA, Parcel B lands are to be transferred to through KRRC to the states or other entities they designate and are intended for the public interest. There are over 8,000 acres of Parcel B land.
2. Data from 2015 PacifiCorp Licensed Hydropower Development Recreation Reports for J.C. Boyle, Copco 1, Copco 2, and Iron Gate.

Table 1-2 Other Existing Recreation Facilities in the Project Area and Proposed Actions

Site	Ownership	Facilities	Reservoir	Proposed Action
Topsy Campground	BLM	Campsites (15), an RV dump, day use areas (2), a boat launch with boarding dock, an accessible fishing pier, restrooms	J.C. Boyle	Modify / Retain
Sportsman's Park	Klamath County	Shooting ranges, dirt racetracks, archery courses, a model aircraft flying field, OHV area, restrooms	J.C. Boyle	Unchanged
Spring Island Boater Access	BLM	Boat launch, shoreline fishing access, interpretive signs, restrooms. Located downstream of J.C. Boyle	J.C. Boyle	Unknown
Klamath River Campground	BLM	Campsites (3), shoreline fishing and boating access, restrooms. Located downstream of J.C. Boyle	J.C. Boyle	Unknown
Turtle Camp	BLM	Primitive camping site downstream of J.C. Boyle	J.C. Boyle	Unknown
Dispersed Site	BLM	Primitive camping site downstream of J.C. Boyle	J.C. Boyle	Unknown

As shown in Tables 1-1 and 1-2, the Project will result in the removal of up to 9 recreation sites that are FERC license requirements along the Klamath River between J.C. Boyle Reservoir and Iron Gate Dam. This will include three separate recreation sites with campgrounds that provide a total of 41 campsites, 5 boat launches, 9 fishing docs, 9 recreation sites with restrooms, and 9 sites that support fishing access.

1.2 Existing Recreation Activities

The existing recreation sites described above primarily provide fishing, boating, and day use access to the three reservoirs. Some sites provide camping facilities for overnight use. In addition, whitewater rafting and associated put-ins, take-outs, and camping occurs in the Hell's Corner Reach between J.C. Boyle powerhouse and Copco Lake. Release flows from J.C. Boyle powerhouse supports whitewater rafting, which operates on a regular schedule and provides consistent flows during daylight hours.

The Project includes permanent removal of recreation sites associated with the reservoirs and the reduction in the number of days with acceptable flows associated with the FERC licensed hydropower facilities for whitewater boating in the Hell's Corner Reach, due to the removal of the J.C. Boyle development. Specifically, at the four developments, KRRC will completely remove a number of recreational facilities and the former recreation areas, parking areas, and access trails will be regraded and revegetated. In the Hell's Corner

Reach of the Klamath River, there will be a loss of flows acceptable for whitewater boating in the only Class IV+ rapids in the region that occur during the late summer.

1.3 Recreation Objectives

This Draft Recreation Plan seeks to identify recreation opportunities that will offset the removal of reservoir recreation sites and the reduction in whitewater boating days associated with the Project. The goal of the plan is to provide new riverine opportunities and facilities that are consistent with pre-hydropower development conditions. The recreation opportunities identified in this plan will need to be implementable by KRRC, offset the removal of reservoir recreation facilities and river access, and represent durable solutions – with parties responsible for maintenance and upkeep identified.

Chapter 2: Recreation Option Identification

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KLAMATH RIVER RENEWAL CORPORATION

2. RECREATION OPPORTUNITY IDENTIFICATION

2.1 Recreation Opportunity Identification Process

KRRC has implemented a comprehensive recreation opportunity survey to support development of a Recreation Plan that will be included in the Project. KRRC has considered opportunities identified in the 2011 *Detailed Plan for Dam Removal – Klamath River Dams* (Detailed Plan) by Reclamation. In addition, KRRC has started an on-going stakeholder outreach process seeking input from potentially impacted recreation users, operators, managers and administrators, including Tribes, state and federal agencies, county agencies and chambers of commerce, local residents, recreation businesses, and public interest groups. This stakeholder outreach process will continue through the development of the Final Recreation Plan scheduled for completion in June of 2019.

The recreation opportunities identified in this plan are all presented at a programmatic or planning level of detail with some opportunities including more detail than others depending on their level development as a part of earlier studies or review by stakeholders. The descriptions presented in Sections 2.2 and 2.3 provide at a minimum, sufficient detail to give reviewers an indication of the specific type of recreation condition they will offset or improve, their general location, the source that identified the opportunity, and in the case of new facilities, their future potential owner/operator if known and in the cases of existing facilities their current owner/operator.

2.1.1 Detailed Plan

The 2011 Detailed Plan was developed by staff from the Bureau of Reclamation's Technical Services Center consistent with the requirements outlined in the 2010 KHSA to inform the Secretarial Determination process with details on the proposed physical methods for removal of the four lower PacifiCorp dams, including plans for waste disposal, reservoir drawdown, reservoir restoration, existing recreation facility modification or removal, and recreation impact mitigation.

The Detailed Plan identified multiple new recreation facilities and river access points for camping and hiking, and river access for boating and fishing along the river channel between J.C. Boyle Reservoir and Iron Gate Dam to replace the function of the existing facilities to be removed or modified due to reservoir drawdown; these new facilities are detailed in Section 2.2.

2.1.2 Stakeholder Outreach

KRRC initiated a stakeholder outreach process to seek input on the recreation opportunities previously identified during development of the 2011 Detailed Plan as well as support with the identification of new opportunities that had not previously been identified. This ongoing outreach effort has included coordination with California and Oregon state officials, Siskiyou County, Klamath County, the Bureau of Land Management (BLM), PacifiCorp, economic development organizations including chambers of commerce, tourism organizations, recreation businesses, local communities (e.g., Copco, Hornbrook), and the general public. Section 2.3 presents recreation opportunities identified during this outreach effort. Table 2-1 identifies the stakeholders that participated in this outreach effort.

KRRC will continue the stakeholder outreach process through the development of the Final Recreation Plan. KRRC will also work with regulators to determine any requirements for the final plan.

Table 2-1 Stakeholder Outreach Participants

Name	Name	Name
All-Outdoors	Hornbrook Residents[1]	Oregon Parks and Recreation Department
American Whitewater	Indigo Creek Outfitters[2]	PacifiCorp
Bruce Kinseth (R-Ranch)	Jack Trout[3]	Quartz Valley Indian Tribe
Bureau of Land Management	Jeff Stone	River Dancers
California Department of Fish and Wildlife	John Jacques (Klamathon Lodge)	Rogue Riverkeeper
California Natural Resources Agency	K. Bermel	Shasta Indian Nation
California Trout	Karuk Tribe	Shasta Nation
Carl and Linda Ebert (Copco Village Residents)	Klamath County Chamber of Commerce	Siskiyou Economic Development Council
Copco Village Residents[1]	Klamath County Economic Development	SWCA [4]
Discover Klamath	Momentum River Expeditions[2]	Trout Unlimited
Discover Siskiyou	Noah's Rafting Adventures[2]	
Fly Fishers International - Oregon Council	Oregon Fish and Wildlife	

Notes

1. Participants at public meetings held by KRRC in Copco Village and Hornbrook in June 2018 to seek input on recreation opportunities to be considered in the Recreation Plan
2. Member of the Upper Klamath Outfitters Association
3. Unaffiliated representatives from local (Klamath River Basin) recreational fishing industry
4. Consultant for Siskiyou County

The outreach effort also focused on the identification of evaluation criteria for these recreation opportunities to refine the list of opportunities identified for potential implementation by KRRC. The results of this feedback are described in greater detail in Section 3 of this plan.

2.2 Recreation Opportunities Identified in the Detailed Plan

This section presents descriptions of recreation features identified in the 2011 Detailed Plan. The Detailed Plan identified a list of potential recreation facilities and access areas that could be implemented under Mitigation Measure REC-1. These features were assumed to support cost estimates developed for the Detailed Plan. The Detailed Plan indicated that these opportunities were not assumed to be the only opportunities that would be considered. KRRC is presenting these opportunities from the Detailed Plan, along with stakeholder-suggested opportunities (see Section 2.3), as opportunities to consider in the development of the Final Recreation Plan. Like all opportunities presented in this draft, those described below will be subject to screening through the process described in Section 3.

Topsy Campground

Topsy Campground is an existing facility located on the southeastern shoreline of J.C. Boyle reservoir (shown on Figure 2-1 as Site 1). It is owned and operated by BLM. The Detailed Plan proposed modifications to accommodate river-based recreation as opposed to its current reservoir-based recreation use. This would include removal and replacement of the current boat ramp to support river access. In addition, the Detailed Plan proposed revegetation of the area around the existing campground. These modifications were identified to provide continued recreational access to the area for camping, hiking, boating, and fishing. BLM would continue to be the owner and operator of this modified facility. In addition to the proposed changes identified in the Detailed Plan, BLM suggested during initial stakeholder outreach completed during the development of this draft Recreation Plan that new camping areas and restrooms be developed next to the new water's edge. Development of additional campsites and parking would provide additional opportunities for camping, fishing, and hiking in this reach. The Detailed Plan proposed completion of these modifications for the year following dam removal and reservoir/river restoration.

Fall Creek Day Use Area

Fall Creek Day Use Area is an existing facility located on the far northeast shore of Iron Gate Reservoir (shown on Figure 2-1 as Site 14). The facility is currently owned and operated by PacifiCorp on Parcel B land. The Detailed Plan proposed that the site be retained and modified to support day use activities and hiking at Fall Creek. Upgrades identified in the plan included the reconstruction of the trail leading to the waterfall and other upgrades to support continued and improved recreational access in the area. The future owner and operator of the Fall Creek Facility is unknown. The Detailed Plan proposed completion of these modifications for the year following dam removal and reservoir/river restoration.

In addition to PacifiCorp's continued operations at Fall Creek, the Project includes development in close proximity to Fall Creek Day Use Area, including the Fall Creek Hatchery and changes to the Yreka water supply line. The area may become unsupportive of additional recreation opportunities.

Jenny Creek Day Use Area and Campground

The existing recreation site at Jenny Creek is located on the northern shoreline of Iron Gate Reservoir, between Copco Road and Jenny Creek (shown on Figure 2-1 as Site 15). This facility includes six campsite/day use sites and several user-defined trails. The Jenny Creek facilities are currently owned and operated by PacifiCorp on Parcel B land. The Detailed Plan proposed the site be expanded and upgraded to accommodate additional campsites and improved amenities. These modifications and upgrades to the Jenny Creek Day Use Area and Campground were proposed to increase recreation activities such as camping, hiking, and fishing at this location. The future owner and operator of the Jenny Creek Facility is unknown. The Detailed Plan proposed completion of these modifications for the year following dam removal and reservoir/river restoration.

