PRELIMINARY DESIGN REPORT

SAN JUAN WATERSHED PROJECT

ORANGE COUNTY, CALIFORNIA

Prepared for:

June 19, 2017
AECOM Project No. 60528385

Prepared by:

AECOM

999 Town and Country Road
Orange, CA 92868
(714) 567-2400
www.aecom.com

ENGINEER / GEOLOGIST CERTIFICATIONS

Bryan Paine, PE
Project Manager and Civil Engineer
Civil Engineer 64334
Date: June 19, 2017

Christopher Goetz, CEG
Project Engineering Geologist
Engineering Geologist 1833
Date: June 19, 2017

Dale Wah, PE, SE
Project Structural Engineer
Structural Engineer 2582
Date: June 19, 2017

Allen Randall, PE
Project Electrical Engineer
Electrical Engineer 9206
Date: June 19, 2017

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Acronyms and Abbreviations

ASCE	American Society of Civil Engineers
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ASTM	American Society for Testing and Materials
CA	Compressed Air
CBC	California Building Code
CFS	Cubic Feet per Second
CMU	Concrete Masonry Unit
FS	Factor of Safety
HEC-RAS	Hydrologic Engineering Center's River Analysis System
HP	Horsepower
lb or lbs	Pound (mass)
OCFCD	Orange County Flood Control District
OCPW	Orange County Public Works
PDR	Preliminary Design Report
PLC	Programmable Logic Controller
PSF	Pounds per Square Foot
PSI	Pounds per Square Inch
SCADA	Supervisory Control and Data Acquisition
SJBA	San Juan Basin Authority
SMWD	Santa Margarita Water District
TBD	To Be Determined
WEI	Wildermuth Environmental, Inc.

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

The San Juan Basin Authority (SJBA) has been involved in the optimization of the San Juan Basin to promote the development and expansion of groundwater production facilities to serve as potable water sources for local water agencies. Currently, the San Juan Basin aquifer has underutilized storage capacity with a high potential for the implementation of recharge facilities. The San Juan Creek and Arroyo Trabuco Creek have been identified by SJBA as having sufficient existing morphology for large scale recharge opportunities.

The proponents of the San Juan Watershed Program are planning to construct up to ten rubber dams over multiple construction phases within both the San Juan Creek and the Arroyo Trabuco (Trabuco Creek). Currently, the existing morphology of the San Juan Basin aquifer allows for incidental recharge in both the San Juan and Arroyo Trabuco Creeks. The dams will act to promote this in-stream recharge capability of the San Juan Basin aquifer by acting as in-stream detention facilities for both dry weather and wet weather flows within the two creeks, allowing for the ponded water to naturally infiltrate into the stream bed. In the case of a severe storm event, the rubber dams will have the capability to deflate to allow full passage of the stormwater flow downstream to the Doheny State Beach estuary outlet to the Pacific Ocean.

The dams will incorporate fish passages to allow for migration of Steelhead Trout in the creeks and a stilling basin with stream bank and channel bottom lining for scour protection and energy dissipation of flood water. Each dam will also include a control building that will house equipment for telemetry, dam controls, surveillance, and compressed air.

Figure 1-1 illustrates the location of three proposed rubber dams within the San Juan Creek that comprises this Project, which is Phase 1 of the San Juan Watershed Program.

Figure 1-1: Project Location Map

1.2 Scope of Work

This Preliminary Design Report (PDR) presents the results of the preliminary design prepared by AECOM, including the basis of design for the Project components, the technical approach and design parameters, design assumptions, applicable codes, guidelines, regulations, and other references. Specifically, our scope includes:

- Alternative Analysis of Various Rubber Dam Systems
- Hydraulic Analysis of Rubber Dam Implementation
- Fish Passage Facilities Design
- Erosion Control and Scour Protection Design
- Geotechnical Investigation
- Surveying and Right-of-Way Acquisition
- Regulatory Compliance and Permitting

- San Juan Capistrano Groundwater Recovery Plant Evaluation
- Final Design Recommendations

2.0 PROJECT DESIGN FEATURES AND DESIGN CRITERIA

2.1 PROJECT FEATURES AND DESIGN CRITERIA

The Project will implement three rubber dams within the San Juan Basin watershed, which will all be located within San Juan Creek (OCFCD Channel L01). The Figures presented in Appendix A illustrate the approximate locations of the three rubber dams as well as the necessary ancillary equipment. The general rubber dam locations were determined based on recommendations developed by Wildermuth Environmental, Inc. (WEI) during the preparation of and outlined in the SJBA Groundwater and Desalination Optimization Program ("Program"), dated March 2016. A site visit was also performed by AECOM, WEI, and SMWD to identify the approximate locations of the three rubber dams. The locations of the auxiliary air compressor and controls building were located within the public right-of-way where possible, and as close to the subsequent rubber dam as possible to minimize pressure losses in the compressed air supply and reduce piping costs. The height of the dams was determined based on the recommendations provided in the Program document. Table 2-1 provides a summary of the design criteria for each of the proposed rubber dams.

Table 2-1: Rubber Dam Preliminary Design Criteria

Rubber Dam No.	OCFCD Channel	Approximate Channel Station	Approximate Dam Length	Approximate Transition Length	Proposed Dam Height
1	San Juan Creek	56+50	218 ft	650 ft	7 ft
2	San Juan Creek	95+00	211 ft	590 ft	9 ft
3	San Juan Creek	120+00	249 ft	400 ft	7 ft

2.2 PROJECT ALTERNATIVES ANALYSIS

Two types of rubber dam systems where analyzed for implementation at the Project site. The first system is a traditional rubber dam consisting of an inflatable rubber air bladder. Figure 2-1 and 2-2 illustrates a typical installation and schematic drawing for the traditional rubber dam installation. The second system consists of both an inflatable rubber air bladder, as well as an adjoining metal gate which is raised as the bladder is inflated. Figures 2-3 and 2-4 illustrate a typical installation and schematic drawing for the rubber dam with metal gate system.

Figure 2-1: Traditional Rubber Dam Installation, Imperial, CA

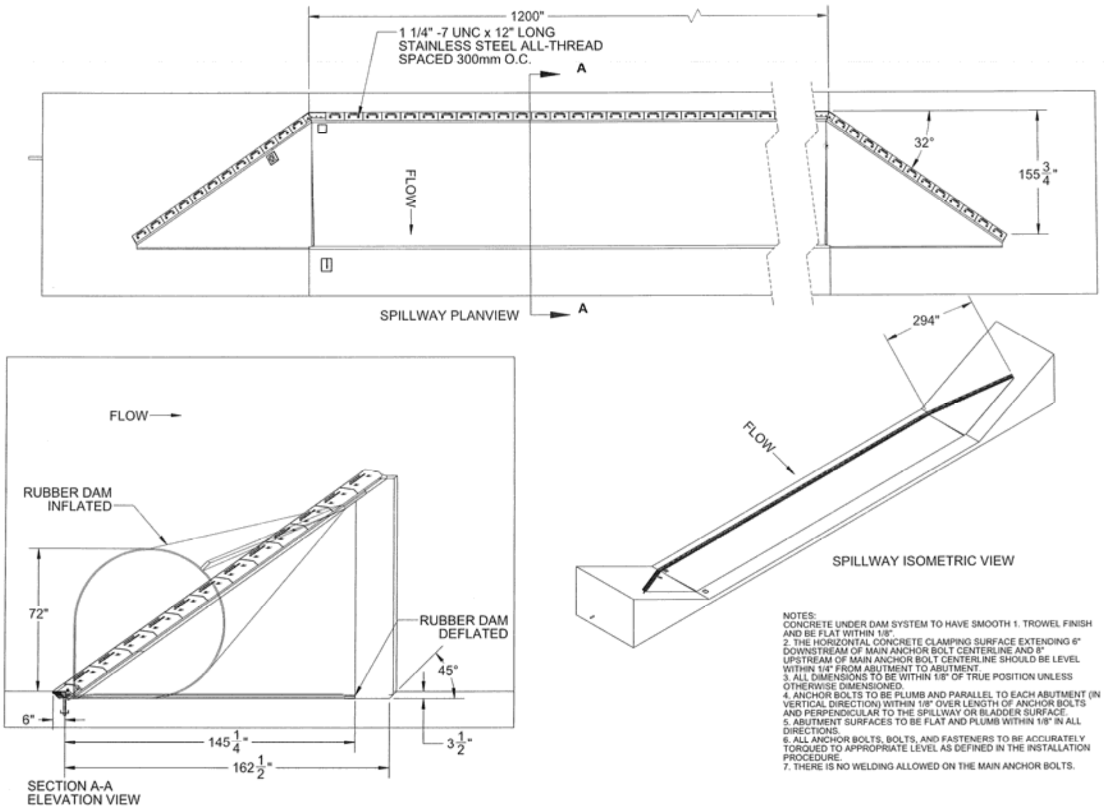


Figure 2-2: Traditional Rubber Dam, Schematic Drawing

Figure 2-3: Rubber Dam with Gate Installation, Salinas, CA

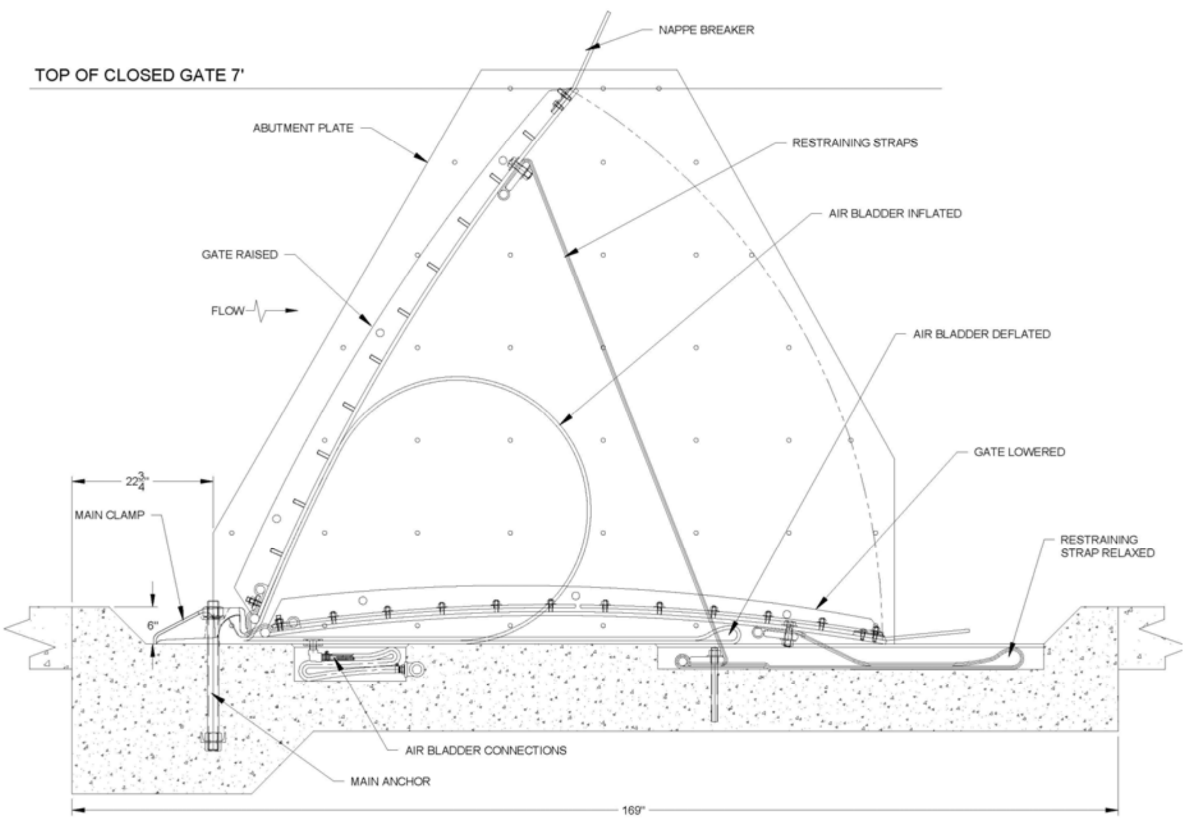


Figure 2-4: Rubber Dam with Gate, Schematic Drawing

In order to determine the most appropriate rubber dam system to implement at the Project site, an alternative analysis was performed to ascertain the advantages and disadvantages of both the traditional rubber dam system and the rubber dam with metal gate system.

TRADITIONAL RUBBER DAM SYSTEM

The traditional rubber dam consists of a rubber air bladder, which can be both inflated and deflated as required. The system requires a concrete foundation/leveling pad to mount the rubber dam to the channel floor and ensure that the dam has sufficient structural capacity to withstand hydrostatic pressures, as well as wave and debris impacts without becoming dislodged from the channel. The system also integrates an abutment structure that connects the rubber dam to the side walls/embankments of the existing channel. Air supply required to inflate the rubber dam is provided via an offsite compressor system, which will be housed in a masonry control building. The rubber dam system will also require level sensor instrumentation and logic controllers in order to automate the inflation and deflation of the rubber dam. The PLC and any other ancillary controls equipment will also be located within the control building.

Based on the Project needs, which includes detaining dry weather and small storm event flows, the traditional rubber dam system will be able to accommodate the required performance from an operational standpoint. However, because the rubber dams will be located within a relatively populated area and will be placed within an existing creek that has the potential for large debris to be present during a storm event, issues can be raised regarding the integrity and longevity of the traditional rubber dam system within the Project setting.

The presence of a relatively populated residential area directly adjacent to the rubber dams promotes a need to detour vandalism against the dams. Such vandalism could result in the ultimate failure of the dam during critical periods of operation if not discovered by operations staff. Currently, the Project site has no security gate isolating the adjacent bike path and crest maintenance road from the actual channel bottom itself, therefore it can be inferred that potential vandals could enter the channel and have access to the rubber dam if they so desired.

Furthermore, the nature of both the San Juan Creek and Trabuco Creek present the possibility that during certain storm events, debris in the form of tree branches, rocks, or abrasive trash may be present in the channel and could potentially collide with the rubber dam, causing penetration of the dam exterior, possibly leading to a system failure.

Since the traditional rubber dam system has fewer components, the system as a whole will require less preventative maintenance and will also have a lower capital cost when compared to the rubber dam with metal gate system. The percentage difference in capital cost between the two gate systems is approximately eight percent.

Table 2-2 provides a summary of the advantages and disadvantages for the traditional rubber dam system.

Table 2-2: Traditional Rubber Dam Alternative Analysis Summary

Advantages	Disadvantages
Lower Capital Costs	Potential for Vandalism
Fewer Preventative Maintenance Concerns and Costs	Potential for Damage from Debris

RUBBER DAM WITH METAL GATE SYSTEM

The rubber dam with metal gate system is similar to the traditional rubber dam system, but it employs an adjoining metal gate on the upstream end of the dam that creates a protective barrier between the oncoming flow and the rubber dam, as depicted in Figure 2-4. The upstream metal gate consists of a series of metal panels that run longitudinally along the width of the rubber dam and are connected together through watertight interpanel seals. The gates are raised as the rubber air bladder is inflated with the top of the gate reaching the required dam height specified for the Project. The gates rotate about an anchor hinge positioned in front of the rubber air bladder that anchors the gates to the concrete footing. The gates are also connected downstream of the rubber air bladder via a series of restraining straps positioned directly behind the rubber air bladder and anchored downstream to the concrete footing. These straps act to keep the metal gate from overturning when inflated and provide additional structural capacity for hydrostatic pressure and wave and debris impacts. As illustrated in Figure 2-4, the concrete footing for the rubber dam with gate can be recessed to allow the full extent of the gate to be placed below the channel bottom when deflated. This promotes an undisturbed flow regime over the top of the dam location during a severe storm event when the dams are subsequently deflated.