Iron Gate Hatchery Day Use Area

The Iron Gate Hatchery Day Use Area is located just downstream of Iron Gate Dam, adjacent to Iron Gate Fish Hatchery (shown on Figure 2-1 as Site 16). The day use site is owned by PacifiCorp on Parcel B land and operated by California Fish and Wildlife (CDFW). The facility currently includes a covered picnic area, a visitor center/interpretive kiosk, and an ADA-accessible to the river shoreline. There is also a boat launch on the river shoreline across from the hatchery. The Detail Plan proposed that the site be retained and modified to provide additional facilities and a reconstructed boat ramp to support continued and improved recreational access in the area. The KHSA includes funding by PacifiCorp for the continued operation of the Iron Gate Fish Hatchery by CDFW for up to 8 years following facility removal, this included the transfer of ownership of the facility to CDFW. Future ownership and plans for operation of the recreation facilities at the Iron Gate Hatchery Day Use Area following facilities removal are however unknown. The Detailed Plan proposed completion of these modifications for the year following dam removal and reservoir/river restoration.

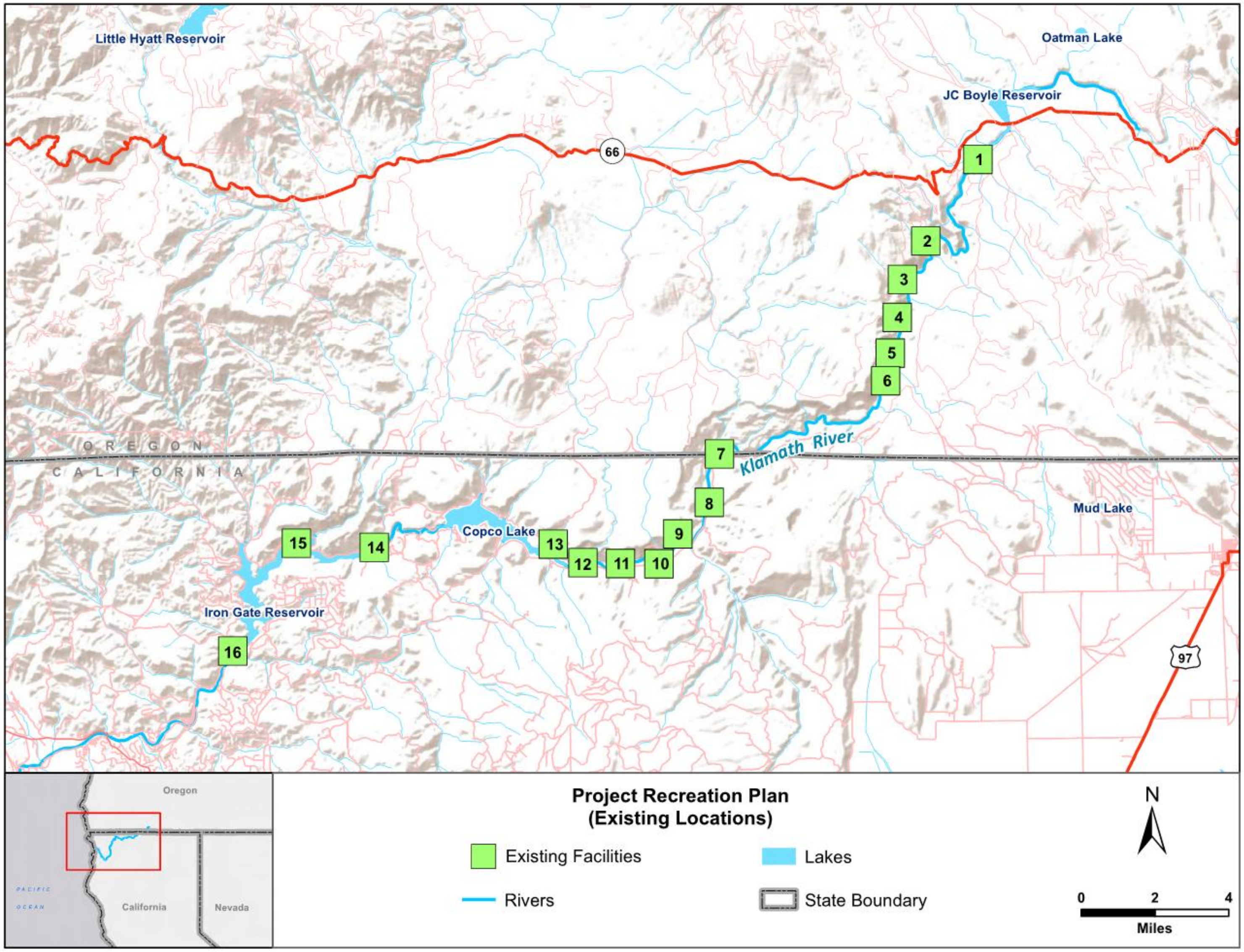

Figure 2-1 Existing Recreation Facility Locations That Could Be Retained or Modified

New Campgrounds

Two small to medium campgrounds were identified for development in the Detailed Plan. These campgrounds would accommodate a total of 20 campsites and include parking, day use facilities and a boat launch. If implemented, these newly developed campgrounds would provide river access, parking, day use amenities, essentially offsetting the loss of campgrounds at other locations post-dam removal. The specific location of these facilities was not identified in the Detailed Plan. The future owner and operator of these facilities is also unknown. The Detailed Plan proposed completion of these developments for the year following dam removal and reservoir/river restoration.

New Routes and Roads

The Detailed Plan identified as a potential recreation opportunity, the development of two potential routes/roads, with one route on each side of the river to provide public recreation access to existing and newly developed facilities on the river. These routes would be developed in coordination with the appropriate federal, state, and local agencies along with any private landowners because of their need to cross land held by multiple owners. These new roadways were identified in the Detailed Plan as permanent features. These roads were proposed in the Detailed Plan given their potential to improve access for recreational uses as well as improve law enforcement's ability to police the area. The specific configuration/layout of these proposed roadways was not provided in the Detailed Plan and no proposed owner/operator for the roadways was identified. The Detailed Plan proposed development of these new roadways would be incorporated into the overall reservoir/river restoration design as appropriate to complement its success.

Non-motorized Trail

The Detailed Plan also identified as a potential recreation opportunity, the development of a new non-motorized trail to provide fishing, biking, and hiking access along the river bank from the current J.C. Boyle dam site to Iron Gate Fish Hatchery. This new trail would be developed in coordination with the appropriate federal, state, and local agencies along with any private landowners because of its need to cross land held by multiple owners. This new trail was identified in the Detailed Plan as a permanent feature. The specific configuration/layout of this new trail was not provided in the Detailed Plan and no proposed owner/operator for the trail was identified. This trail would be developed in a way to be connected to any existing and developed recreation facilities developed as part of the Final Recreation Plan or in coordination with other regional efforts. The Detailed Plan proposed completion of this new trail for the year following dam removal and reservoir/river restoration.

2.3 Recreation Opportunities Identified through Stakeholder Outreach

This section presents descriptions of the recreation features identified during the initial stakeholder outreach effort described above in Section 2.1.2. The recreation opportunities identified during this process varied in levels of detail depending on what was provided by the stakeholders at the outreach meetings they participated in and in some cases in follow up submittals provided to KRRC in writing. In some cases, stakeholders identified opportunities that had already been evaluated as a part of the Detailed Plan effort described above in Section 2.2, those opportunities are not described again in this section. The opportunities identified ranged from the establishment of additional river access points, the funding of tourism campaigns, promoting regional recreation, and the development of commercial recreation establishments on the river. Suggestions were made the retention and/or improvement of existing facilities as well as the development of new facilities. KRRC is presenting these opportunities, along with those included in the Detailed Plan (see Section 2.2), as opportunities to consider in the development of the Final Recreation Plan. Like all opportunities presented in this draft, those described below would be subject to screening through the evaluation process described in Section 3.

2.3.1 Existing Facilities

Stakeholders suggested several potential recreation opportunities and features that could be developed at existing recreation sites in the project area that were not proposed for modification in the Detailed Plan.

Spring Island Boater Access

Spring Island Boater Access is located downstream of J.C. Boyle (shown on Figure 2-1 as Site 2). This site is owned and operated by BLM. The facility currently provides river access for boating. Stakeholders requested that the site be retained and enhanced to improve the site's conditions, if possible. Suggested enhancements could include an improved boat launch, access road, day use area, and/or restrooms and additional parking. Stakeholders indicated that Spring Island Boater Access is important to boaters as a location that would break up the whitewater rafting run upstream and downstream of the point where a clear shift in difficulty would occur. Retention of this site would allow the continued use of an established boater access site. BLM would continue to be the owner and operator of the access. If included in the Final Recreation Plan, completion of any enhancements to the site would be scheduled for the year following facility removal and reservoir/river restoration.

Campground South of J.C. Boyle Powerhouse

Stakeholders requested a campground be developed south of J.C. Boyle Powerhouse or enhancements be made to the campgrounds at one of the three existing river-side campgrounds operated by BLM (BLM Dispersed Site 1, Klamath River Campground, and Turtle Camp shown on Figure 2-1 as Sites 3, 4, 5). Klamath River Campground and Turtle Camp currently allow campfires and access for kayaks and small rafts. These existing sites could be enhanced to include defined campsites and improved boat launches, access roads, day use facilities, and/or restrooms. Enhancements to these sites or the development of a new site that would provide improved river access and river-side camping would provide additional opportunities for camping, boating, and hiking in this reach. BLM would continue to be the owner and operator of this modified facility. If included in the Final Recreation Plan, completion of these modifications would be scheduled for the year following facility removal and reservoir/river restoration.

Klamath River Campground and Turtle Camp

Klamath River Campground and Turtle Camp, shown on Figure 2-1 as Sites 4 and 5, are located south of J.C. Boyle Powerhouse. Klamath River Campground and Turtle Camp currently allow campfires and access for kayaks and small rafts. The sites are owned and operated by BLM. BLM suggested KRRC increase the number of camping sites and provide additional day use parking to accommodate additional users. Improvements to Copco Big Bend Road would be necessary. Development of additional campsites and parking would provide additional opportunities for camping, fishing, and hiking in this reach. BLM would continue to be the owner and operator of this modified facility. If included in the Final Recreation Plan, completion of these modifications would be scheduled for the year following facility removal and reservoir/river restoration.

Frain Ranch Campground

Frain Ranch is an existing dispersed recreation area and undeveloped campground in Oregon located between J.C. Boyle Reservoir and Copco (shown on Figure 2-1 as Site 6). Ownership of the land is divided between PacifiCorp (Parcel A) and BLM and is operated by the BLM. This site is mainly used by boaters, campers, and ATV users. Stakeholders requested that the site be enhanced to provide a developed campground on lands owned by the BLM with defined campsites, restrooms, picnic tables, and fire rings. Development at this site would require improvements to Topsy Grade Road, the main access road for the site. These enhancements were identified to provide additional opportunities for camping, boating, and hiking. BLM would continue to be the owner and operator of this modified facility. The entity responsible for long-term maintenance of the improved road has not yet been identified. If included in the Final Recreation Plan, completion of these modifications would be scheduled for the year following facility removal and reservoir/river restoration.

Stateline Boater Takeout

Stateline Boater Takeout is located between J.C. Boyle Reservoir and Copco Lake (shown on Figure 2-1 as Site 7), just below the state line. Ownership of the lands at this site is divided between BLM and PacifiCorp (Parcel A) and the site is currently operated by the BLM. Stakeholders requested that the site be retained and modified to allow future boating access and shoreline fishing. The portion of this access point owned by PacifiCorp is on Parcel A property, which would generally be retained by PacifiCorp after license surrender; however, the future ownership of this property is unknown. To improve river access following facility removal, stakeholders suggested the portion of the access point on BLM property could be upgraded to support additional use. Retention of and enhancements at this facility would allow the continued use of a recreation facility that offers river access for boating, fishing, and day use. BLM would continue to be the owner and operator of the modified facility. Completion of these modifications would be scheduled for the year following facility removal and reservoir/river restoration.

PacifiCorp Fishing Access Sites 1 through 6

PacifiCorp Fishing Access Sites 1-6 are located just upstream of Copco Lake (shown on Figure 2-1 as Sites 8 through 13). These sites are owned and operated by PacifiCorp (Parcel A), but they are not part of the FERC license for the hydroelectric developments. The facilities currently provide river access for fishing (and rafting at sites #1 and #6) along with some amenities for users. Stakeholders requested that access to these sites be maintained and if possible improved. PacifiCorp will retain ownership of these sites following license surrender for the hydroelectric developments and public access will no longer be available. It is unknown whether these sites would be sold to another entity or whether public access agreements could be granted in the future by PacifiCorp. If it is possible to maintain or enhance these sites, they could continue to provide river access for recreational fishing and boating uses. If included in the Final Recreation Plan, completion of any modifications at these sites would be scheduled for the year following facility removal and reservoir/river restoration.

R-Ranch

R-Ranch is located downstream of Iron Gate Reservoir in Hornbrook, California. The ranch currently supports camping, dirt bike and ATV riding, fishing, hiking, hunting, swimming, and horseback riding. Stakeholders suggested the ranch be expanded or enhanced to provide additional recreation opportunities. This expansion could include the development of a waterpark or similar attraction. R-Ranch is privately owned and operated. Future ownership and operations would remain unchanged. An expansion of R-Ranch would provide additional recreation, potentially reducing the impact from the loss of reservoir recreation. If included in the Final Recreation Plan, completion of any enhancements at R-Ranch would be scheduled for the year following facility removal and reservoir/river restoration.

2.3.2 New Facilities and Plans

This section presents descriptions of recreation opportunities stakeholders identified during outreach that were not directly linked to the retention of an existing facility.

Fishing Access Upstream of J.C. Boyle Powerhouse

Fishing access could be provided along the river approximately one mile upstream of the J.C. Boyle Powerhouse. The specific location of this access site was not however identified by the stakeholders that suggested it as a recreation opportunity for consideration. Currently, there is no trail next to river in this area, but there is the power canal access road that runs parallel to the river that could be connected to this new site. If the power canal access road would be closed to vehicles after dam removal, it could be converted to a trail and used for river access in this area. This new feature would provide river access for recreation uses such as fishing and walking. The future owner and operator of this facility is unknown. If included in the Final

Recreation Plan, completion of the development of these facilities would be scheduled for the year following facility removal/ river restoration.

Day Use and River Access at J.C. Boyle Powerhouse

Stakeholders recommended consideration of day use site to provide river access at the J.C. Boyle Powerhouse. The land directly surrounding J.C. Boyle Powerhouse and substation has been identified by stakeholders as a large and flat area that could serve as an effective location for a day use facility and/or campground. This land is currently owned by BLM, and BLM would continue to own the land following facilities removal and could potentially operate any new recreational facilities developed on this land. Development of a recreation facility at this site could increase recreational use and provide additional river access for hiking, fishing, and boating. If included in the Final Recreation Plan, completion of the development of these facilities would be scheduled for the year following facility removal/ river restoration.

New River Access Locations

Multiple whitewater rafting access locations were suggested by stakeholders between Keno Dam and the Iron Gate Hatchery. These locations were chosen based on known or expected changes in river conditions (rafting difficulty levels) and are shown in Figure 2-2. The site numbers identified for each access point in Figure 2-2 correspond to the site numbers listed for the descriptions of each access point presented in Table 2-2. Some of the locations identified were recommended for development prior to dam deconstruction to allow the continued use of existing river runs and to reduce the loss of boating access during dam decommissioning. No boating access will be allowed in the reservoirs themselves during drawdown and dam removal because conditions will constantly be changing, and it will be too risky to allow boating in the former reservoir areas due to the operation of the diversion facilities (e.g., large gates and tunnels at the dams) as well as the potential for mass movements of reservoir sediment into the river. Non-reservoir portions of the Klamath River system will remain accessible to boating during drawdown and dam removal. If included in the Final Recreation Plan, development of these pre-construction access sites needed during drawdown and dam decommissioning would need to be located outside of the existing reservoir footprints and scheduled for completion prior to the initiation of reservoir drawdown. The future owner and operator of these facilities is unknown. If included in the Final Recreation Plan, the remaining access sites would be completed the year following facility removal and reservoir/river restoration.

Table 2-2 Stakeholder Suggested Whitewater Rafting Access Points

Site ID	Location	Proposed Recreation Development
17	Keno Dam	Proposed access on river left. There is no existing facility for the run from Keno to J.C. Boyle. This would provide an additional river access point.
18	Highway 66 Bridge Crossing	Proposed access on river left. The current reservoir boat ramp could become a good location for rafting access point. This point could serve as a take-out for the Keno run and a put-in for the reach currently under J.C. Boyle Reservoir that would become available after dam removal.

Site ID	Location	Proposed Recreation Development
1*	Below J.C. Boyle Dam	Proposed on river left. Would serve as a put-in for the Boyle Bypass run during dam removal and future take-out for the extended Keno run post dam removal. Depending on river conditions post drawdown, this site might be exchangeable with access at Topsy Campground (if Topsy Campground is retained).
2	Spring Island Boater Access	Existing boater access site suggested for retention. This site is important to boaters as a location that breaks up the runs at a point where the difficulty changes. If this point is retained there would not be a need for a point at the J.C. Boyle Powerhouse.
19	Above Caldera	Proposed on river right, opposite to Frain Ranch. This would serve as an important location for rafters as the run changes from a class 3 to a class 4. The location opposite to the existing access site at Frain Ranch would provide boaters the opportunity to run the J.C. Boyle run and have shuttle access on the south side of the river. Currently boaters can only be shuttled on the north side, which restricts accessibility and reduces potential recreation use. This location would serve as a take-out for the J.C. Boyle Bypass run or put-in for Hell's Corner gorge. There is an existing road on the west side of the river that goes down to Caldera that could serve as an access road for this point.
7	Stateline Boater Takeout	Existing boater access site suggested for retention.
8	PacifiCorp Fishing Access Site 6	Existing boater access site suggested for retention. As noted above, this site is located on PacifiCorp Parcel A lands. Ability to obtain for future public access is uncertain.
13	PacifiCorp Fishing Access Site 1	Existing boater access site suggested for retention. As noted above, this site is located on PacifiCorp Parcel A lands. Ability to obtain for future public access is uncertain.
20	Above Copco 1 Dam	Proposed on river right. This point would serve as a take-out for the run currently under Copco Lake and a future put-in for the Copco 2 Bypass (Ward's Canyon) and Iron Gate runs. This area is anticipated to break up a Class 2 run (run under Copco Lake) and a Class 4 run (Ward's Canyon).
21	Copco 2 Dam (Ward's Canyon)	Proposed on river right, approximately 1,500 feet downstream of Copco 1 Dam. During drawdown and dam decommissioning activities, stakeholders indicated that this point could serve as an important access site for boaters, providing a put-in for the Ward's Canyon run. Given this facility's close proximity to Copco 1 Dam it would be located in an active construction area during dam removal. Stakeholders requested limited access to this site on a schedule coordinated with KRRC and contractors on-site. After dam removal has been completed, the site would serve as a put-in for the Iron Gate run. There is an existing dirt road that could provide access to this site.
22	Copco 2 Powerhouse	Proposed on river left. This site would serve as a take-out for the Ward's Canyon run or a put-in for the future Iron Gate run. It would represent a break in runs where there is a shift in difficulty.
14	Fall Creek	Proposed on river right. This point could serve as a take-out for upstream runs and a put-in for the run currently under Iron Gate Dam.
15	Jenny Creek Confluence	Proposed on river right. Stakeholders indicated that this site could allow boating during drawdown and serve as a take-out for the upper portion of the run currently under Iron Gate Reservoir and a future put-in for runs to Iron Gate and beyond. This site is interchangeable with the Camp Creek Confluence location.

Site ID	Location	Proposed Recreation Development
23	Camp Creek Confluence	Proposed on river right. Stakeholders indicated that this site could allow boating during drawdown and serve as a take-out for the upper portion of the run currently under Iron Gate Reservoir and a future put-in for runs to Iron Gate and beyond. This site is interchangeable with the Jenny Creek Confluence location, but may be a better location, based on bathymetry and pre-dam topographic maps.
16	Iron Gate Hatchery	Existing boater access site suggested for retention. Improvements to the existing facilities offered at Iron Gate Hatchery could provide needed access for boaters and serve as a take-out for the future Iron Gate run following dam removal.

*This site was proposed to be placed in close proximity to the existing Topsy Campground and is therefore represented in Figure 2-2 as site 1, Topsy Campground.