Based on the Project needs, which includes detaining dry weather and small storm event flows, the rubber dam system with metal gates will be able to accommodate the required performance from an operational standpoint. The dams will offer much greater protection from both vandalism and potential damage from channel debris due to the armoring effect of the rigid metal gate located upstream of the rubber air bladder. Since the metal gate completely covers the rubber air bladder while deflated, and extends fairly high above the air bladder while inflated, it would be difficult for a potential vandal to reach the air bladder to cause a disruption. Furthermore, because the gate is upstream of the rubber air bladder, any abrasive debris in the channel will be blocked from contacting the less rigid rubber, which will thereby decrease the potential for rupturing of the rubber and causing system failure.

Since the rubber dam with metal gate has inherently more components when compared to the traditional rubber dam system, the rubber dam with gate system will require more preventative maintenance and will also have a higher capital cost.

Table 2-3 provides a summary of the advantages and disadvantages for the rubber dam with metal gate system.

Table 2-3: Rubber Dam with Metal Gate Alternative Analysis Summary

Advantages	Disadvantages
Protection from Vandalism	Higher Capital Costs
Protection from Debris Damage	Greater Preventative Maintenance Concerns and Costs

RECOMMENDATION

Based on the above alternative analysis for both the traditional rubber dam system and rubber dam with metal gate system, we recommend implementation of the rubber dam with metal gate system for the Project. The rubber dam with metal gate will provide substantially greater protection from vandalism and potential abrasive debris flow and will therefore increase the integrity and longevity of the dam installation when compared to the traditional rubber dam. Given the advantages and disadvantages as shown in Table 2-3, we believe the advantages of the rubber dam with metal gate system outweigh the disadvantages.

3.0 PRELIMINARY DESIGN

3.1 HYDRAULIC DESIGN

A hydraulic analysis of the San Juan Channel and rubber dams was performed in order to determine the effects the water levels and velocities in the channel. A one-dimensional, steady flow hydraulic model was created to model the three rubber dams using USACE HEC River Analysis System (HEC-RAS version 5.03).

Design of the transition structures were designed based upon OCFCD Design Manual standards. Flow in the San Juan Creek Channel is mostly stable and subcritical. The straight line deflection for a transition wall for subcritical flow specified by the manual is specified to be between 10 and 30 degrees. The channel transitions were designed with these requirements and all fall within the acceptable range. The main concern with design of transition structures the loss or gain of velocity head in the channel. Using the HEC-RAS model velocity heads between the existing conditions and proposed conditions are at the entrance and exit of each transition are minimal.

The weir flow coefficients shown below were used to model the flow over each rubber dam:

Traditional Rubber Dam

Weir Type…………………………………………………….…..Rectangular Sharp Crested Weir

Weir Coefficient………………………………………….…….2.5 (*Provided by HTE Engineering)*

Rubber Dam with Metal Gate

Weir Type…………………………………………………….…..Rectangular Sharp Crested Weir

Weir Coefficient………………………………………….…….3.3 (*Provided by Obermeyer Hydro, Inc.*)

Exiting site topography was determined using a recent site survey performed by Huitt-Zollars. A surface topography was created survey using AutoCAD Civil 3-D. The cross sections and reach lengths and geometry were cut in Civil 3-D and imported into HEC-RAS. A typical reach length of 100 feet was used for the sections. The rubber dams were modeled as inline structures and were placed at the invert of the channel at Stations 120+00, 95+00 and 56+50. Channel transitions from open trapezoidal channel to vertical wall channel and back were placed upstream and downstream of the dam. Downstream stilling basins designs were also incorporated into the model. For modeling purposes, a Manning's roughness coefficient of 0.020 was assigned to the main channel concrete lined channels with gravel bottoms (Open Channel Hydraulics, Chow 1959). A roughness coefficient of 0.033 was assigned to inside the energy dissipator, similar to values for used for rip rap lined channels (Chow 1959).

To analyze the effects of the rubber dams and its appurtenances, two distinct modeling scenarios were considered:

Scenario A: Dams fully inflated with 1 foot of overtopping and normal flow conditions; and

Scenario B: Dams fully deflated at high flow conditions

The results of the HEC-RAS model for Scenario A at each profile show that the hydraulic jump takes place inside the dissipator structure for each dam. See Appendix B-1. The results of Scenario B show that the there is a minimal difference in the energy grade line at the entrance and exits of the channel transitions. See Appendix B-1.

A further analysis was performed using Bentley FlowMaster V8i to determine the resulting discharge over the three rubber dams for both the traditional rubber dam and rubber dam with metal gate alternatives. It was assumed for the analysis that the headwater elevation would be 1-ft above the dam crest elevation, and the tailwater depth would be negligible. The results of the FlowMaster analysis are provided in Table 3-1 and Appendix B-2.

Table 3-1: Hydraulic Analysis Results Summary

Rubber Dam No.	OCFCD Channel	Water Surface Over Dam [ft]	Traditional Rubber Dam Capacity [cfs]	Rubber Dam Metal Gate Capacity [cfs]	Inundation Area [sq. ft]	Detention Volume [ac-ft]
1	San Juan Creek	1	545	719	304,600	24.8
2	San Juan Creek	1	528	696	273,800	30.5
3	San Juan Creek	1	623	822	245,000	21.0

It can be concluded from the Table 3-1 that the rubber dam with metal gate alternative will provide an approximately 32% greater discharge capacity when compared to the traditional rubber dam. This is important from a detention perspective since it is more beneficial to keep the dams inflated as much as possible to retain the greatest amount of stormwater for infiltration purposes. It can therefore be concluded that the rubber dam with metal gate alternative is more beneficial hydraulically for the Project because the dams will be able to remain inflated for a greater magnitude storm and resultantly retain the upstream storage volume for infiltration during such a storm event. The traditional rubber dam in contrast will need to deflate in the presence of a significantly lower magnitude storm and would lose the upstream detention volume which had previously been accumulated behind the dam.

3.2 GEOTECHNICAL DESIGN

AECOM will conduct a geotechnical investigation and prepare a separate Geotechnical Investigation Report to support the project findings. A total of ten rotary wash borings, 50 to 100 feet in depth, consisting of three borings at each dam site and one additional boring at a location deemed necessary by WEI will be performed. The purpose of the borings will be to perform insitu testing, obtain samples for laboratory testing, and to evaluate the subsurface stratigraphy. At each dam, one boring will be drilled in the channel bottom, and the two remaining borings will be drilled in the crown of the east and west channel levees, respectively. AECOM has received the approved encroachment permit from OCPW to perform the borings in the San Juan Creek Channel, as well as the approved well construction permit for the borings from the Orange County Health Care Agency, Environmental Health Division.

3.3 STRUCTURAL DESIGN

RUBBER DAM

Each rubber dam installation will require a concrete foundation, as well as an abutment structure on each end that connects the dam to the existing channel walls. The structures will need to be designed with adequate strength and acceptable factors of safety for stability (overturning, sliding and flotation) and soil bearing capacity under all design loading conditions, including seismic and flood loads.

The structural analyses will consider three load cases: Case I – Usual Loading, Case II – Unusual Loading, and Case III – Extreme Loading. The load cases consider the following loading conditions:

- Case I – Usual Loading (normal operating mode)
  - Headwater hydrostatic load due to maximum normal pool elevation
  - No tailwater load (conservative assumption)
  - Dead load
  - Uplift, as applicable
  - Sedimentation load
- Case II – Unusual Loading (freeboard design event)
  - Headwater hydrostatic load due to freeboard pool elevation
  - Tailwater load
  - Dead load
  - Uplift, as applicable
  - Sedimentation load

- Case III – Extreme Loading (normal operating with earthquake)
  - Headwater hydrostatic load due to maximum normal pool elevation
  - Seismic load due to Risk-Targeted Maximum Considered Earthquake (MCE_R), including hydrodynamic water pressure and dynamic earth pressure
  - No tailwater load (conservative assumption)
  - Dead load
  - Uplift, as applicable

A stability analysis will be performed for each rubber dam structure, and will include overturning, sliding, and flotation, as well as soil bearing checks. The factor of safety (FS) for structure stability against sliding will be determined using the following equation, which is the same as that used by the Army Corps of Engineers for gravity dams:

$$FS = \frac{CA + (W-U)\tan\phi}{H}$$

Where: C = cohesion value of concrete on subgrade, psf

A = base area considered, psf

tan ϕ = coefficient of internal friction

W = sum of vertical forces (except uplift), lb

U = Uplift forces, lb

H = sum of horizontal forces, lb

For the three load cases described above, the factors of safety against sliding are as follows:

Case I – Usual Loading:	FS ≥ 3.0
Case II – Unusual Loading:	FS ≥ 2.0
Case III – Extreme Loading:	FS ≥ 1.5

The following criteria will be used for the resultant of the soil bearing pressure, to ensure an adequate factor of safety against overturning:

Case I – Usual Loading:	Resultant within middle 1/3 of base width
Case II – Unusual Loading:	Resultant within middle 1/2 of base width
Case III – Extreme Loading:	Resultant within base width

The following criteria will be used for checking soil bearing pressure:

Case I – Usual Loading: ≤ allowable

Case II – Unusual Loading: ≤ allowable

Case III – Extreme Loading: ≤ 1.33 x allowable

The criteria for factor of safety for flotation are expressed as the ratio of vertical forces to uplift forces, W/U.

Where: FS = W/U

W = sum of vertical forces (except uplift), lb

U = uplift forces, lb

The factor of safety against flotation for all load cases will be at least 1.25.

The structural design of the rubber dam superstructure and its anchorage to the foundation will be designed by the manufacturer. The structural design of the foundation and abutment structures will be in accordance with the industry standard for inflatable dams, utilizing the following material design parameters and design loads:

Structural concrete: fc' = 4,000 psi (at 28 days)

Reinforcement (ASTM A615, Grade 60): fy = 60,000 psi

Structural steel:

Steel members: ASTM A36, A572

Steel members, stainless: ASTM A276, Type 304 or 304L

Steel sheet pile: ASTM A572

Structural bolts: ASTM A325

Dead Loads:

Concrete	150 lb/ft^3
Steel	490 lb/ft^3
Water	62.4 lb/ft^3

Live Loads:

Soil loads
(active, passive and at-rest soil pressure): To be determined (TBD)

Hydrostatic: 62.4 lb/ft3

Seismic Loads: TBD, in accordance with ASCE 7-10

Hydrodynamic Seismic Load: The hydrodynamic load (F) imposed on the unit width of structures from pool water will be calculated based on the Westergaard method using the following formula:

$$F = 0.583\, \gamma_w\, H^2\, (\alpha/g)$$

Where: γ_w = unit weight of water, 62.4 pcf

H = water head (feet)

α = ground acceleration during earthquake (% of gravity)

g = acceleration due to gravity

CONTROL BUILDING

The proposed control building will consist of a reinforced concrete foundation and concrete block (cmu) wall structure, with structural steel roof framing and metal roof deck (roofing material TBD). The structural engineering design of the building will be in accordance with the 2016 California Building Code (CBC) [based upon the 2015 International Building Code (IBC)], which will become effective on January 1, 2017, and any amendments to the code established by the local authority having jurisdiction (SMWD and/or the City of San Juan Capistrano). Structural analyses and design will be performed using RISA 3-D and Enercalc, computer-assisted design programs.

The control building structural design will also be in accordance with the following codes, included by reference in the 2016 CBC:

- ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures*
- ACI 318-14, *Building Code Requirements for Structural Concrete*
- TMS 602-11/ACI 530-11, *Building Code Requirements for Masonry Structures*
- AISC 360, *Specification for Structural Steel Buildings* (for the steel roof framing of the control building)

Basic materials of construction shall conform to the following:

Structural concrete: f ’c = 3,000 psi min.

Concrete masonry units (ASTM C90): Min. net area compressive strength = 1,800 psi

Masonry grout (ASTM C476): f’c = 2,000 psi

Reinforcement (ASTM A615, Grade 60): fy = 60,000 psi

Structural steel:

Structural steel (wide flange shapes): ASTM A992, Grade 50

Structural steel (angles, channels, plates): ASTM A36

Hollow structural sections (rectangular and circular tubes): ASTM A500, Grade B

Steel connection bolts (basic): ASTM A 307, Grade A

Stainless steel:

Stainless steel tubes: ASTM A554, Grade 316

Stainless steel bolts: ASTM F593, Alloy 316

Stainless steel nuts: ASTM F594, Alloy 316

3.4 ELECTRICAL AND CONTROLS DESIGN

The rubber dam control system will be installed inside the respective control houses identified on the figures in Appendix A. The pneumatic piping will be routed from the control houses to the respective dam locations in the channel. Each rubber dam will require two pneumatic control lines, one for inflating the dam, and one for deflating the dam.

The rubber dams will be controlled by a vendor supplied programmable logic controller (PLC) located inside the control house. A pressure transducer will be installed on the upstream side of the rubber dam to measure the pool elevation and relay this information to the PLC which will automate the deflation or inflation of the rubber air bladder. Operations staff will also have the ability to manually inflate or deflate the dam as required.

The control system equipment for the rubber dam operation will consist of the following items:

- Two 20 HP rotary screw air compressors
- Stainless steel, Type 316, compressed air piping
- 200 gallon air receiver tank
- 5 HP Air Dryer
- Electrically actuated air control valves (Inflation and Deflation)
- Pressure regulating valve

- Check valve
- PLC
- HMI touch screen panel
- Building exhaust fan

All of the main components for the operating system will require 480-volt, 3-phase power service. Appendix A presents a detailed mechanical layout of a typical rubber dam control house.

3.5 Proposed System Operation

The rubber dams will be designed to operate in a normally inflated state and will stay inflated for the majority of the time. They will automatically be lowered by the dam control system whenever the upstream water surface elevation rises to a height of one foot above the rubber dam crest. The dams will manually be lowered when a significant storm event is forecasted. The rubber dam PLC will control the deflation of the rubber air bladder by a pressure transducer installed on the upstream side of the rubber dam. The PLC will relay signals to the air control valves to close the inflation line and open the deflation line and subsequently release the pressurized air within the rubber air bladder into the deflation line to be discharged to the atmosphere.

Once the peak storm event has passed and the upstream water surface elevation has dropped to a certain minimum height below the dam crest, the pressure transducer will signal the PLC to begin the inflation process of the dam. The PLC will relay signals to the two air compressors to fill the receiver tank and pressurized air can then be provided to the rubber dam to facilitate the inflation of the rubber air bladder. Any fluctuations in the air bladder pressure will be monitored and adjustments will be made to maintain the dam position.

3.6 Electrical Requirements

The electrical equipment for the operation of the rubber dam control systems will be installed inside their respective control houses. The utility company power meter will be located outside the control rooms. Meter Panel ‘A’ located inside the buildings will bring power from the utility meter to the 5 KVA Mini Power Zone, which powers the LED lights and exhaust fans in the control room. Panel ‘A’ also powers the duplex Compressor Control Panel which in turn powers the two motors of the air compressor. Refer to Appendix A for the Single line diagrams.

The equipment requiring electrical supply for each rubber dam will include the following items:

- Meter Panel ‘A’
- Mini Power Zone (5 KVA)

- Two 20 HP rotary screw air compressors
- 5 HP air dryer
- Pressure Transducer
- Building Lighting
- Building Exhaust fan

Instrumentation Requirements

The instrumentation system will consist of microwave and antenna to communicate to the District's SCADA communications system central control. The equipment manufacturer and the model numbers are as follows

- PLC – Allen Bradley Compact Logix Controller L33 ER
- PLC Enclosure – Hoffman and powder coated color white
- Microwave – Ubiquity 5.8Ghz AC Air Prizm (combined unit of Microwave and Antenna)
- Network Switch – Netonix Panel Mounted POE

Security

The security will consist of two cameras, as manufactured by Axis. One PTZ camera will be installed to monitor the dam, and a fixed camera will be installed to monitor the compressor room. Intrusion alarm switches will be installed on the Control Building door, and the signals will be sent to the Central Control via the SCADA system.

3.7 Fish Passage Facilities Design

Introduction

Steelhead Trout are the anadromous, or ocean-going form of the species Oncorhynchus mykiss, with adults spawning in freshwater, and juveniles rearing in freshwater before migrating to the ocean to grow and sexually mature before returning as adults to reproduce in freshwater. Steelhead in southern California comprise a "distinct population segment" (DPS) of the species O. mykiss that is ecologically discrete from other populations of O. mykiss along the West Coast of North America. Under the U.S. Endangered Species Act of 1973 (ESA), this DPS qualifies for protection as a separate species. The final designation for the Southern California Steelhead DPS as endangered was issued on January 5, 2006 (71 FR 834). The final critical habitat designation for the Southern California Steelhead DPS was issued on September 2, 2005 (70 FR 52488). Critical habitat includes San Juan Creek. The Final Southern California Steelhead

Recovery Plan was issued by the National Marine Fisheries Service (NMFS) in January 2012. Steelhead in the San Juan Creek watershed are classified as Core 1, or the highest priority for recovery actions, which include providing for natural rates of migration to upstream spawning and rearing areas, and passage of smolts and kelts downstream to the estuary and ocean.

Adult and Smolt Migration

Steelhead are a highly migratory species. The species exhibits a greater variation in the time and location spent at each life history stage than other Pacific salmon. The specific timing of adult spawning migration can vary by a month or more among streams within a region, occurring in winter and early spring, depending on factors such as runoff and sand bar breaching. For San Juan Creek the highest monthly mean discharges occur from December through March.

Similarly, juvenile steelhead moving to the estuary and ocean take advantage of high flow events as a transportation mechanism and emigration in San Juan Creek would occur typically late winter and spring.

Steelhead Passage Design Considerations

A number of flow magnitudes are important in the design of fish passage facilities and there can be differences between a fish passage design flow range and flows within or emanating from a fishway. This narrative describes the concepts of fishway flows, attraction flows, and fish passage design flows and how they are factored into the design alternatives. Fish passage design criteria and guidelines are published by NMFS for the Northwest Region and are used here as guidance and comparison. Guidance for fish passage design flows is provided by the NMFS Southwest Region for stream crossings and through California Department of Fish and Wildlife (CDFW) for formal fishways.

Description of Flow-Related Fish Passage Concepts for Design

Definitions of key terms and descriptions of important flow related fish passage concepts for design are provided here and are taken from NMFS (2008).

Fishway: The fishway is the set of facilities, structures, devices, measures, and project operations that together constitute, and are essential to the success of, an upstream or downstream fish passage system.

Fishway Entrance: The fishway entrance is the component of an upstream passage facility that discharges attraction flow into the tailwater, where upstream migrating fish enter (and flow exits) the fishway.

Fishway Flow: Fishway flow is the flow through the fishway itself.

Auxiliary Water System: The auxiliary water system is a hydraulic system that augments fish passage flow at various points in the upstream passage facility. Typically, large amounts of auxiliary water flow are added in the fishway entrance pool in order to increase the attraction of the fishway entrance.

Attraction Flow: Attraction is the guidance of fish to find the migration pathway over a dam or impediment. It is a key component to minimizing migration delay. It could account for a high portion of the success of fish passage and it is often the most difficult to predict during design. This is because of variables such as uncertainty of behavior of individual fish, and variable and changing hydraulic conditions below the dam and fishway entrance. Fish attraction includes attraction to the vicinity of the fishway entrance and passage into the entrance. The ratio of fishway entrance flow to the river flow downstream is often used as a design guide. Ratios of fishway flow of five to ten percent of downstream flow are often applied. For example, if the flow coming out of a fishway entrance is 100 cubic feet per second (cfs) and the total river flow in the vicinity of the fishway is 1,000 cfs then the attraction ratio is 0.10. The ratio of momentum (equivalent to the product of flow rate and velocity) has also been used. It is important to note that simple percentages or ratios alone do not account for the other attraction considerations. NMFS (2008) describes attraction flow: "Attraction flow from the fishway entrance should be between 5% and 10% of fish passage design high flow … Generally speaking, the higher percentages of total river flow used for attraction into the fishway, the more effective the facility will be in providing upstream passage. Some situations may require more than 10% of the passage design high flow, if site features obscure approach routes to the passage facility." CDFW (2009) refers to these NMFS criteria and to Bates (1992), who described entrance flows, which include fishway flow and can include an auxiliary water system flow, as typically three to ten percent of the downstream flow at the high fish passage design flow in a sample of effective fishways in simple tailwater situations.

Design Flow Range: The design streamflow range for fish passage, bracketed by the designated fish passage design high and low flows, constitutes the bounds of the fish passage facility design where fish passage facilities must operate within the specified design criteria. Within this range of streamflow, the fishway design must allow for safe, timely, and efficient fish passage. Outside of this flow range, fish must either not be present or not be actively migrating, or must be able to pass safely without need of a fish passage facility. Site-specific information is critical to determine the design time period and river flows for the passage facility – local hydrology may require that these design streamflows be modified for a particular site.

High Fish Passage Design Flow: Design high flow for fishways is the mean daily average streamflow that is exceeded 5% of the time during periods when migrating fish are normally present at the site. This is determined by summarizing the previous 25 years of mean daily streamflows occurring during the fish passage season, or by an appropriate artificial stream flow duration methodology if streamflow records are not available. Shorter data sets of stream flow records may be used if they encompass a broad range of flow conditions. The fish passage design high flow is the highest streamflow for which migrants are expected to be present, migrating, and dependent on the proposed facility for safe passage.

Low Fish Passage Design Flow: Design low flow for fishways is the mean daily average streamflow that is exceeded 95% of the time during periods when migrating fish are normally present at the site… The fish passage design low flow is the lowest streamflow for which migrants are expected to be present, migrating, and dependent on the proposed facility for safe passage.

The following Figure 3-1 illustrates a fish passage facility at a rubber dam on the Russian River, California. The facilities on San Juan and Trabuco creeks would be smaller, but conceptually similar in design. The following Figure 3-2 illustrates a schematic of a typical fish passage structure, which can be implemented for this Project.

Figure 3-1: Fish Passage Facility Example, Salinas, CA

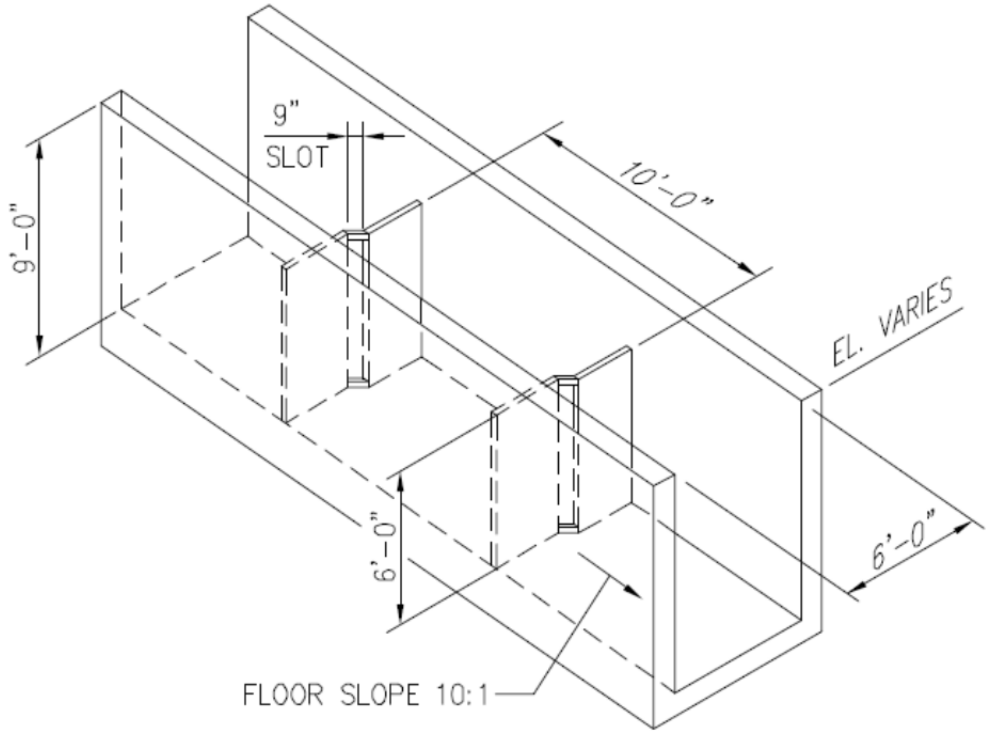


Figure 3-2: Typical Fish Passage Structure Schematic

3.8 STILLING BASIN DESIGN

The rubber dam structures will include a downstream stilling basin, which will be designed to dissipate energy of water flowing over the top of the dam. When water is spilling over each dam, a hydraulic jump will occur within the stilling basin and the excess energy will dissipate within the structure and the downstream channel will not be damaged.

It is anticipated that the rubber dams will be fully inflated (7 or 9 feet high) during low flow conditions (i.e. less than one foot of overtopping) and will be fully deflated during flood conditions. It is also anticipated that deflation will occur gradually during a flood scenario to prevent rapid release of impounded water. However, the following scenarios were evaluated as extreme conditions that could potentially occur due to dam malfunction or miss-operation:

1) Fully inflated dams with 1-ft of overtopping followed by complete instantaneous deflation,

2) Fully inflated dams with 11 feet (1-ft typical + 10-ft additional) of overtopping and no deflation.

Both of these scenarios would require a stilling basin downstream of the rubber dams to prevent erosion that could undermine the dam. Scenario 1 is the critical scenario for the stilling basin design. The preliminary design consists of a 50 or 65 foot long Type 3 stilling basin with an invert elevation 12 or 14 feet below existing ground followed by riprap extending approximately 20 feet downstream of the stilling basin. A summary of pertinent information related to the stilling basin are summarized in Table 3-2 and the supporting calculations provided in Appendix B-3. A preliminary layout of the stilling basin design is provided in Appendix A.

Table 3-2: Preliminary Stilling Basin Design and Channel Characteristics

Characteristic	Dam 1	Dam 2	Dam 3
Fully Inflated Dam Height (feet)	7.0	9.0	7.0
Stilling Basin Type (USBR 1984)	III	III	III
Stilling Basin Drop (feet)	12.0	14.0	12.0
Stilling Basin Length (feet)	50	65	50
Riprap Transition Length (feet)	20	20	20

4.0 PREVENTATIVE MAINTENANCE PROCEDURES

4.1 Rubber Dam Systems

Annual preventative maintenance on the rubber dams will include inspection of the metal gate panels (if used), inspection and tightening of the panel clamping devices, and inspection and testing of the rubber air bladders. Preventative maintenance of the rubber dams should be performed during dry weather flow periods in the summer months when the flow in the channel is low.

Annual preventative maintenance on the rubber dam auxiliary components will include inspection and/or replacement of the compressor mechanical seals, greasing and/or replacing compressor motor bearings, cleaning and/or replacing compressor air filters, and inspection and exercising of the inflation and deflation control valves and actuators.

General annual preventative maintenance in and around the rubber dam structure will include periodic removal of accumulated sediment and debris, inspection and replacement of the riprap scour protection, and inspection and maintenance of all concrete structures.

4.2 Fish Passage Facilities

Similar to the rubber dam systems, maintenance of the fish passage facilities should be performed during dry weather flow periods in the summer months when the flow in the channel is low and the probability of any fish being present is low. The fish passage facilities should be completely dewatered to permit access and inspection of the inside of the facilities.

Typical maintenance procedures will include periodic removal of sediment and debris from within the fish passage structure and annual removal and re-installation of all stop logs.

4.3 Long Term Shutdown Procedures

In the event that the rubber dams are to be deflated for an extended period of time, the following shutdown procedures should be followed to ensure the integrity of the rubber dam system components:

- Deflate rubber dam. Gate panels and/or air bladders do not need to be removed
- Close each rubber dam inflation butterfly valve
- Disconnect and secure all auxiliary electrical and lighting equipment
- Install stop logs at the entrance and exit to the fish passage structures
- Install solid cover panels over the fish passage structures

5.0 REGULATORY COMPLIANCE AND PERMITTING

5.1 INTRODUCTION

San Juan Creek and Arroyo Trabuco Creek are state and federal jurisdictional waters. Activities within and the creeks are regulated under state and federal laws including the federal Clean Water Act (CWA) Sections 404 and 401; Federal Endangered Species Act (FESA) Section 7; California Endangered Species Act (CESA) and California Fish and Game Code (CDFC) Section 1600 et seq. Permits from the state and federal regulatory agencies will be required to construct and operate the three proposed rubber dams in the creeks.

The locations of the proposed rubber dams are within channelized segments of the San Juan Creek and Arroyo Trabuco Creek that have concrete side levees and earthen channel bottoms. Little to no vegetation exists within these segments of the creek. The watershed is identified by the National Marine Fisheries Service (NMFS) as within the 2012 Southern California Steelhead Recovery Plan area. The Southern California Steelhead (Oncorhynchus mykiss) is a federally listed endangered species[1].

Agencies may be concerned that installation of rubber dams could affect two issues in particular:

- The ability for the creeks to be improved for fish passage in the future.
  - The proposed project will incorporate a fish passage design, as well as other structural and operational best management practices, so that any future steelhead restoration project may proceed even with the rubber dams in place.
- The diversion of freshwater that may be important to downstream aquatic resources that may rely on freshwater and brackish water for estuarine habitats.
  - Unlike other river mouth estuaries in Southern California (e.g., Upper Newport Bay, Orange County; San Mateo Creek Lagoon, Northern San Diego County), the river mouth portion of San Diego Creek does not support any downstream, vegetated habitat.

Below is a summary of each required permit as well as the process and timeframe to obtain the permit from each agency. Per the direction of the SMWD, AECOM will conduct pre-application coordination with RWQCB and CDFW, as well as coordinate with these agencies during the permit process.

[1] California Steelhead Trout (*Oncorhynchus mykiss*), Southern California Distinct Population Segment. Listed as Federally Endangered in 1997 and reaffirmed in 2006.

5.2 Clean Water Act Section 404 Compliance

Clean Water Act (CWA) Section 404 compliance is administered by the U.S. Army Corps of Engineers, Los Angeles District, Regulatory Division (Corps). For projects in the San Juan Creek and San Mateo Creek Watersheds, the Corps prepared a Special Area Management Plan (SAMP) that sets forth a watershed specific permit framework and watershed mitigation strategy for regulated activities in these two watersheds. The SAMP was established to balance economic development and infrastructure maintenance with protection of aquatic resources in the watersheds. The SAMP permitting framework centers on conservation of high integrity aquatic resource and streamlined permitting in areas with lower integrity aquatic resources, with a compensatory mitigation/restoration program for no net loss of functions and values of aquatic resources in the watersheds. The Corps revoked 20 of the existing Nationwide Permits (NWPs) as part of the SAMP.