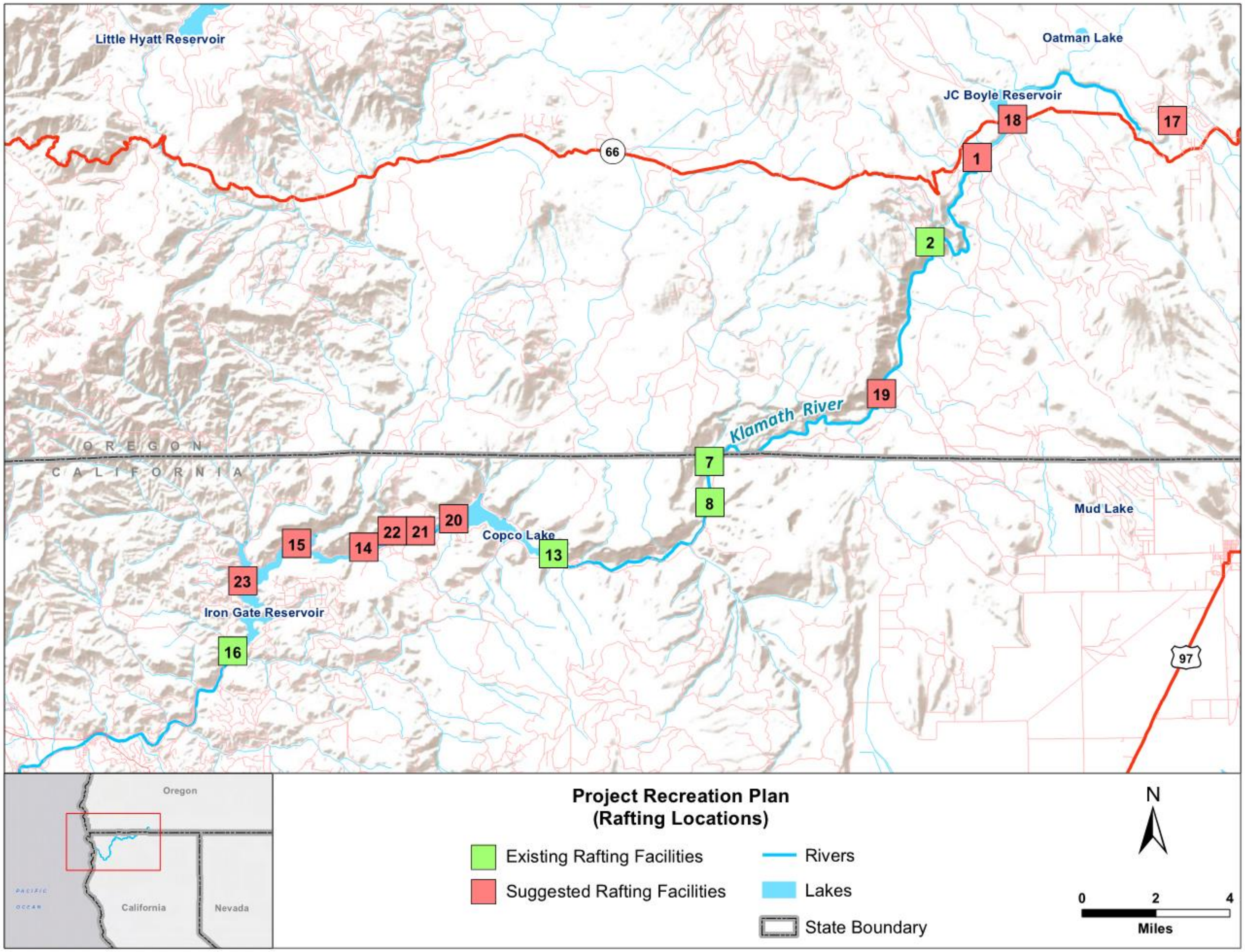

Figure 2-2 Potential Proposed River Access Sites

Copco 2 Bypass Reach

Stakeholders identified riparian vegetation that has grown into the historic river channel in the Copco 2 bypass reach due to low flows as a substantial safety hazard for future water-based recreation in that stretch of the river. The stakeholders indicated that the complete removal of this woody vegetation in the historic river channel prior to facilities removal would be most efficient to avoid complications generated by with vegetation removal attempted after the reach is inundated. Vegetation removal would make the reach navigable for boaters, providing an additional whitewater rafting run that would increase recreational boating use in the restored river. If included in the Final Recreation Plan, completion of vegetation removal would be scheduled for the year prior to reservoir drawdown.

Road Improvement

Stakeholders suggested that improvements could be made to some of the existing roadways that provide access to the Klamath River. The stakeholders indicated that many of the existing access roads in the area between Keno Dam and Iron Gate Dam are in need of improvement and long-term maintenance. Some of the roads have become unnavigable and inadequate for use to access recreation facilities. These poor road conditions also contribute to difficulties experienced by law enforcement personnel that need to access these areas. Stakeholders proposed that improvements be made to existing roads, such as Topsy Grade Road and Copco Big Bend Road, to improve accessibility and policing which could result in increased recreational use in the area. Specific stretches of roadways that need improvements have not been determined. It is assumed that roadways would continue to be owned and maintained by their current owners following any improvements. If included in the Final Recreation Plan, completion of roadway construction would be scheduled for the year following facility removal and reservoir/river restoration.

Access During Deconstruction

Stakeholders suggested that, where possible, access to roads currently used for river access be retained during the drawdown and deconstruction periods. These roads include but are not limited to the access road leading to J.C. Boyle Powerhouse and the dirt road near Copco 2 Dam, on river right. Road access could involve placing a flagger in established areas to direct traffic or establishing time intervals during which roads could be made open to the public. Providing road access that allows continued use for boaters and whitewater rafters during construction periods would reduce the impact made to boating in the Hell's Corner Reach during this time. Access requests would be coordinated with the contractor responsible for dam deconstruction activities. The terms of the access agreement would be determined and shared prior to facility removal and reservoir/river restoration.

Frain Ranch Bridge

Stakeholders suggested that a new bridge could be constructed to replace an old bridge that crossed the Klamath River at Frain Ranch. Reconstruction of this bridge would provide a point of access to either side of the river, increasing accessibility and recreational use in the area. The future owner and operator responsible for maintenance at the new bridge is unknown. If included in the Final Recreation Plan, completion of bridge reconstruction would be scheduled for the year following facility removal and reservoir/river restoration.

RV Park in Seiad Valley or Happy Camp

A RV park with full hookups and amenities to be developed in Seiad Valley or Happy Camp was identified as a potential recreation opportunity by stakeholders. The RV park could generate revenue and tourism within the county, potentially offsetting lost tax revenue due to dam removal. The location of this park and its proposed owner and operator were not identified. If included in the Final Recreation Plan, completion of the development of the RV park would be scheduled for the year following facility removal.

Walking Trails/Wildlife Viewing/ Interpretive Trails

The development of educational recreational use sites and interpretative exhibits in the area was identified by stakeholders as a potential recreation opportunity. It was suggested that instead of full removal of dam infrastructure, some infrastructure (e.g., fish ladders, powerhouses, etc.) could be retained and signage added to promote educational tourism. Trails could be developed and routed to take recreational users through or by some of these remaining structures (preferably those with historic backgrounds). Signage promoting wildlife viewing could also be provided along these trails.

Locations for these trails have not yet been determined but could include areas around Copco residential areas or in the reservoir footprints of JC Boyle, Copco, and Iron Gate reservoirs. Development of recreational activities close to residential areas at Copco could provide residents with beneficial uses to offset the loss of reservoir-based recreation opportunities. Interpretative trails could provide additional recreational uses and opportunities for walking and tourism and as well as utilize local services. Future owners and operators of the remaining infrastructure were not identified. If included in the Final Recreation Plan, completion of the proposed trails and educational sites would be scheduled for the year following facility removal and reservoir/river restoration.

Flatwater Recreation in Siskiyou County

New or enhanced day use and/or camping sites could be developed in Siskiyou County to replace lost flatwater recreation opportunities. Locations have not yet been determined but could include the enhancement of existing recreation facilities and/or the development of new facilities at Lake Shastina or Medicine Lake. Specific amenities that would be available at these sites were not specified. The future owner and operator of these facilities is unknown. The development of additional day use and/or camping sites could promote recreational use and potentially offset lost flatwater recreation opportunities due to facility removal. If included in the Final Recreation Plan, completion of the development of these facilities would be scheduled for the year following facility removal.

Fishing Access Upstream or Downstream of J.C. Boyle Powerhouse

Fishing access sites could be developed upstream or downstream of J.C. Boyle Powerhouse in the J.C. Boyle Powerhouse footprint and in the bypass reach. Stakeholders did not identify specific locations for these new access sites. With the removal of dam facilities an increase in steelhead fish is expected in this reach of the river. Development of fishing access sites in this area would promote increased fishing activity and recreational use in the hydroelectric reach. The future owner and operator of these facilities is unknown. If included in the Final Recreation Plan, completion of development of these access sites would be scheduled for the year following facility removal/ river restoration.

Whitewater Park

Stakeholders identified the development of an in-river or off-river whitewater park along the river as a potential facility that could help offset whitewater rafting impacts in the Hell's Corner Reach by facilities removal. The proposed facility could be established by diverting from the river to provide whitewater conditions for recreational users to practice whitewater boating. The site could include day use areas and various amenities. A whitewater park would provide additional recreational opportunities for boating and could be a newly established tourist attraction, which could provide economic benefits for the county. The location of this park has not yet been determined. The future owner and operator is also unknown. Initiation of construction of the whitewater park would be scheduled for the year following facility removal alongside ongoing river restoration activities.

Recreational Gold Mining

Recreational gold panning opportunities could be established in areas on the river in Siskiyou County where users could participate in the county's history and culture. Specific locations where gold panning might be supported have not yet been determined. These locations could provide interpretative signage for the activity, including information on the history of gold mining in the county. Stakeholders indicated that the establishment of gold panning opportunities along the river could attract tourists and contribute to recreational use and available activities in the area. The future owner and operator of these facilities is unknown. If included in the Final Recreation Plan, development of these access points would be scheduled for the year following facility removal/river restoration.

New ADA Facilities

The Detailed Plan identified Camp Creek as an existing facility that would be removed after dam removal. Camp Creek is one of the few ADA recreation facilities in Siskiyou County. The Detailed Plan proposed that at least one of the recreation facilities retained along the Klamath River between J.C. Boyle Dam and Iron Gate Dam be upgraded to an ADA facility to offset this lost facility. Stakeholders noted during outreach meetings that shifting demographics for recreational users in the area could warrant the development additional ADA-accessible facilities. These facilities could include, but are not limited to, fishing access sites, boat ramps, and restrooms. The specific location of this replacement facility was not determined in the Detailed Plan. The future owner and operator of this facility is unknown. If included in the Final Recreation Plan, development of the proposed facility would be scheduled for the year following facility removal and reservoir/river restoration.