The proposed rubber dam project may qualify under the Corps SAMP Letter of Permission (LOP) process, (rather than an standard individual permit) because: 1) a rubber dam project qualifies as an eligible activity under the LOP (e.g. public water storage facility/impoundment); and 2) the aquatic resources of San Juan Creek in the area of the proposed rubber dams are not characterized as high integrity aquatic resources under the SAMP. Permitting under the LOP is generally a more streamlined process with pre-established mitigation requirements and conditions and, therefore; has a predictable mitigation outcome and shorter (45-day) timeframe for processing.

Pre-application Coordination: The process for obtaining a LOP begins with a pre-application coordination meeting (required for projects that result in a permanent loss to jurisdictional Waters of the United States (WoUS) greater than 0.1 acre) and involves the Corps, California Department of Fish and Wildlife (CDFW), San Diego Regional Water Quality Control Board (RWQCB), and United States Fish and Wildlife Service (USFWS). The following information is required to be submitted prior to the meeting:

- A delineation of WoUS, including wetlands, for the project area;
- A site location and plan view of the project areas and acreage to be impacted showing permanent and temporary impacts to WoUS;
- A draft statement addressing the Section 404(b)(1) Guidelines;
- A draft mitigation plan, if unavoidable impacts occur to riparian habitat and/or wetlands; and;
- When appropriate, a cultural resources inventory and results from an endangered or threatened species survey for the project area.

A written record of the proceedings must be provided afterwards to the Corps, documenting substantive issues discussed, agency recommendations, and any pertinent conclusions.

LOP Application: If the Corps determines that the project qualifies for an LOP, an application can be submitted with all required documentation that details the project description, survey of existing aquatic resources, impacts to aquatic resources, and a mitigation plan addressing unavoidable impacts to WoUS, with the goal of no net loss of wetlands.

LOP Processing Procedures: Within 7 calendar days, the Corps will determine if the application is complete. If the application is incomplete, the Corps, within 7 calendar days, will provide notification of the missing information that must still be submitted. Within 10 calendar days of receiving a complete application, the Corps will submit materials to the CDFG, RWQCB, USFWS, United States Environmental Protection Agency (EPA), National Oceanic Atmospheric Administration (NOAA) Fisheries, and State Historic Preservation Officer (SHPO). The agencies (except for SHPO) will provide comments to the Corps within 21 calendar days. The SHPO will provide comment within 30 calendar days. In evaluating the application the Corps will consider the following:

- Conformity of the proposed project with the SAMP;
- Accuracy of the wetland delineation and the resource assessment;
- Minimization of impacts to the maximum extent practicable;
- Consistency of the proposed project-specific compensatory mitigation with the SAMP compensatory mitigation policy framework (see below);
- Whether threatened or endangered species issues have been resolved in a manner consistent the Endangered Species Act through the issuance of an incidental take statement or through reference to the local Natural Communities Conservation Planning program; and
- Status of compliance with the National Historic Preservation Act.

Issuance of the LOP: The Corps will review the resource agency comments received and make a final determination within 45 calendar days of receiving the complete application. If the project meets the criteria for LOP authorization and agency concerns are adequately addressed, an LOP will be issued. If the project does not meet the LOP authorization criteria, the Corps will notify the applicant of the need for review through a standard individual permit process. Finally, a Section 401 Water Quality Certification or waiver must be obtained from RWQCB. An LOP will not be issued until Section 401 Certification or a waiver is obtained. If no Section 401 Certification has been issued within 45 days after submittal of a complete application, the Corps will issue a provisional LOP.

- Timeline: After submittal (May 2017), 7 days completeness review and 45 days to process LOP (July 2017). A Section 7 consultation, an expected part of the process, may take an additional few months (October 2017).

General Conditions: The LOP contains a pre-existing list of General Conditions applicable to all projects permitted under an LOP. Most of the conditions are standard conditions found in many Corps permits. Of note to the proposed project, General Condition 19 specifies that for projects resulting in construction or replacement of stream crossings in Arroyo Trabuco or San Juan Creek, the resulting structure must comply with NOAA-Fisheries and CDFW requirements for fish passage.

It is anticipated that there would be either a formal or informal Section 7 consultation per the Federal Endangered Species Act (FESA) with the United States Fish and Wildlife Service for potential impacts to designated critical habitat for steelhead trout. Part of the application materials to the Corps will include a Biological Assessment, will utilize information in the biological technical report prepared by the District's CEQA consultant to the extent possible.

Compensatory Mitigation: The LOP requires No Net Loss in Acreage and Functions. Overall values and functions should not be reduced within the San Juan Creek Watershed on a program level. In addition, all permanent impacts are required to be mitigated at a minimum of 1:1 ratio (acreage created and restored/acreage permanently impacted) in accordance with specific SAMP program analysis and procedures. For the proposed rubber dams in San Juan Creek and Arroyo Trabuco Creek, the approximate 1.41 acres of permanent impacts[2] will require at least 1.41 acres of restoration within the San Juan Creek Watershed.

Another authorization that may be required from the Corps is a **Section 408 Permit (Rivers and Harbors Act Section 14)** from the Corps to grant permission for the alteration, occupation or use a Corps civil works project (e.g. levees along San Juan Creek).

  - Timeline: To be determined. The first task is to confirm that a Section 408 authorization will be needed. If required, then the process may be completed within the total duration of the project, but may extend through the end of 2017.

State Permits Compliance with Section 401 of the Clean Water Act and Section 1600 et seq. of the Fish and Game Code

[2] The potential permanent impacts for the three facilities area as follows: Rubber Dam No. 1: 0.56 acre; Rubber Dam No. 2: 0.56 acre; Rubber Dam No. 3: 0.29 acre.

- **California Fish and Game Code (FGC) Section 1602 Streambed Alteration Agreement from the California Department of Fish and Wildlife (CDFW).**
    - Timeline: After submittal (May 2017), 30 days completeness review and 60 days to process certification (August 2017).

- **CWA Section 401 Water Quality Certification from the San Diego Regional Water Quality Control Board (RWQCB).**
    - Timeline: After submittal (May 2017), 30 days completeness review and 60 days to process certification (August 2017).

6.0 PRELIMINARY DESIGN SPECIFICATIONS

In final design, AECOM will prepare the technical specifications and bidding schedule for the contract documents. AECOM will incorporate SMWD's bidding and contract requirements and special provisions into the contract documents. SMWD will provide Part I, Part II, and Part III Division 1 (General) specifications. The remaining Part III technical specification sections anticipated are listed below:

PART I – BIDDING AND CONTRACTUAL DOCUMENTS

(TO BE PROVIDED BY SMWD)

PART II – STANDARD AND REFERENCE SPECIFICATIONS, DEFINITIONS AND ABBREVIATIONS

(TO BE PROVIDED BY SMWD)

PART III – PROJECT TECHNICAL SPECIFICATIONS

DIVISION 00 PROCURMENT AND CONTRACTING REQUIREMENTS

DIVISION 01 GENERAL REQUIREMENTS

(TO BE PROVIDED BY SMWD)

DIVISION 02 EXISTING CONDITIONS

02000 GENERAL EARTHWORK AND GRADING
02010 STRUCTURE EARTHWORK
02020 TRENCHING, BACKFILLING, AND COMPACTING
02040 DEWATERING
02050 DEMOLITION, SALVAGE AND PROTECTION
02220 EXCAVATION AND FOUNDATION TREATMENT

DIVISION 03 CONCRETE

03100 CONCRETE FORMWORK
03200 CONCRETE REINFORCEMENT
03260 CONCRETE JOINTS AND WATERSTOPS
03300 CAST-IN-PLACE CONCRETE
03351 CONCRETE FLOOR FINISHES
03600 GROUT

DIVISION 04 MASONRY

04100 MORTAR AND MASONRY GROUT
04230 CONCRETE MASONRY UNIT
04232 REINFORCED CONCRETE BLOCK MASONRY

DIVISION 05 METALS

05120 STRUCTURAL STEEL AND MISCELLANEOUS METAL WORK
05500 METAL FABRICATIONS
05520 HANDRAILS

DIVISION 06 WOOD AND PLASTICS

DIVISION 07 THERMAL AND MOISTURE PROTECTION

07190 WATER REPELLENTS
07210 THERMAL INSULATION
07321 CONCRETE ROOF TILES
07620 SHEET METAL FLASHING AND TRIM
07720 ROOF ACCESSORIES
07900 JOINT SEALERS

DIVISION 08 DOORS AND WINDOWS

08111 HOLLOW METAL DOORS AND FRAMES
08170 INTEGRATED DOOR OPENING ASSEMBLIES
08710 FINISH HARDWARE
08910 LOUVERS

DIVISION 09 FINISHES

09900 PAINT AND COATINGS

DIVISION 10 SPECIALTIES

10440 FIRE PROTECTION SPECIALTIES

DIVISION 11 EQUIPMENT

11285 INFLATABLE RUBBER DAM SYSTEMS
11500 COMPRESSORS, GENERAL
11510 ROTARY SCREW AIR COMPRESSORS
11511 AUXILIARY EQUIPMENT FOR COMPRESSORS

DIVISION 12 FURNISHINGS

DIVISION 13 SPECIAL CONSTRUCTION

DIVISION 14 CONVEYING SYSTEMS

DIVISION 15 MECHANICAL

15006 PIPE SUPPORTS
15065 STAINLESS STEEL PIPE
15100 MANUAL VALVES
15121 ELECTRIC MOTOR ACTUATORS
15700 EXHAUST FANS

DIVISION 16 ELECTRICAL

16010	GENERAL ELECTRICAL REQUIREMENTS
16050	BASIC ELECTRICAL EQUIPMENT AND MATERIALS
16110	CONDUIT SYSTEMS
16120	WIRE AND CABLE
16135	CABINETS AND ENCLOSURES
16140	SWITCHES AND RECEPTACLES
16150	ELECTRIC MOTORS
16155	LOW VOLTAGE MOTOR CONTROL
16160	PANELBOARDS
16390	GROUNDING
16400	SERVICE AND DISTRIBUTION
16460	TRANSFORMERS
16470	DISTRIBUTION AND LIGHTING PANELBOARD
16500	LIGHTING
16950	ELECTRICAL TESTING
16975	TESTING AND START-UP

DIVISION 17 SCADA

17000	GENERAL INSTRUMENTATION CONTROL REQUIREMENTS
17020	VIBRATION MONITORING EQUIPMENT
17050	PRESSURE TRANSDUCERS
17100	PLC PROGRAMMING
17300	PLCS AND PROGRAMMABLE OPERATOR INTERFACES
17305	SCADA CONTROL PANELS
17315	SCADA HARDWARE
17320	SCADA SPECIAL CONTROL SYSTEM PROGRAMMING REQUIREMENTS
17321	SCADA FACTORY AND FIELD TESTING
17330	SCADA SYSTEM HARDWARE AND SOFTWARE
17350	TELEMETRY & CONTROL SYSTEMS – COMMUNICATIONS EQUIPMENT
17500	UNINTERRUPTIBLE POWER SUPPLY

7.0 PRELIMINARY CONSTRUCTION COST ESTIMATE

The preliminary construction cost estimate is current for June 2017, based on the preliminary design presented herein and preliminary quantity takeoffs. The unit prices represent contractor bid values, assuming that the work will be bid and performed by a nationally recognized and qualified construction contractor working under a competitively bid contract award. Unit prices and extended amounts represent the contractor's construction costs. In addition, allowances have been added to the estimate to cover contractor administration, construction cost growth after award of the contract, and contingency.

Two separate construction cost elements were performed for both the rubber dam with metal gate system and the traditional rubber dam system and are presented in Table 7-1 and 7-2 respectively. The cost breakdown for both options includes a 20 percent contingency. The total project construction cost is $20.9M for the rubber dam with metal gate system, and $20.7M for the traditional rubber dam system.

Table 7-1: Preliminary Construction Cost Estimate (Rubber Dam with Metal Gate System)

Item	Description	Unit	Quantity	Unit Price	Amount
1	Mobilization/Demobilization	LS	1	$250,000	$250,000
2	Site Clearing and Dewatering	LS	1	$50,000	$50,000
3	Channel Excavation for Rubber Dams No. 1, 2, and 3	CY	40,000	$25	$1,000,000
4	Channel Compaction for Rubber Dams No. 1, 2, and 3	SF	78,000	$20	$1,560,000
5	Rubber Dam System for Dam No. 1 (Including all Auxiliary Control and Instrumentation Equipment)	LS	1	$740,000	$740,000
6	Rubber Dam System for Dam No. 2 (Including all Auxiliary Control and Instrumentation Equipment)	LS	1	$850,000	$850,000
7	Rubber Dam System for Dam No. 3 (Including all Auxiliary Control and Instrumentation Equipment)	LS	1	$670,000	$670,000
8	Concrete Foundation for Rubber Dams No. 1, 2, and 3	CY	1,000	$900	$900,000
9	Concrete Transition Structure Walls for Rubber Dams No. 1, 2, and 3	CY	1,630	$900	$1,467,000
10	CMU Control Houses for Rubber Dams No. 1, 2, and 3	SF	1,000	$200	$200,000
11	2” SST Compressed Air Piping for Rubber Dams No. 1, 2, and 3	LF	1,500	$100	$150,000
12	Fish Chute and Gates for Rubber Dams No. 1, 2, and 3	LS	1	$1,500,000	$1,500,000
13	Concrete Stilling Basin for Rubber Dams No. 1, 2, and 3	CY	3,800	$900	$3,420,000
14	Riprap Transition for Erosion Control	CY	2,000	$65	$130,000
15	Electrical and Controls Equipment	LS	1	$900,000	$900,000
				Subtotal	$13,787,000
Contractor General Requirements & Administration (15%)					$2,068,000
				Subtotal	$15,855,000
Allowance for Construction Cost Growth After Contract (10%)					$1,586,000
				Subtotal	$17,441,000
Contingency Allowance for Unidentified Items, Quantities, Pricing (20%)					$3,488,000
				TOTAL	**$20,900,000**

Table 7-2: Preliminary Construction Cost Estimate (Traditional Rubber Dam System)

Item	Description	Unit	Quantity	Unit Price	Amount
1	Mobilization/Demobilization	LS	1	$250,000	$250,000
2	Site Clearing and Dewatering	LS	1	$50,000	$50,000
3	Channel Excavation for Rubber Dams No. 1, 2, and 3	CY	40,000	$25	$1,000,000
4	Channel Compaction for Rubber Dams No. 1, 2, and 3	SF	78,000	$20	$1,560,000
5	Rubber Dam System for Dam No. 1 (Including all Auxiliary Control and Instrumentation Equipment)	LS	1	$690,000	$690,000
6	Rubber Dam System for Dam No. 2 (Including all Auxiliary Control and Instrumentation Equipment)	LS	1	$800,000	$800,000
7	Rubber Dam System for Dam No. 3 (Including all Auxiliary Control and Instrumentation Equipment)	LS	1	$630,000	$630,000
8	Concrete Foundation for Rubber Dams No. 1, 2, and 3	CY	1,000	$900	$900,000
9	Concrete Transition Structure Walls for Rubber Dams No. 1, 2, and 3	CY	1,630	$900	$1,467,000
10	CMU Control Houses for Rubber Dams No. 1, 2, and 3	SF	1,000	$200	$200,000
11	2” SST Compressed Air Piping for Rubber Dams No. 1, 2, and 3	LF	1,500	$100	$150,000
12	Fish Chute and Gates for Rubber Dams No. 1, 2, and 3	LS	1	$1,500,000	$1,500,000
13	Concrete Stilling Basin for Rubber Dams No. 1, 2, and 3	CY	3,800	$900	$3,420,000
14	Riprap Transition for Erosion Control	CY	2,000	$65	$130,000
15	Electrical and Controls Equipment	LS	1	$900,000	$900,000
				Subtotal	$13,647,000
Contractor General Requirements & Administration (15%)					$2,047,000
				Subtotal	$15,694,000
Allowance for Construction Cost Growth After Contract (10%)					$1,569,000
				Subtotal	$17,263,000
Contingency Allowance for Unidentified Items, Quantities, Pricing (20%)					$3,453,000
				TOTAL	**$20,700,000**

8.0 CONSTRUCTION CONSIDERATIONS

8.1 Site Access, Staging, and Constructability

Site construction access will be primarily from one of the two existing concrete channel ramps within the Project vicinity. One ramp is located adjacent to Via Madrigal at the approximate San Juan Creek Channel (L01) Sta. 100+00, and the other is located at the end of Calle Perfecto at approximate channel Sta. 129+00. There is currently no security gate separating the channel crown road or bike path from the channel bottom. Security measures will have to be taken during construction to ensure that any vandalism and theft are detoured, which could be mitigated by installing a temporary site perimeter fence and entry gate around the construction work.