Fishing Lodges

Stakeholders identified the development of two to five public fishing lodges to support fly fishing tourism along the hydroelectric reach as a recreation opportunity that should be considered. The fish lodges could provide year-round guided drift boat fishing, both fly and conventional fishing, for salmon, steelhead, and trout. Locations have not yet been determined but could be developed on Parcel B lands. Stakeholders suggested that these fishing lodges could be owned and operated under public/private partnerships, but the specific future owners and operators of these developments were not identified. Fees for facility use may be collected, but exclusive membership would not be permitted, and open access would be required. Fishing lodges could provide additional fishing access, increase recreational use in the area, additional jobs, and serve as a revenue generator to help offset lost tax revenue resulting from facilities removal. If included in the Final Recreation Plan, completion of development of these facilities would be scheduled for the year following facility removal and reservoir/river restoration.

River-side Commercial Recreational Development

Stakeholders suggested that commercial recreation facilities that could support recreational tourism could be developed on the river in the hydroelectric reach. The types of recreational uses for these developments were not specified. Potential locations were also not identified but facilities could be developed on Parcel B lands adjacent to the river. Similar to the fishing lodges described above, stakeholders suggested that these commercial developments could be owned and operated under public/private partnerships, but the specific future owners and operators of these developments were not identified. Fees for facility use may be collected, but exclusive membership would not be permitted, and open access would be required. River-side commercial recreation development could provide additional recreation opportunities such as fishing, hiking, boating, among other opportunities, as well as serve as a revenue generator to help offset lost tax revenue due to facilities removal. If included in the Final Recreation Plan, completion of development of these facilities would be scheduled for the year following facility removal and reservoir/river restoration.

Siskiyou Tourism Plan

The Siskiyou County County-wide Tourism Marketing Plan (Siskiyou Tourism Plan) includes a variety of ideas intended to promote tourism within the county by reaching a broader audience. Stakeholders proposed that some elements in the Siskiyou Tourism Plan be implemented as part of the Final Recreation Plan. The Siskiyou Tourism Plan highlights a lack of available tourism promotion funding, which poses a significant challenge for the county. Through either direct funding or partnering to develop destination awareness for attractions and outdoor recreation opportunities within the county, this recreation opportunity could promote continued recreational uses such as hiking, fishing, hunting, biking, and boating which could help reduce the loss of recreation use due to reservoir removal. If included in the Final Recreation Plan, implementation of this plan could be scheduled to coincide with facility removal and continue for an undetermined period following completion of river and reservoir restoration.

Upgrade Private Campgrounds

Numerous private campgrounds were identified in the region by stakeholders as being important recreational resources. These facilities are owned and operated by a variety of private owners and operators. Modifications and/or upgrades to these facilities were suggested by stakeholders as a way to provide continued and improved recreational use in the area. The future owner and operator of these sites would be the current owners and operators. If included in the Final Recreation Plan, completion of the upgrades proposed to these sites would be scheduled for the year following facility removal/ river restoration.

Transportation Plan

Development of a Transportation Plan that identifies appropriate roads and trails that could provide access to existing and newly developed recreation facilities was identified by stakeholders as important for planning potential recreation facilities and road improvements. Stakeholders suggested that the plan also identify which lands the roads cross and the entity or entities with current and future responsibility for road maintenance. The Transportation Plan would help inform the identification of new access routes for development in the future along with potential existing roadways that could be repurposed for trail use. The timeline for the plan was not specified. If included in the Final Recreation Plan, efforts developing the plan could begin prior to reservoir drawdown.

Enhance Private Docks

Several homeowners use private docks to access the Klamath River for fishing. Stakeholders from the Copco Village community suggested these private docks be extended to the newly formed river. The extension of private docks post dam removal would provide continued access for residents. If included in the Final Recreation Plan, completion of these modifications would be scheduled for the year following facility removal and reservoir/river restoration.

Klamath Hot Springs

Stakeholders suggested that a recreation facility near the historic Klamath Hot Springs Resort could be developed as commercial recreation facility. Development of a structure with restrooms and shelter for visitors could increase access to the existing hot springs near Shovel Creek. The potential future owner and operator of this facility was not identified. If included in the Final Recreation Plan, completion of the development of this facility would be scheduled for the year following facility removal and reservoir/river restoration.

2.4 Summary of Identified Recreation Opportunities

Table 2-3 presents a summary of the recreation opportunities identified including details on the location, current and future ownership if known, and where the opportunity was identified.

Table 2-3 Identified Recreation Opportunities

Site ID	Feature	Proposed Recreation Development	Current Owner/Operator	Origin
1	Topsy Campground	Replace or redesign boat ramp for river access and revegetate the reservoir rim in the vicinity of the campground	Owned and operated by BLM on J.C. Boyle Reservoir	Detailed Plan
14	Fall Creek Day Use Area	Upgrade facilities and reconstruct trail leading to Fall Creek waterfall	Owned/operated by PacifiCorp (Parcel B); located on Copco Road which is maintained by PacifiCorp	Detailed Plan
15	Jenny Creek Campground	Expand campground and upgrade facilities to provide Jenny Creek and Klamath River recreation	Owned/operated by PacifiCorp (Parcel B) on the edge of Iron Gate Reservoir	Detailed Plan
16	Iron Gate Hatchery Day Use Area	Reconstruct day use site to provide additional facilities and a boat ramp	Owned by PacifiCorp (Parcel B) and operated by CDFW	Detailed Plan
--	New Campgrounds	Two small to medium campgrounds in TBD location	N/A	Detailed Plan
--	New Routes/Roads	Provide routes on each side of the river that could be retained permanently to provide public recreation access to the river at defined locations	N/A	Detailed Plan
--	Non-motorized Trail	Construct trail to provide fisherman, biking, and hiking access from JC Boyle dam site to Iron Gate fish hatchery	New trail would need to cross PacifiCorp (Parcel A and B), BLM, private lands and potentially USFS land	Detailed Plan
2	Spring Island Boater Access	Retain/Enhance existing Spring Island boater put in below JC Boyle Powerhouse on the Klamath River and provide additional parking	BLM owns land	American Whitewater and BLM
3, 4, 5	Campground South of JC Boyle Powerhouse	Enhance and develop a new campground near JC Boyle Powerhouse; Klamath River Campground (primitive), Dispersed Site 1 and Turtle Camp could be modified or improved	BLM operates Klamath River campground (primitive), Dispersed Site 1 and Turtle Camp	American Whitewater

Site ID	Feature	Proposed Recreation Development	Current Owner/Operator	Origin
6	Frain Ranch Campground	Enhance and develop campground and improve Topsy Grade Road to Frain Ranch; Frain Ranch is a dispersed recreation site used by boaters and campers	Operated by BLM on PacifiCorp (Parcel A) land between Copco and JC Boyle Powerhouse	American Whitewater
8 through 13	PacifiCorp Fishing Access Sites 1 through 6	Maintain or enhance fishing access sites on Parcel A land between Copco Lake and Stateline. Sites include signage, porta-johns, and trash receptacles	Owned/operated by PacifiCorp (Parcel A); these sites are part of the FERC Lower Klamath Project definition	American Whitewater & Fishing Interests
7	Stateline Boater Takeout	Retain/enhance existing boater takeout on the river at Stateline to accommodate multiple parties in the take-out area and provide additional camp sites	Operated by BLM on PacifiCorp (Parcel A) land	American Whitewater and BLM
--	Fishing Access Upstream of J.C. Boyle Powerhouse	Provide fishing access along the river near the powerhouse approximately 1 mile up stream	BLM owns land	BLM
--	Day Use and River Access at J.C. Boyle	Provide recreational use/access in the large flat area on the river by the powerhouse and substation	BLM owns land	BLM
1, 2, 7, 8, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23	New River Access Locations	Develop river boating access with amenities (restrooms, road access, parking) in areas where the difficulty of river navigation changes	BLM and PacifiCorp-owned land (Parcel A and B)	American Whitewater
--	Copco 2 Bypass Reach	Remove riverine vegetation to provide safe boating thoroughfare in the Copco bypass reach	Owned and operated by PacifiCorp (Parcel B)	American Whitewater
--	Road Improvement	Improvements to the existing roads, including but not limited to Topsy Grade Road and Copco Big Bend Road	Various	Multiple stakeholders

Site ID	Feature	Proposed Recreation Development	Current Owner/Operator	Origin
--	Access During Construction	Provide access to roads that lead to river access for boaters to use during drawdown and deconstruction periods. Access could be granted by flagger or established time intervals for public use.	N/A	Upper Klamath Outfitters Association and American Whitewater
--	Frain Ranch Bridge	Construct a replacement bridge that crosses the Klamath River at Frain Ranch to provide continuous access to both side of the river	N/A	BLM
--	RV Park in Seiad Valley or Happy Camp	Develop an RV park with full hookups that would be generate revenue and tourism	N/A	SWCA[1]
--	Walking Trails / Wildlife Viewing / Interpretive Trails	Retain portions of the dam structures, provide interpretive signage, and develop a walking trail around it. Trails could also incorporate wildlife viewing. Construct trails around Copco Village residential areas to provide recreation opportunities for residents.	PacifiCorp-owned land (Parcel B)	SWCA[1]
--	Flatwater Recreation in Siskiyou County	Develop day use and/or camping sites in TBD locations for public recreational use to replace lost flatwater recreation opportunities. Locations could include Lake Shastina and Medicine Lake.	N/A	SWCA[1]
--	Fishing Access Upstream or Downstream of J.C. Boyle Powerhouse	Develop fishing access sites in the J.C. Boyle Powerhouse footprint and in the bypass reach	BLM and PacifiCorp-owned land (Parcel A and B)	BLM and ODFW
--	Whitewater Park	Develop an in-river or off-river whitewater park	N/A	SWCA[1]

Site ID	Feature	Proposed Recreation Development	Current Owner/Operator	Origin
--	Recreational Gold Mining	Establish gold panning recreation opportunities in Siskiyou County	N/A	SWCA[1]
--	New ADA Facility	Provide at least one ADA facility to retain the current ratio of ADA opportunities in the area.	N/A	Detailed Plan, SWCA[1], Oregon Council, Copco Village Residents
--	Fishing Lodges	Provide up to five public fishing lodges that could support fly fishing tourism along the current hydroelectric reach. These could be developed on Parcel B land under public/private ownership	N/A	John Jacques
--	River-side Commercial Recreation Development	Develop commercial recreation uses at points along the river.	N/A	John Jacques
--	Siskiyou Tourism Plan	Provide funding to establish a tourism campaign that would point people to other recreation facilities within Siskiyou County. This could include strategically placed signage.	N/A	SWCA[1], Siskiyou Economic Development Council / Discover Siskiyou
--	Upgrade Private Campgrounds	Improve existing private campgrounds in the area	Unidentified private owners	Siskiyou Economic Development Council / Discover Siskiyou
--	Transportation Plan	Develop a transportation plan that identifies appropriate roads and trails that could provide access to recreation facilities	N/A	BLM
--	Expand R-Ranch	Expand the recreation opportunities provided at R-Ranch. This could include the development of a water park.	Bruce Kinseth	Bruce Kinseth
--	Enhance Private Docks	Enhance private docks that are currently on the reservoir to provide river access	Various private owners	Copco Village Resident

Site ID	Feature	Proposed Recreation Development	Current Owner/Operator	Origin
3,5	BLM Klamath River Campground and [Turtle] Camp	Increase the number of camping sites and increase the day use area parking and related infrastructure. Existing road will need to be enhanced.	BLM	BLM
1	Topsy Campground	Develop new camping areas and bathrooms next to the new water's edge. Remove and replace existing boat ramp and dock.	BLM	BLM
--	Klamath Hot Springs	Develop structure with restrooms and shelter at the Klamath Hot Springs near the Klamath River's confluence with Shovel Creek	N/A	K. Bermel

Notes

1. Consultant for Siskiyou County
2. Frain Ranch Bridge does not currently exist. Current ownership of the lands where the bridge could be developed is divided between PacifiCorp (Parcel A) and BLM.