Contractor staging areas will be fairly limited due to the populated residential and commercial areas surrounding the rubber dam sites. Potential contractor staging areas have been identified as being either at the undeveloped plot of land at the end of Calle Perfecto at approximate channel Sta. 129+00, the undeveloped plot of land at the end of Alipaz St. at approximate channel Sta. 88+00, or at the City owned Descanso Park, located at the approximate Trabuco Creek Channel (L02) Sta. 20+00.

Since both San Juan Creek Channel and Trabuco Creek Channel are active drainage facilities, all construction activities will need to develop a stormwater diversion plan in the event of a rainfall occurrence. It is recommended that the channel portion of the construction be performed outside the rainy season within the months from April to October. San Juan Creek Channel has an existing roadway bridge crossing at Stonehill Drive at approximate Sta. 50+00, which is downstream of the proposed site for Rubber Dam No. 1. The presence of the roadway bridge will limit the access the contractor has for the construction of this dam from the downstream channel due to the limited clearance of the roadway bridge from the channel floor.

The control houses for the rubber dams are proposed to be placed within the OCPW right-of-way, which is resultantly in close proximity to residential neighborhoods and commercial zones. Provisions will need to be incorporated during construction to notify home owners of the presence of construction activities and to ensure that precautions for pedestrian safety, vandalism and theft are taken into account.

8.2 Preliminary Construction Schedule

Appendix C presents a preliminary schedule for the construction of the three rubber dam facilities. The total Project duration is estimated to take approximately 250 days from the time of the award of the contract and the issuing of the notice to proceed.

9.0 STATEMENT OF LIMITATIONS

This report has been prepared by AECOM for the sole use of San Juan Watershed Project proponents in the evaluation of the Project described above. The scope of services performed during this preliminary design stage may not be appropriate to satisfy the needs of other users, and any use or re-use of this document or of the findings, conclusions, or recommendations presented herein is at the sole risk of said user.

Background information, design basis, and other data have been furnished to AECOM by SMWD and/or third parties, which AECOM has used in preparing this report. AECOM has relied on this information as furnished, and is neither responsible for nor has confirmed the accuracy of this information. This report is based on data, site conditions and other information that is generally applicable as of June 2017, and the conclusions and recommendations herein are therefore applicable only to that time frame.

This report has been prepared based on certain key assumptions made by AECOM, which substantially affect the conclusions and recommendations of this report. These assumptions, although thought to be reasonable and appropriate, may not prove to be true in the future. The conclusions and recommendations of AECOM are conditioned upon these assumptions

10.0 REFERENCES

California Department of Fish and Wildlife. 2009. Fish Passage Design and Implementation. Part XII in California Salmonid Stream Habitat Restoration Manual.

Chow, V. (1959) Open Channel Hydraulics. New York, New York: McGraw-Hill

HEC-RAS (U.S. Army Corps of Engineers, Hydraulic Engineering Center) 2016. *River Analysis System (HEC-RAS) version 5.0.3*. September

King, H., (1976) Handbook of Hydraulics. New York, New York: McGraw-Hill

National Marine Fisheries Service 2008. Anadromous Salmonid Passage Facility Design, NMFS, Northwest Region, Portland, Oregon.

National Marine Fisheries Service 2012. Southern California steelhead Recovery Plan. Southwest Region, Protected Resources Division, Long Beach, California.

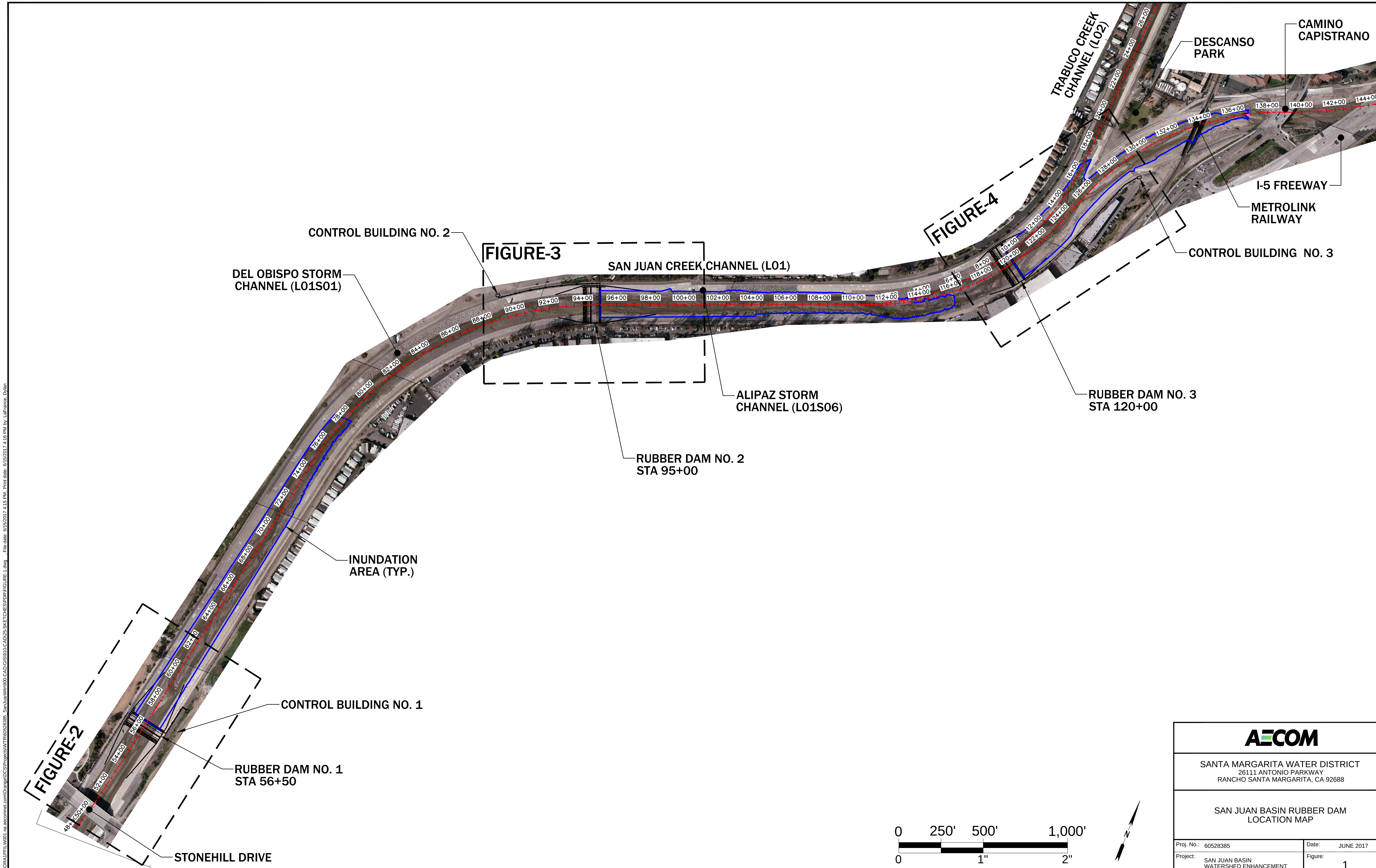
SJBA (San Juan Basin Authority). *Groundwater and Desalination Optimization Program. Foundational Actions Fund Program.* March, 2016

USBR (U.S. Department of the Interior, Bureau of Reclamation) 1990. *Hydraulic Design of Stilling Basins and Energy Dissipators, Ninth Printing.*

U.S. Army Corps of Engineers (1995) *Gravity Dam Design* (EM 1110-2-2200).

WEI (Wildermuth Environmental, Inc.). *San Juan Basin Groundwater and Facilities Management Plan.* November, 2013

APPENDIX A PRELIMINARY DESIGN PLANS



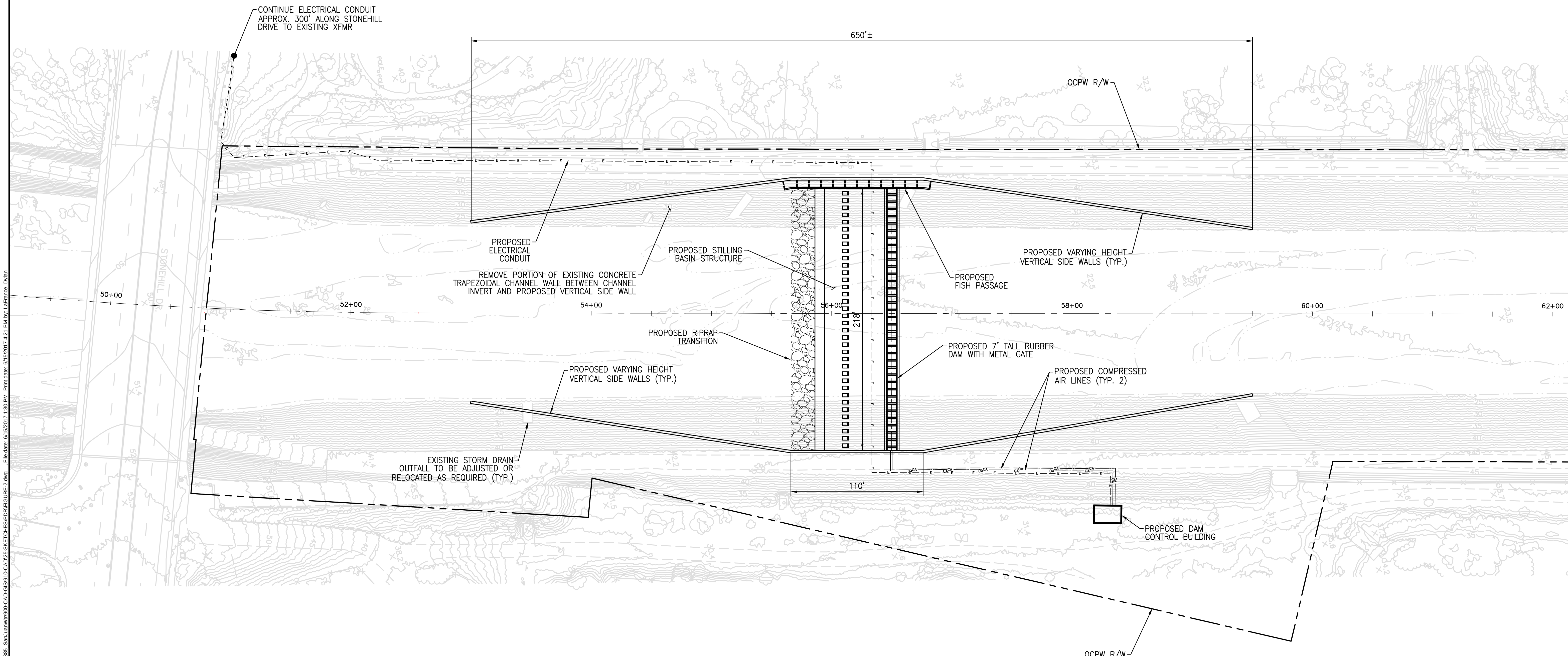
AECOM

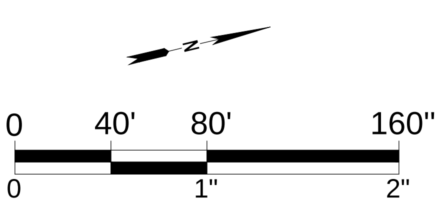
SANTA MARGARITA WATER DISTRICT
26111 ANTONIO PARKWAY
RANCHO SANTA MARGARITA, CA 92688

SAN JUAN BASIN RUBBER DAM
LOCATION MAP

Proj. No.:	60528385	Date:	JUNE 2017
Project:	SAN JUAN BASIN WATERSHED ENHANCEMENT	Figure:	1

\\USORA1FP1LW001.na.aecomnet.com\Orange\DCS\Projects\WTR\60528385_SanJuanWtr\900-CAD-GIS\910-CAD\25-SKETCHES\PDF\FIGURE-1.dwg File date: 6/15/2017 4:15 PM, Print date: 6/15/2017 4:15 PM by: LaFrance, Dylan





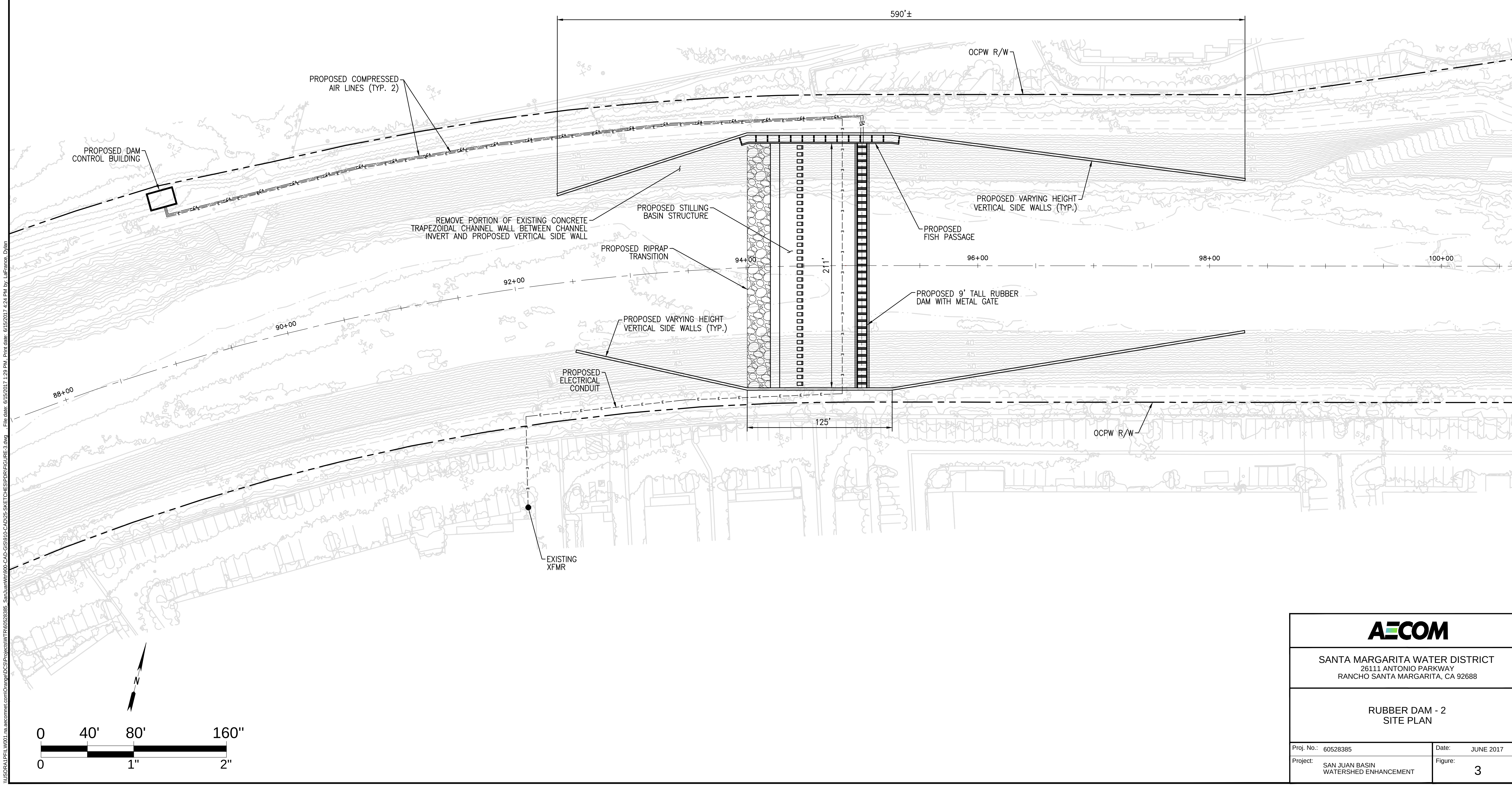
AECOM

SANTA MARGARITA WATER DISTRICT
26111 ANTONIO PARKWAY
RANCHO SANTA MARGARITA, CA 92688

RUBBER DAM - 1
SITE PLAN

Proj. No.:	60528385	Date:	JUNE 2017
Project:	SAN JUAN BASIN WATERSHED ENHANCEMENT	Figure:	2