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Chapter 3: Recreation Opportunity Evaluation and Screening

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3. RECREATION OPPORTUNITY EVALUATION AND SCREENING

KRRC is developing evaluation and screening criteria that will be used to measure each recreation opportunity's consistency with the Recreation Objectives developed for this plan (Section 1.3). In addition, KRRC sought and continues to seek input on appropriate screening criteria as part of the stakeholder outreach effort that is underway in support of developing this plan. The preliminary criteria that have been identified, will be utilized during development of the Final Recreation Plan to measure whether each recreation opportunity will:

A. Directly address the recreation impacts generated by implementation of the KHSA.
B. Directly address or offset changes in the localized reservoir recreation or Hells Corner boating near where the impacts are occuring.
C. Improve access to or usability of an existing recreation resource on lands with a land manager/owner that will accept and agree to maintain the new or upgraded facility.
D. new or substantially increased O&M demands.
E. Not result in impacts to sensitive river and riparian habitats including important river spawning areas in and adjacent to any river channel.
F. Minimize and mitigate for any impacts to culturally sensitive areas.
G. Integrate into the existing communities and infrastructure.
H. Contribute to the regional recreation vision of Klamath River restoration
I. Be acceptible to law enforcement
J. Avoid impacts to local economics
K. Be implementable through available funding

Each opportunity that will be proposed for implementation by KRRC will need to support the criteria presented in the Final Recreation Plan. The preliminary criteria presented above are not final and may change in response to feedback received during the refinement and finalization of the plan. It is anticipated that the evaluation completed for the Final Recreation Plan will measure the degree to which each opportunity supports these criteria. Some of the recreation opportunities identified in this Draft Recreation Plan and others identified through continued stakeholder outreach may fully support some criteria and only partially support others. KRRC will use the screening process to identify in the Final Recreation Plan the proposed recreation facilities that are best able to support these criteria. The preliminary plans for how each screening criteria will be used to evaluate the recreation opportunities is presented below.

Criterion A will verify that each opportunity provides new or supports existing recreation activities or river access. Similarly, Criterion B tests whether a recreation opportunity will address, or offset, recreation impacts in the areas near where the impacts are occurring is measuring how well that the recreation facility or access point will improve conditions along the newly formed river channel between J.C. Boyle Reservoir and Iron Gate Dam. These criteria will evaluate recreation opportunities both qualitatively to verify the proposed location and type of facility and quantitatively to measure the amount of recreation access and use these facilities will provide to offset the removed facilities described in Section 1.2.1.

Criterion C was developed to ensure the durability of opportunities implemented as a result of this plan. Following the completion of facility removal and river restoration activities, KRRC will surrender its license for these facilities and will be unable to operate and maintain any new recreation features developed by this plan, jeopardizing their continued success in mitigating the impacts they were developed to address. For an opportunity to perform well under Criterion C, an entity responsible for its ownership, operation, and ongoing maintenance will need to be identified. Criterion D then evaluates whether each opportunity will generate new or substantially increased O&M demands given the need for this Recreation Plan to ensure the selection and implementation of durable solutions.

Criteria E and F utilized in this evaluation effort were identifed through stakeholder input. Participants in the outreach efforts detailed concerns that potential recreation facilities or river access points created by this Recreation Plan could potentially impact locations important for spawning and rearing along the newly formed river channel and could potentially be developed in areas at or nearby culturally significant resources. The evaluations under both of these criteria will rely on existing resource mapping, river restoration plans and input from the stakeholder groups that raised these concerns.

Criteria G and H were developed to ensure the seamless integration of recreation opportunities into the local communities as well as the entire region. These criteria evaluate each opportunity's potential to integrate into the communities and existing infrastructure and its consistency with the overall vision for a restored Klamath River. The evaluations under both criteria will rely heavily on stakeholder feedback received during outreach and the plans and objectives of local agencies.

Criterion I was developed to evaluate each opportunities acceptability to local law enforcement. During outreach, stakeholders indicated that recreation opportunities developed in the area will need to be accessible by law enforcement to minimize risk and vandalism. The existing access roads in several areas near the river need improvement and their current condition results in slower response times for law enforcement. This criterion will evaluate whether the option will be sufficiently accessible to law enforcement.

Criterion J was developed to assess each opportunity's impact to the local economies in Siskiyou and Klamath counties. This criterion will evaluate recreation opportunities both qualitatively and quantitatively to determine how the opportunity benefits the local economy and/or provides a means to offset lost tax revenue resulting from dam removal.

Criterion K was developed to determine whether available funding will be sufficient to support the development of each opportunity.

Chapter 4: Recreation Plan Implementation

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4. RECREATION PLAN FINALIZATION

This Draft Recreation Plan identifies the types of recreation opportunities and facilities consistent with pre-hydropower development conditions that will be developed to achieve the goals of the plan. This draft plan also describes the process envisioned by KRRC to evaluate these opportunities and identify the proposed facilities that will ultimately be recommended for implementation in the Final Recreation Plan.

Based on the anticipated removal of reservoir recreation sites and reduced whitewater rafting use under the Project, KRRC has identified the need to implement, in the Klamath River Basin, recreation facility upgrades and/or new facility developments to provide, at minimum, the types of facilities that are proposed in this Draft Recreation Plan. KRRC configured these proposed opportunities to offset the anticipated effects on recreation access associated with dam and associated reservoir removal. The proposed location of specific opportunity types identified below was driven by KRRC's desire to support continued recreation use and access throughout the project area. Under the Amended KHSA, the existing license for the four dams will be transferred to KRRC to implement their removal. Following their removal, KRRC will surrender this license. Ultimately, the ownership, operation, and ongoing maintenance of the recreation opportunities developed by this plan will be the responsibility of the parties that the lands are transferred to.

KRRC initiated a stakeholder outreach process to seek input on the recreation opportunities previously identified during development of the 2011 *Detailed Plan for Dam Removal – Klamath River Dams* (Detailed Plan) as well as support with the identification of new opportunities that had not previously been considered. This ongoing outreach effort has included coordination with California and Oregon state officials, Siskiyou County, Klamath County, the BLM, PacifiCorp, economic development organizations including chambers of commerce, tourism organizations, recreation businesses, local communities, and the broader public. The outreach effort will continue throughout the refinement of this draft plan into a Final Recreation Plan scheduled for completion in June of 2019.

4.1 Proposed Recreation Facilities

KRRC, through its review of the potential recreation facilities removed under the Project and through preliminary stakeholder outreach, has identified two types of recreation access facilities that if developed will offset recreation access that will be eliminated by implementation of the Project – whitewater boat put-in/take-out sites and fishing access sites. In addition, KRRC intends to continue to collect input from stakeholders on both the refinement of these options with the identification of specific locations for implementation and additional detail on the types of amenities developed at each site. KRRC also intends to collect input from these stakeholders on new recreation opportunities beyond the new and upgraded access sites identified in this draft plan.

4.1.1 River Access Sites – Whitewater Put-in/Take-out

To offset reductions in boating access on the Klamath River generated by both the removal of reservoir boating access locations and reductions in river flow conditions capable of supporting whitewater rafting and kayaking, KRRC has identified the development of river access sites that will support whitewater activities. This draft plan assumes the development of new or improved existing river access sites to allow for new whitewater boat access at or near the upstream and downstream ends of J.C. Boyle Reservoir, Copco Lake, and Iron Gate Reservoir. Developing put-in/take-out facilities at these locations will provide access to new sections of the river not currently accessible with the reservoirs in place.

These general locations will be refined during development of the Final Recreation Plan to incorporate input from stakeholders on site preferences, including input from future users on the specific locations anticipated to provide the best recreation experience. KRRC will also seek stakeholder input on any important in-river and river-adjacent habitat areas as well as sections of the river with specific cultural sensitivities to avoid and/or protect from future use. Preliminary feedback that has been provided by stakeholders on whitewater access preferences focused on identifying locations along the river with known or anticipated changes in future rafting/kayaking difficulty levels to better facilitate use of these sections by whitewater rafters and kayakers of varying skill levels.

KRRC will develop these river access sites to include at a minimum:

- An area near or along the adjacent roadway for the parking of trucks with trailers used to transport whitewater rafts, large passenger vans and buses for transporting commercial whitewater rafters,
- If necessary, an access road between any new parking areas and the adjacent existing roadway, and
- If necessary, developed paths from the area designated for parking to the river edge wide enough to support the portage of rafts.

Development of these whitewater access sites are assumed to require slope stabilization, drainage improvement, grading activities, and vegetation removal where necessary to develop parking areas, access roads and paths down to the river, if necessary, for raft portage.

4.1.2 River Access Sites – Fishing Access

To offset the loss of reservoir recreation sites that support flatwater recreation, KRRC has identified the development or improvement of access sites that will support fishing access on the river. This draft plan assumes the development of new or improved existing access sites to allow for access to the river for fishing and other active and passive recreation activities, including swimming. These sites could potentially be shared in some cases with the whitewater access sites identified above. KRRC will develop the sites to allow for new fishing access sites at locations along the river near or in the existing footprints of J.C. Boyle Reservoir, Copco Lake, Iron Gate Reservoir, and Copco No. 2.

Similar to the whitewater access sites described above, these general locations will be refined during development of the Final Recreation Plan to incorporate input from stakeholders on future user site preferences along with stakeholder concerns for biological and/or cultural resources. KRRC assumes that this will include input from stakeholders on preferred amenities at some or all of the sites. These amenities could potentially include fishing docks and Americans with Disabilities Act compliant features to support site accessibility.

KRRC will develop these river access sites to include at a minimum:

- An area near or on a road shoulder for the parking of personal vehicles,
- If necessary, an access road between any new parking areas and the adjacent existing roadway, and
- If necessary, developed trails from the area designated for parking to the river edge.

Similar to the whitewater access sites, development of these fishing access sites are assumed to require slope stabilization, drainage improvement, grading activities and vegetation removal where necessary to develop parking areas and access trails leading down to the river.

4.1.3 Other Recreation Facilities

KRRC intends to continue stakeholder outreach efforts during development of the Final Recreation Plan to refine the proposed recreation facilities identified above. KRRC intends this outreach effort to identify specific locations for recreation facility development and refine the site-specific details on the configuration of the preliminary amenities described above.

In addition to this refinement, KRRC intends to continue to collect input on other recreation facilities in the Klamath River Basin from stakeholders that could be developed in addition to or potentially in place of the facilities identified for implementation in this draft plan to offset impacts on reservoir recreation and whitewater recreation access in the Hell's Corner Reach associated with implementation of the Project.

4.2 Final Recreation Plan

As the Final Recreation Plan is developed, an evaluation and screening process will be implemented with input from stakeholders to identify the specific locations of, features developed for, and plans for operation and maintenance of the ultimate recreation opportunities. In addition, as was noted above, KRRC anticipates that additional recreation opportunities that have been identified during development of the final plan will perform well in this evaluation and screening process and could potentially be proposed by KRRC for implementation in the Final Recreation Plan alongside or in place of the facility types identified in this draft plan.

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KLAMATH RIVER RENEWAL CORPORATION

VIA U.S. MAIL AND EMAIL

October 10, 2018

State Water Resources Control Board
Division of Water Rights - Water Quality Certification Program
Attn: Parker Thaler
P.O. Box 2000
Sacramento, CA 95812-2000

Subject: Proposed Update to Definite Plan – Appendix I - AR-7 Freshwater Mussels

Dear Mr. Thaler:

This correspondence follows recent discussions between the Klamath River Renewal Corporation (KRRC) and the State Water Resources Control Board (SWRCB) and California Department of Fish and Wildlife (CDFW) concerning KRRC's proposed revision to Aquatic Resource (AR-7), the measure to reduce project effects to freshwater mussels located between Iron Gate Dam and Cottonwood Creek. On a short-term basis, mussels located in this reach are expected to experience moderate to high mortality due to bedload burial associated with the sediment release during the removal of the Klamath River dams. The management objective of this measure during this period is to reduce this mortality by relocation of individual animals.

The three mussel taxa in the Klamath River include *Gonidea angulata* (Western ridged mussel), *Margaritifera falcata* (Western pearlshell mussel), and *Anodonta sp.* (floater mussel) (Davis et al. 2013). Mussels are abundant and widely distributed throughout the mainstem Klamath River and tributaries. *G. angulata* is more widely distributed and more abundant than the other species (Davis et al. 2013). *Anodonta sp.* are located immediately below Iron Gate Dam, but are uncommon elsewhere. *M. falcata* is most abundant between the Salmon River and Trinity River confluences, and are nearly equally common as *G. angulata* in the vicinity of the Trinity River (Davis et al. 2013). Mussel abundance also generally declines with increasing distance downstream from Iron Gate Dam, suggesting the effects of the increasing hydrologic variability of the Klamath River with distance from Iron Gate. Davis et al. (2013) concluded that habitats located further downstream had lower probabilities of supporting mussels due to more variable conditions.

During meetings in 2017, the Aquatic Technical Working Group (ATWG) reviewed relocation opportunities including moving mussels to the Keno to J.C. Boyle Reservoir reach. In June 2018, KRRC reviewed habitat conditions in the Keno to J.C. Boyle Reservoir reach and determined there is insufficient suitable freshwater mussel habitat in the reach. As there is insufficient habitat in the Keno to J.C. Boyle Reservoir reach, KRRC is now proposing to relocate mussels to the Klamath River downstream from the Trinity River confluence, or upstream of Copco Reservoir in the J.C. Boyle Dam to Copco Reservoir reach. In 2019, KRRC will be completing a more comprehensive freshwater mussel habitat reconnaissance to document existing freshwater mussel locations in the Iron Gate Dam to Cottonwood Creek reach, and to determine appropriate relocation sites in the two aforementioned reaches. *G. angulata* and *M. falcata* will mainly be targeted for relocation as there is appropriate habitat downstream from the Trinity River for both taxa (Davis et al. 2013). *G. angulata* have also been found upstream from Copco Reservoir (Byron and Tupen 2017). There are no recent published records of *M. falcata* upstream of Copco Reservoir.

The attached document summarizes the proposed updated language for the Detailed Plan – Appendix I. Narrative updates include the AR summary section, and Chapter 9 - Freshwater Mussels.

We appreciate your consideration of this proposed revision to measure AR-7. Please acknowledge receipt of this correspondence. If you have any questions on the application, please feel free to contact me at 510-679-6929 or mark@klamathrenewal.org.

Mark Bransom

Mark Bransom
Chief Executive Officer
Klamath River Renewal Corporation

cc: Erin Ragazzi, State Water Resources Control Board

encl: Appendix I – Freshwater Mussel Updated Language dated September 21, 2018.

Update for 20170929_krrc-tech_report.pdg

PDF p.262, report p. 7-8

First paragraph: “beds that will be salvaged and translocated is predicated on the available habitat in the Klamath River downstream from the Trinity River confluence (RM 43.4), and between J.C. Boyle Dam (RM 230.6) and Copco Reservoir (RM 209.0), and the abundance of mussels between Iron Gate Dam…”

9. FRESHWATER MUSSELS

The objective of the freshwater mussels measure is to address reservoir drawdown and project effects on freshwater mussels located in the Klamath River in the Hydroelectric Reach and downstream from Iron Gate Dam (RM 193.1). The 2012 EIS/R AR-7 focused conducting a freshwater mussel relocation pilot study followed by the salvage and relocation of freshwater mussels prior to reservoir drawdown. Salvaged mussels were to be held in a temporary location for later placement following reservoir drawdown, and placed in locations that will not be affected by the reservoir drawdown. Based on a review of the information discussed in greater detail below, KRRC and the ATWG concluded that a moderate scale freshwater mussel relocation effort is warranted. The proposed measure includes a freshwater mussel reconnaissance in 2019 followed by a limited freshwater mussel salvage prior to reservoir drawdown. Specifically, KRRC will salvage freshwater mussels from the 8-mile long Iron Gate Dam (RM 193.1) to Cottonwood Creek (RM 185.1) reach and translocate these mussels to one or more appropriate locations in the Klamath River downstream from the Trinity River confluence (RM 43.4), and between J.C. Boyle Dam (RM 230.6) and Copco Reservoir (RM 209.0). The translocation sites will be determined following the 2019 reconnaissance and discussion with the ATWG.

9.1 Proposed Measure

Based on a review of the 2012 EIS/R AR-7 presented in Section 9.2 below, input from the ATWG, and current freshwater mussels literature, the KRRC concluded that revisions to AR-7 are necessary to offset the anticipated short-term effects of the Project on freshwater mussels. The proposed measure includes a reconnaissance, salvage, and relocation of freshwater mussels from the 8-mile reach between Iron Gate Dam and the Cottonwood Creek confluence with the Klamath River. The monitoring and adaptive management plan has two specific actions.

- **Action 1:** KRRC will complete a reconnaissance in 2019 to assess the distribution and density of freshwater mussels in the 8-mile long bedload deposition reach from Iron Gate Dam (RM 193.1) downstream to the Cottonwood Creek confluence (RM 185.1). The reconnaissance effort will determine if the mussel beds identified in the 2007-2010 surveys are still present, and estimate abundance of a subset of the mussel beds in the reach.

- **Action 2**: Based on the reconnaissance and discussions with ATWG, KRRC will salvage and relocate a portion of the freshwater mussels located between Iron Gate Dam and Cottonwood Creek prior to drawdown to reduce project effects to the mussel community. Up to 20,000 mussels are planned for translocation to appropriate habitats in the Klamath River downstream from the Trinity River confluence (RM 43.4), and between J.C. Boyle Dam (RM 230.6) and Copco Reservoir (RM 209.0). Translocation sites will be located in areas that are anticipated by KRRC to experience minimal changes in channel bed elevation due to sediment deposition associated with the Project.

The proposed measure is intended to reduce project effects on freshwater mussels located downstream from Iron Gate Dam. The following sections provide additional detail on the proposed measure actions.

9.1.1 Action 1: Freshwater Mussel Reconnaissance

The KRRC will prepare a reconnaissance plan to assess freshwater mussels in the Iron Gate Dam to Cottonwood Creek reach in 2018. Habitat conditions will also be evaluated downstream from the Trinity River confluence, and between J.C. Boyle Dam and Copco Reservoir to determine the habitat capacity for translocated mussels. An existing freshwater mussel data set (base data for Davis et al. 2013), compiled by the Karuk Tribe, USFWS, and other collaborators from 2007 to 2010 for the Klamath River downstream from Iron Gate Dam, will be reviewed and used to plan the reconnaissance. The reconnaissance will confirm mussel beds identified in the 2007-2010 surveys and estimate abundance at a subset of the mussel beds locations. Habitat metrics in the potential translocation reach will be evaluated to maximize translocation success. The freshwater mussel reconnaissance and translocation reach habitat assessment are anticipated to take 5 days.

9.1.2 Action 2: Freshwater Mussel Salvage and Relocation

The KRRC will coordinate and implement a freshwater mussel salvage plan with freshwater mussel specialists. Based on the reconnaissance, a portion of the freshwater mussels located between Iron Gate Dam and Cottonwood Creek will be salvaged and relocated to reduce project effects to the freshwater mussel community. The freshwater mussel salvage and translocation effort is anticipated to require 10 days. The percentage of the existing mussel beds that will be salvaged and translocated is predicated on the available habitat in the Klamath River downstream from the Trinity River confluence, and between J.C. Boyle Dam and Copco Reservoir, and the abundance of mussels between Iron Gate Dam and Cottonwood Creek. Approximately 15,000 to 20,000 mussels are planned for translocation. During the course of these actions, it is not anticipated that the entire population of mussels residing below Iron Gate Dam will be recovered.