\\USORA1PFILW001.na.aecomnet.com\Orange\DCS\Projects\WTR\60528385_SanJuanWM\900-CAD-GIS\910-CAD\25-SKETCHES\PDR\FIGURE-2.dwg File date: 6/15/2017 1:30 PM, Print date: 6/15/2017 4:21 PM by: LaFrance, Dylan

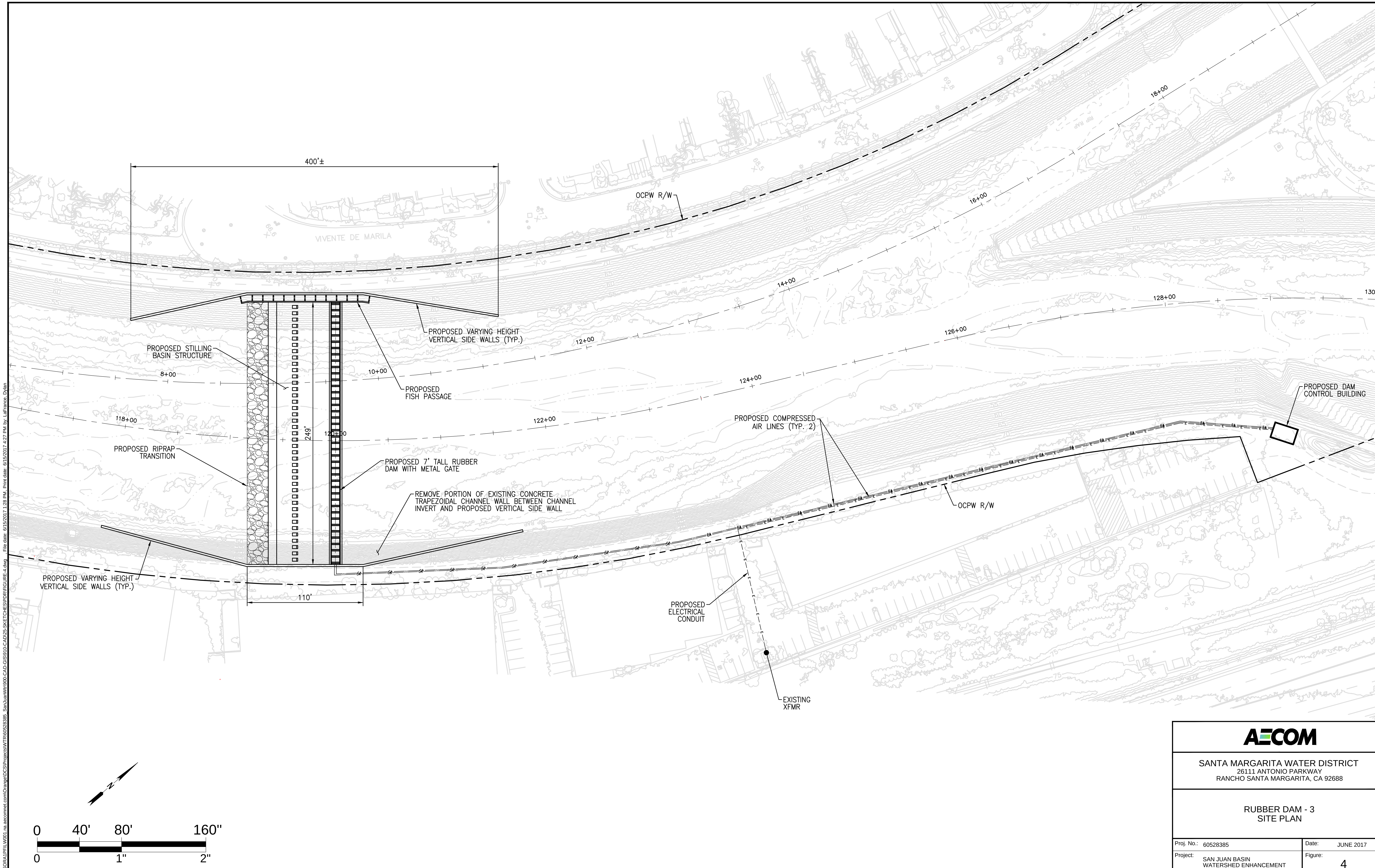


AECOM

SANTA MARGARITA WATER DISTRICT
26111 ANTONIO PARKWAY
RANCHO SANTA MARGARITA, CA 92688

RUBBER DAM - 2
SITE PLAN

Proj. No.:	60528385	Date:	JUNE 2017
Project:	SAN JUAN BASIN WATERSHED ENHANCEMENT	Figure:	3

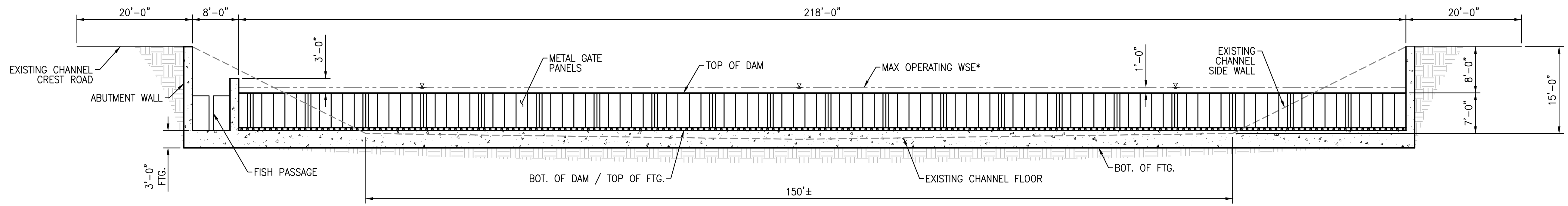


AECOM

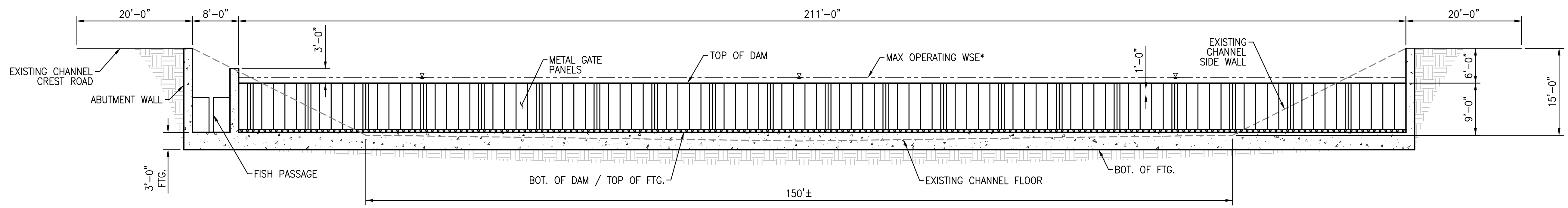
SANTA MARGARITA WATER DISTRICT
26111 ANTONIO PARKWAY
RANCHO SANTA MARGARITA, CA 92688

RUBBER DAM - 3
SITE PLAN

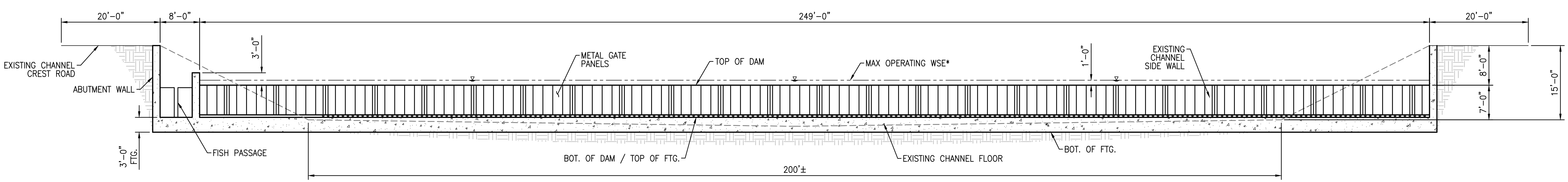
Proj. No.:	60528385	Date:	JUNE 2017
Project:	SAN JUAN BASIN WATERSHED ENHANCEMENT	Figure:	4



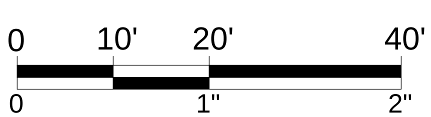
TYPICAL DAM NO. 1 SECTION
SCALE: 1" = 10'



TYPICAL DAM NO. 2 SECTION
SCALE: 1" = 10'



TYPICAL DAM NO. 3 SECTION
SCALE: 1" = 10'



ABBREVIATIONS

BOT	BOTTOM
FTG	FOOTING
MAX	MAXIMUM
WSE	WATER SURFACE ELEVATION

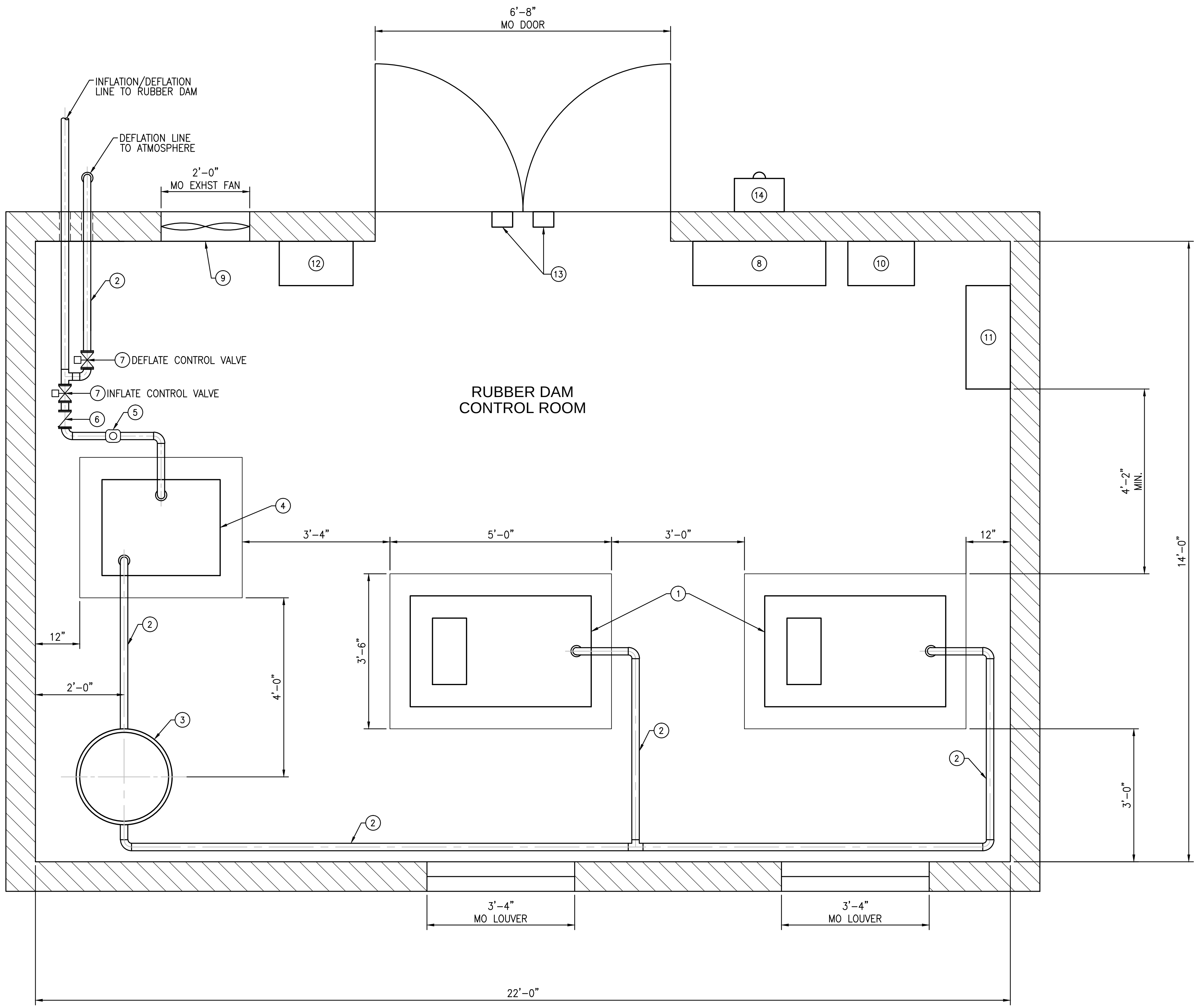
* THE MAXIMUM OPERATING WSE FOR THE RUBBER DAMS HAS BEEN SET AT 1'-0" ABOVE THE CREST OF THE INFLATED DAM. A LEVEL SENSOR/TRANSMITOR INSTRUMENT WILL TRIGGER THE DAMS TO DEFLATE IF THE WATER LEVEL EXCEEDS THE MAX WSE.

AECOM

SANTA MARGARITA WATER DISTRICT
26111 ANTONIO PARKWAY
RANCHO SANTA MARGARITA, CA 92688

TYPICAL RUBBER DAM SECTIONS

Proj. No.:	60528385	Date:	JUNE 2017
Project:	SAN JUAN BASIN WATERSHED ENHANCEMENT	Figure:	5



PLAN
SCALE: 3/4" = 1'-0"

CONSTRUCTION NOTES

1. 20 HP COMPRESSOR UNIT
2. 2" SST. PRESSURIZED AIR HEADER
3. 200 GAL RECIEVER TANK
4. 5 HP AIR DRYER
5. 2" PRESSURE REGULATING VALVE
6. 2" CHECK VALVE
7. 2" BUTTERFLY CONTROL VALVE WITH ELECTRIC ACTUATOR
8. RUBBER DAM CONTROL PANEL
9. EXHAUST FAN
10. MINI POWER ZONE "B"
11. POWER PANEL "A"
12. BUILDING PLC
13. INTRUSION SWITCHES
14. UTILITY POWER METER

ABBREVIATIONS

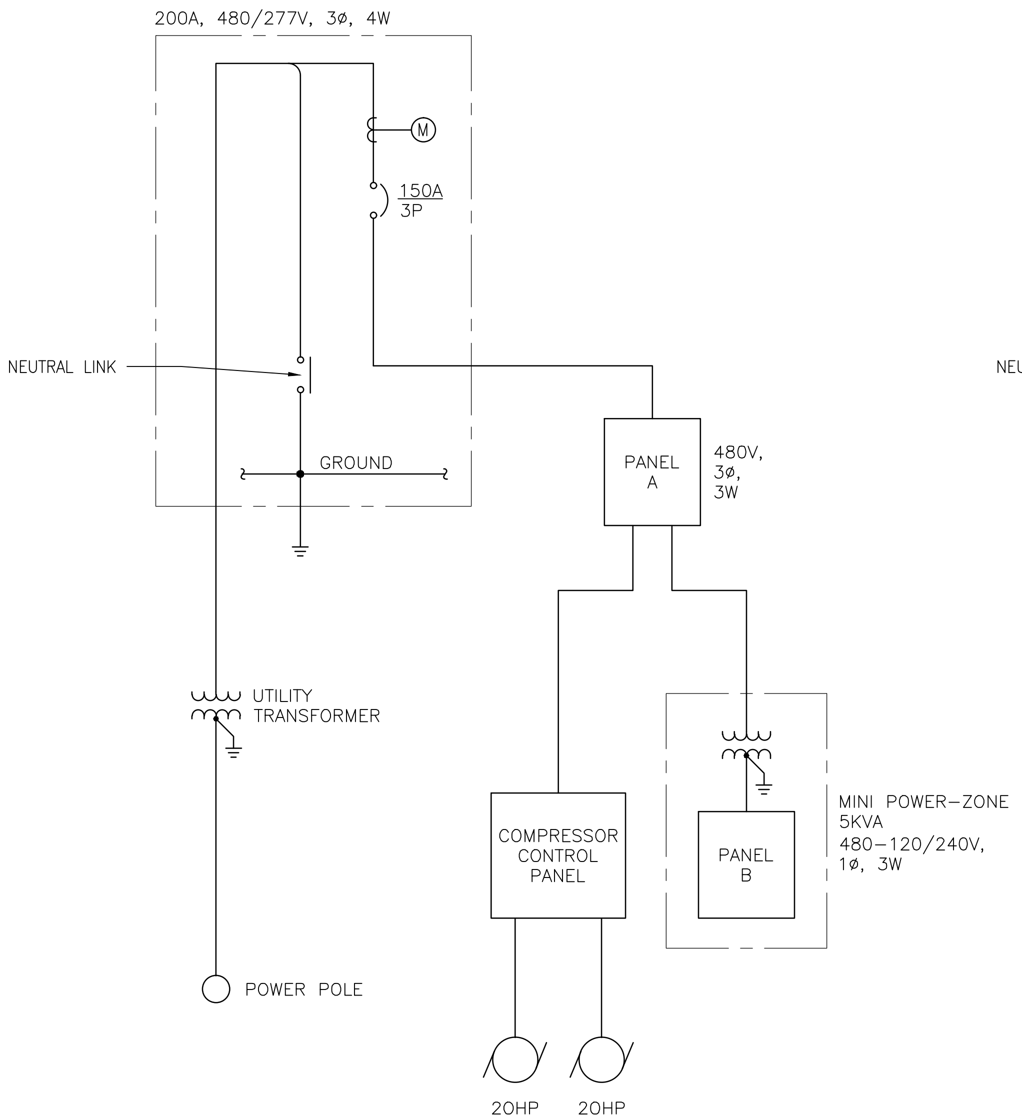
EXHST	EXHAUST
GAL	GALLON
HP	HORSE POWER
MIN	MINIMUM
MO	MODULAR OPENING
PLC	PROGRAMMABLE LOGIC CONTROLLER

AECOM

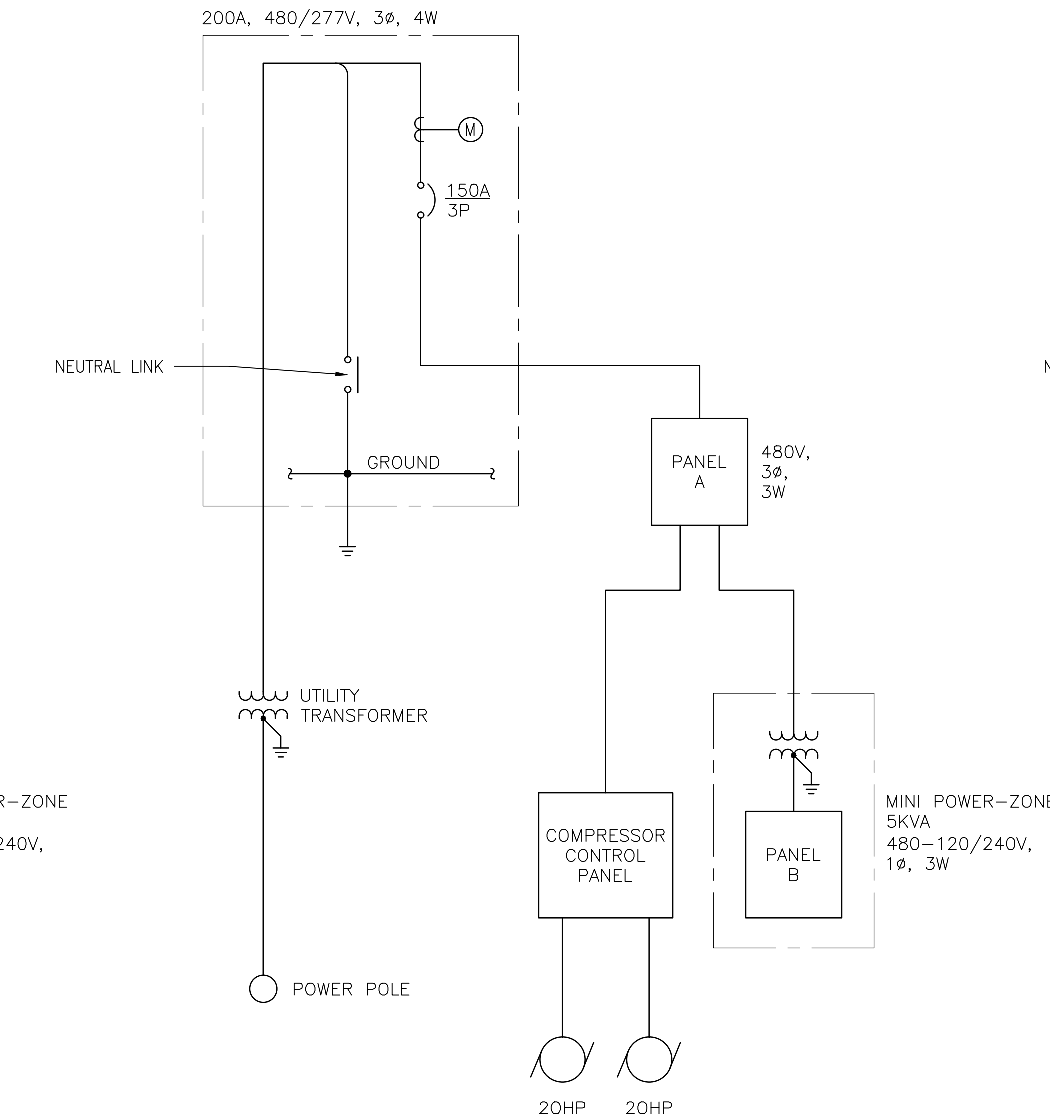
SANTA MARGARITA WATER DISTRICT
26111 ANTONIO PARKWAY
RANCHO SANTA MARGARITA, CA 92688

RUBBER DAM CONTROL ROOM

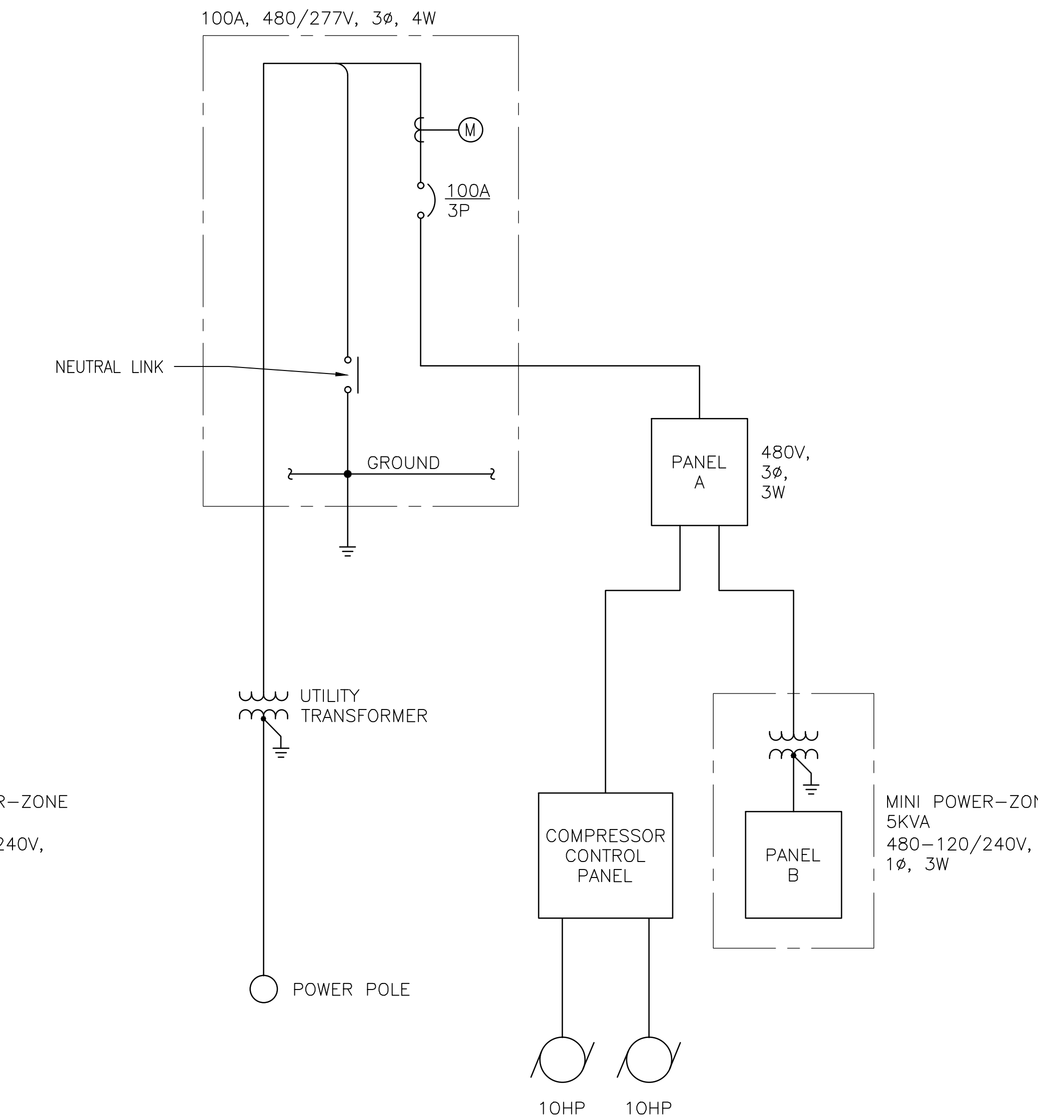
Proj. No.:	60528385	Date:	JUNE 2017
Project:	SAN JUAN BASIN WATERSHED ENHANCEMENT	Figure:	6



SINGLE LINE DIAGRAM - RUBBER DAM 1



SINGLE LINE DIAGRAM - RUBBER DAM 2



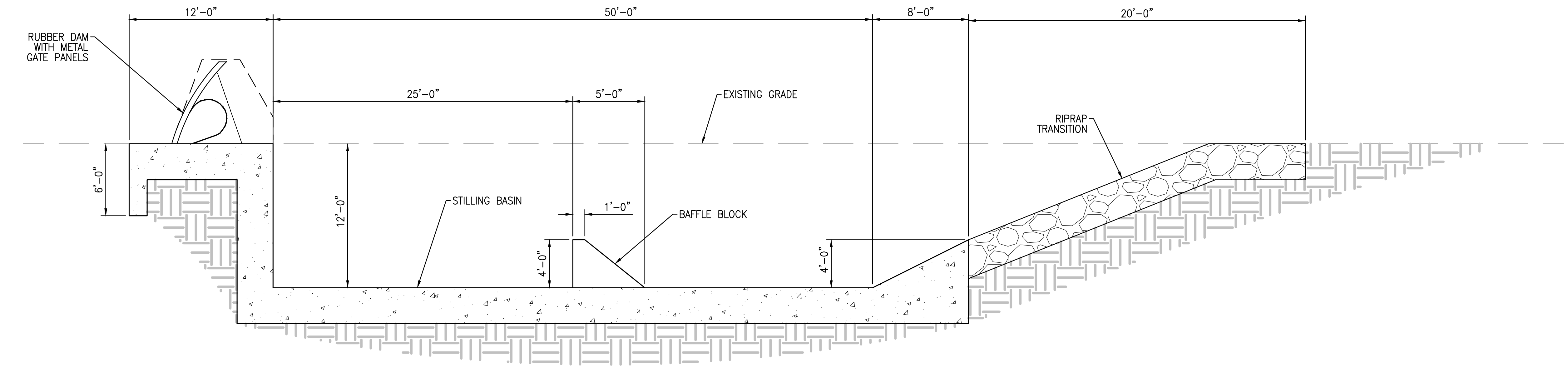
SINGLE LINE DIAGRAM - RUBBER DAM 3

AECOM

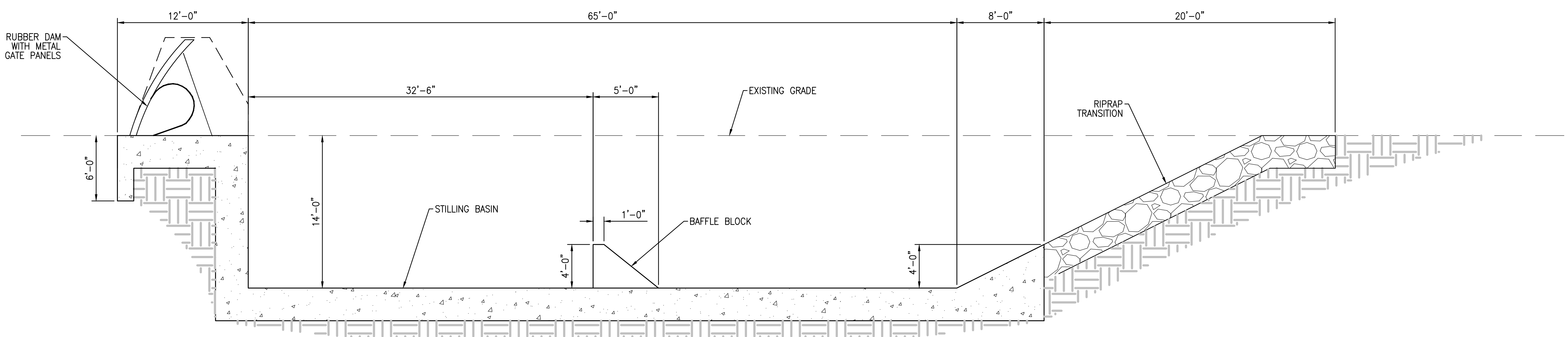
SANTA MARGARITA WATER DISTRICT
26111 ANTONIO PARKWAY
RANCHO SANTA MARGARITA, CA 92688