9.2 Summary of the Affected Species, Anticipated Project Benefits and Effects, Recent Literature, 2012 EIS/R AR-7, and Proposed Measure

The following sections review the components of the 2012 EIS/R AR-7, anticipated project effects and long-term benefits on freshwater mussels, and current freshwater mussel literature.

9.2.1 Affected Species

Species intended to be addressed in the 2012 EIS/R AR-7 include:

- Oregon floater *(Anodonta oregonensis)*
- California floater *(A. californiensis)*
- Western ridged mussel *(Gonidea angulata)*
- Western pearlshell mussel *(Margaritifera falcata)*

9.2.2 Anticipated Project Effects on Measure Species

Short-term effects of the Project (prolonged exposure to high suspended sediment levels and bedload movement) are predicted to be deleterious to freshwater mussels in the Hydroelectric Reach and in the lower Klamath River downstream from Iron Gate Dam (Reclamation and CDFG 2012). Substantial freshwater mussel population reductions are expected due to sediment effects and possibly low dissolved oxygen levels. The change in hydrological properties following project implementation may also disrupt the current distribution of freshwater mussels downstream from Iron Gate Dam (Davis et al. 2013). Table 9-1 includes the likely and worst-case effects on freshwater mussel species in the Klamath River.

Table 9-1 2012 EIS/R anticipated effects summary for freshwater mussels

Species	Life Stage	Likely Effects	Worst Effects
California Floater Oregon Floater Western Ridged Western Pearlshell	All	Substantial reduction in populations	Substantial reduction in populations

Source: USBR and CDFG 2012

The following sections include descriptions of anticipated effects to freshwater mussels based on information 2012 EIS/R (Reclamation and CDFG 2012; Vol. 1, pp. 3.3-173 to 3.3-175) as well as additional information from additional freshwater mussel studies, some of which were completed after the publication of the 2012 EIS/EIR.

Freshwater Mussels

Available studies have evaluated Klamath River Basin freshwater mussel age structure, growth rates, and size distribution (*G. angulata*; Tennant 2010); population distribution and habitat use (Krall 2010; Davis et al. 2013; May and Pryor 2015); and habitat associations (Westover 2010; Davis et al. 2013). Klamath River mussels are long lived (from 10 to more than 100 years, depending on species) and may not reach sexual maturity until 4 years of age or more. *Anodonta* species are found primarily downstream from Iron Gate Dam, and likely benefit from the stable hydrology and fine sediment deposits attributed to hydroregulation below the dam (Davis et al. 2013). *G. angulata* is the most abundant freshwater mussel in the Klamath River and the species is widely distributed between Iron Gate Dam and the Trinity River (Westover 2010;

Davis et al. 2013). *M. falcata* is the least abundant freshwater mussel found in the Klamath River and seems to be mostly found downstream from the confluence of the Salmon River (Westover 2010; Davis et al. 2013).

Freshwater mussel tolerance of high suspended sediment, low dissolved oxygen, and bedload deposition are not well understood. Vannote and Minshall (1982) evaluated freshwater mussels in an aggrading river system in Idaho and concluded that *G. angulata* appear to be better adapted for aggrading rivers based on siphon positions, shell morphology, and foot placement in the underlying substrate. *M. falcata* seemed to be less adapted for aggrading rivers due to a less developed siphon for filtering water. *M. falcata* also rarely burrow into substrate more than 25-40 percent of the valve length which may increase the mussel's susceptibility to scour (Vannote and Minshall 1982). *G. angulata* migrate vertically in the channel bed and are capable of maintaining position near the channel bed surface (Vannote and Minshall 1982). *M. falcata* are not known to migrate and are therefore more susceptible to sediment burial. *Anodonta* species are likewise susceptible to sediment scour and burial due to their thinner shells. Mussels that are dislodged from their normal vertical position and fall onto their sides may not regain the normal position and may perish (Vannote and Minshall 1982).

Mussels play important roles in aquatic ecosystems. Mussels influence water quality, nutrient cycling, and habitat and are also known as "ecosystem engineers" that actively modify their environment (Xerces Society 2009; Lopes-Lima et al. 2016; Lummer et al. 2016). They filter fine sediment and organic particles, create byproducts that are food items for macroinvertebrates, and comprise the greatest proportion of animal biomass in some waterbodies (Xerces Society 2009). In the Klamath River Basin, freshwater mussels filter and sequester toxins including toxigenic algae microsystins (Kann et al. 2010) and mercury (Bettaso and Goodman 2010). Filtration of waterborne toxins may result in bioaccumulation in freshwater mussels leading to human consumption risks (Bettaso and Goodman 2010; Kann et al. 2010).

The Project is anticipated to result in high suspended sediment levels and bedload deposition in the 8 miles of the Klamath River between Iron Gate Dam and Cottonwood Creek. Extremely poor water quality due to high suspended sediment concentrations is expected in the first 2 miles of the Klamath River downstream from Iron Gate Dam (Reclamation and CDFG 2012). Fine sediment effects on freshwater mussels include gill clogging, possible growth reduction, and impairment to mussel larval stages (Lummer et al. 2016). Due to both the anticipated deleterious high suspended sediment concentrations and low dissolved oxygen levels, freshwater mussels downstream from Iron Gate Dam may experience substantial mortality with the most significant impacts anticipated to mussels located immediately downstream from Iron Gate Dam.

Over the long-term, freshwater mussels are expected to benefit from the Project through the conversion of Hydroelectric Reach reservoirs to gravel bed rivers which will restore freshwater mussel habitat, reduce water quality and water temperature impairments related to the reservoirs, and restore access for anadromous and resident host fish species that will distribute freshwater mussel larvae throughout the Klamath River upstream from Iron Gate Dam. However, due to the long time freshwater mussels take to reach sexual maturity, the recolonization and/or growth of existing freshwater mussel populations upstream of Iron Gate Dam may be slow and may not be readily noticeable for some time.

9.2.3 2012 EIS/R AR-7

The 2012 EIS/R AR-1 (Vol. I, pp. 3.3-248 to 3.3-249) directed the salvage of freshwater mussels from the Hydroelectric Reach and downstream from Iron Gate Dam. Salvaged mussels were to be relocated to suitable instream habitat unaffected by high suspended sediment concentrations, or could be placed in temporary facilities and returned to the Klamath River following the Project. A salvage and relocation pilot study was also suggested to assess salvage feasibility and relocated mussel survival. Based on the pilot study results, a detailed salvage and relocation plan was to be developed.

9.2.4 KRRC's and the ATWG's Review of AR-7 for Feasibility and Appropriateness

The KRRC assessed the feasibility and appropriateness of AR-7 through multiple planning meetings held with the ATWG between May and August 2017. During these meetings, current information on Klamath River fisheries was presented and information on other dam removal projects conducted in the western United States was reviewed to understand how the aquatic ecosystem might respond, as discussed above. The ATWG's concerns regarding the 2012 AR-7 included:

- Unfamiliarity with successful freshwater mussel relocation efforts.
- Disease transmission concerns.

The following sections provide additional information regarding AR-7 feasibility and appropriateness, based on fisheries literature and ATWG input.

Unfamiliarity with Successful Freshwater Mussel Relocation Efforts

The ATWG was unfamiliar with successful freshwater mussel translocation efforts. Anecdotal information discussed during the ATWG planning meeting (Yreka, CA, May 23, 2017) alluded to low translocation success for the Elwha Dam Removal Project and highway construction projects. Additional information was acquired by the KRRC on the Elwha Dam Removal Project freshwater mussel (*M. falcata*) translocation. For that project, freshwater mussels were translocated to two sites and remained in one site prior to the dam removal project (P. Crain, U.S. Park Service, personal communication, 2017). The relocated freshwater mussels had high survival following the translocation and prior to the dam removals. Subsequent events that impacted the translocated mussels resulted in high mussel mortality. The events included raccoon predation due to shallow habitat at the first translocation site, and excessive sediment deposition at a side channel translocation site. The third monitored site was an artificial outfall channel from the water treatment facility that went dry due to inadvertent project operations. Mussels that remained in the Elwha River downstream from Elwha Dam are suspected to have experienced high mortality due to excessive sediment deposition following dam removal, followed by channel scour during the post-dam sediment sorting process.

Freshwater mussel translocation project monitoring results are not well represented in the fisheries literature. Unpublished freshwater mussel translocation monitoring manuscripts were reviewed to better understand the range of potential translocation success. Fernandez (2013) described the translocation success of 265 individual *M. falcata* in coastal southwest Washington. Between 55 percent and 95 percent of the transplanted *M. falcata* were accounted for in the translocation sites between one and three years following the translocation.

A review of translocation projects found mean mortality of relocated mussels was 49 percent based on an average recovery rate of 43 percent (Cope and Waller 1995). Cope and Waller (1995) found that survival of relocated mussels was generally poor and the factors influencing the survival of relocated mussels were poorly understood. For mussel relocation to be successful, more consideration must be given to habitat characterization at both the source and translocation sites. Olden et al. (2010) and Germano et al. (2015) offer considerations for successful freshwater organism and wildlife translocation efforts, respectively Luzier and Miller (2009) offer suggestions and considerations for freshwater mussel translocations.

Disease Transmission Concerns

The role of freshwater mussels in freshwater disease transmission is not well understood. Freshwater mussels are known to provide habitat for polychaete worms, one of the hosts in the life *C. shasta*. Polychaetes have been infrequently collected from freshwater mussel shells in the Hydroelectric Reach of the Klamath River (PacifiCorp 2004). Mussels may serve as a vector for other fish pathogens like *Flavobacterium columnare* and *Ichthyophthirius multifiliis* that are endemic to the Klamath River Basin (K. Kwak, CDFW, personal communication 2017).

Freshwater mussels inhabit the Klamath River upstream from Iron Gate Dam (Byron and Tupen 2017) and in tributaries upstream (Byron and Tupen 2017) and downstream from Iron Gate Dam (Davis et al. 2013; Howard et al. 2015; May and Pryor 2015), disease transmission may be less of a concern.

9.3 Summary

The Project is anticipated to have significant short-term effects, but long-term benefits for freshwater mussels. The 2012 EIS/R AR-7 included a freshwater mussel salvage and relocation pilot study followed by an informed salvage and relocation plan prior to the Project. The proposed measure includes completing a reconnaissance of existing freshwater mussels from Iron Gate Dam to Cottonwood Creek and potential translocation habitat on the Klamath River downstream from the Trinity River confluence, and between J.C. Boyle Dam and Copco Reservoir. KRRC will salvage and relocate freshwater mussels prior to the reservoir drawdown. It is not anticipated that the entire population of mussels residing below Iron Gate Dam will be recovered.