SINGLE LINE DIAGRAMS

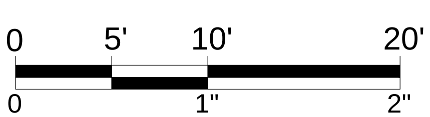
Proj. No.:	60528385	Date:	JUNE 2017
Project:	SAN JUAN BASIN WATERSHED ENHANCEMENT	Figure:	7



TYPICAL DAM NO. 1 & 3 SECTION
SCALE: 1" = 5'



TYPICAL DAM NO. 2 SECTION
SCALE: 1" = 5'



AECOM

SANTA MARGARITA WATER DISTRICT
26111 ANTONIO PARKWAY
RANCHO SANTA MARGARITA, CA 92688

STILLING BASIN SECTIONS

Proj. No.:	60528385	Date:	JUNE 2017
Project:	SAN JUAN BASIN WATERSHED ENHANCEMENT	Figure:	8

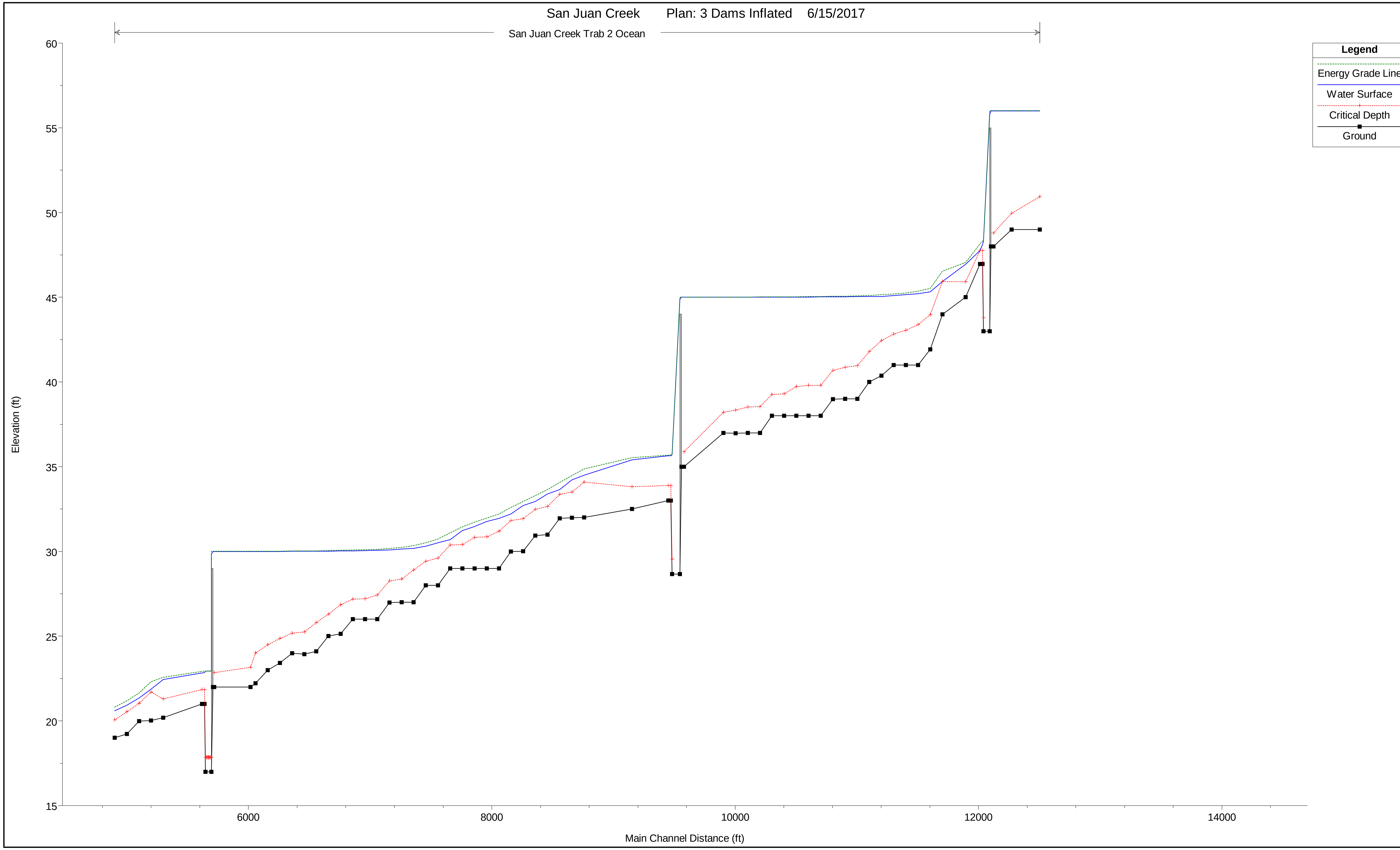
APPENDIX B HYDRAULIC ANALYSIS RESULTS

Appendix B-1 HEC-RAS Water Surface Profiles

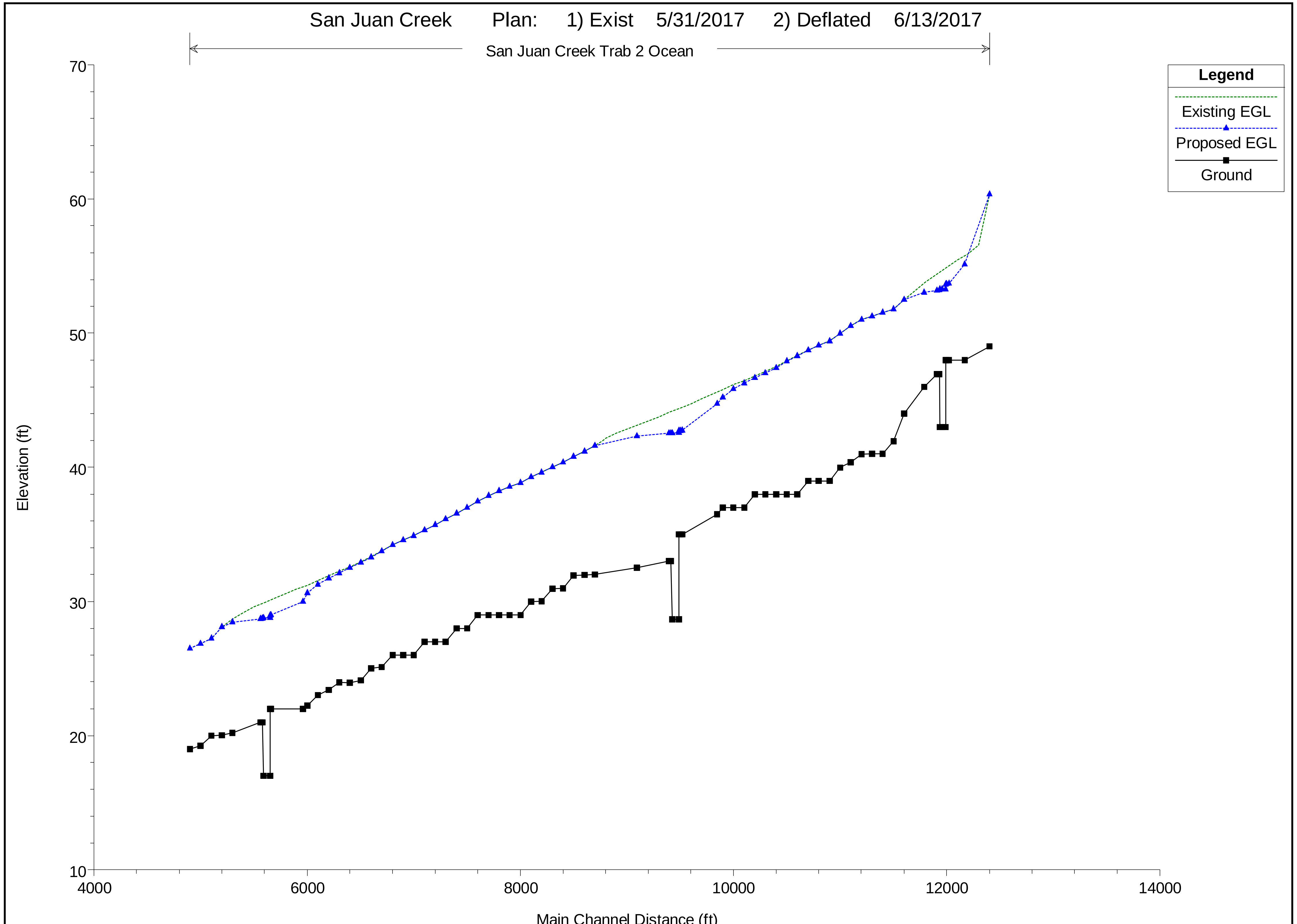
Appendix B-2 FlowMaster Weir Discharge Calculations

Appendix B-3 USBR Stilling Basing Design Calculations

SCENARIO A: DAMS FULLY INFLATED - NORMAL FLOW CONDITIONS



SCENARIO B: DAMS FULLY DEFLATED - HIGH FLOW CONDITIONS



FLOWMASTER WEIR DISCHARGE RESULTS

Rubber Dam No. 1 - Metal Gate

Project Description

Solve For	Discharge		

Input Data

Headwater Elevation		8.00	ft
Crest Elevation		7.00	ft
Tailwater Elevation		0.00	ft
Weir Coefficient		3.30	US
Crest Length		218.00	ft
Number Of Contractions	0		

Results

Discharge	719.40	ft³/s
Headwater Height Above Crest	1.00	ft
Tailwater Height Above Crest	-7.00	ft
Flow Area	218.00	ft²
Velocity	3.30	ft/s
Wetted Perimeter	220.00	ft
Top Width	218.00	ft

Rubber Dam No. 1 - Traditional

Project Description

Solve For	Discharge

Input Data

Headwater Elevation	8.00	ft
Crest Elevation	7.00	ft
Tailwater Elevation	0.00	ft
Weir Coefficient	2.50	US
Crest Length	218.00	ft
Number Of Contractions	0	

Results

Discharge	545.00	ft³/s
Headwater Height Above Crest	1.00	ft
Tailwater Height Above Crest	-7.00	ft
Flow Area	218.00	ft²
Velocity	2.50	ft/s
Wetted Perimeter	220.00	ft
Top Width	218.00	ft

Rubber Dam No. 2 - Metal Gate

Project Description

Solve For	Discharge

Input Data

Headwater Elevation	10.00	ft
Crest Elevation	9.00	ft
Tailwater Elevation	0.00	ft
Weir Coefficient	3.30	US
Crest Length	211.00	ft
Number Of Contractions	0	

Results

Discharge	696.30	ft³/s
Headwater Height Above Crest	1.00	ft
Tailwater Height Above Crest	-9.00	ft
Flow Area	211.00	ft²
Velocity	3.30	ft/s
Wetted Perimeter	213.00	ft
Top Width	211.00	ft

Rubber Dam No. 2 - Traditional

Project Description

Solve For	Discharge

Input Data

Headwater Elevation		10.00	ft
Crest Elevation		9.00	ft
Tailwater Elevation		0.00	ft
Weir Coefficient		2.50	US
Crest Length		211.00	ft
Number Of Contractions	0		

Results

Discharge	527.50	ft³/s
Headwater Height Above Crest	1.00	ft
Tailwater Height Above Crest	-9.00	ft
Flow Area	211.00	ft²
Velocity	2.50	ft/s
Wetted Perimeter	213.00	ft
Top Width	211.00	ft

Rubber Dam No. 3 - Metal Gate

Project Description

Solve For	Discharge

Input Data

Headwater Elevation	8.00	ft
Crest Elevation	7.00	ft
Tailwater Elevation	0.00	ft
Weir Coefficient	3.30	US
Crest Length	249.00	ft
Number Of Contractions	0	

Results

Discharge	821.70	ft^3/s
Headwater Height Above Crest	1.00	ft
Tailwater Height Above Crest	-7.00	ft
Flow Area	249.00	ft^2
Velocity	3.30	ft/s
Wetted Perimeter	251.00	ft
Top Width	249.00	ft

Rubber Dam No. 3 - Traditional

Project Description

Solve For	Discharge

Input Data

Headwater Elevation	8.00	ft
Crest Elevation	7.00	ft
Tailwater Elevation	0.00	ft
Weir Coefficient	2.50	US
Crest Length	249.00	ft
Number Of Contractions	0	

Results

Discharge	622.50	ft^3/s
Headwater Height Above Crest	1.00	ft
Tailwater Height Above Crest	-7.00	ft
Flow Area	249.00	ft^2
Velocity	2.50	ft/s
Wetted Perimeter	251.00	ft
Top Width	249.00	ft

SMWD SAN JUAN WATERSHED RUBBER DAMS

RUBBER DAM STILLING BASIN DESIGN

PERFORMED BY:	DL	3/22/2017
CHECKED BY:	JD	3/22/2017
REVIEWED BY:	LF	3/22/2017

Channel Roughness (Manning's n)	0.020	*From OCFCD As-Built L01-101-1-A
Channel Slope (s) [ft/ft]	0.005	*Average Slope from Survey
Flow Continuity Error (cfs)	0.0	

SCENARIO	Dam 1 (Gate)	Dam 1 (Blader)	Dam 2 (Gate)	Dam 2 (Blader)	Notes
Dam Height (P) [feet]	9.0	9.0	7.0	7.0	
Upstream Water Level Height (H_e)	10.0	10.0	8.0	8.0	*Assumed 1ft Above Dam Crest
Weir Coefficient (C)	3.3	2.5	3.3	2.5	*From Vendor Provided Data
Initial Flow (q) [cfs/ft]	3.3	2.5	3.3	2.5	*Assumed Dam at Full Inflation Height
Initial Critical Depth (d_c) [feet]	0.7	0.6	0.7	0.6	
Initial Normal Depth (d_n) [feet]	0.8	0.6	0.8	0.6	
Initial Downstream Critical Velocity (ft/s)	4.7	4.3	4.7	4.3	
Initial Downstream Critical Velocity Head (feet)	0.35	0.29	0.35	0.29	
Stilling Basin Drop (Y) [feet]	14	12	12	10	
Final Weir Coefficient	3.3	2.5	3.3	2.5	*From Vendor Provided Data
Final Flow (q) [cfs/ft]	**104**	**79**	**75**	**57**	*Assumed Completly Deflated Dam
Entrance Velocity Head [feet]	21.2	19.8	17.8	16.3	*H_e+Y-D1
Entrance Flow Depth (feet)	2.8	2.2	2.2	1.7	*Solver Solution
Entrance Velocity (V) [ft/s]	**36.9**	**35.7**	**33.9**	**32.4**	
Total Entrance Head (feet)	24.0	22.0	20.0	18.0	
Entrance Froude Number (F_r)	3.9	4.0	4.0	4.3	
TW/D1 Factor	4.4	4.5	4.4	4.5	*USBR Hydraulic Design of Stilling Basins and Energy Dissipators (Figure 11)
Tailwater Depth (TW) [feet]	12.4	10.0	9.7	7.9	
Tailwater Velocity (feet/s)	8.4	7.9	7.7	7.2	
Tailwater Velocity Head (feet)	1.1	1.0	0.9	0.8	
Tailwater Total Head (feet)	13.5	10.9	10.6	8.7	
Total Initial Downstream Critical Head (feet)	1.0	0.9	1.0	0.9	
Required Tailwater Head (feet)	-0.5	-1.1	-1.4	-1.3	
Computed Entrance Flow (q) (cfs)	104	79	75	57	
Differential Flow (q) [cfs]	0.0	0.0	0.0	0.0	*Continuity Check
Type I L/D2 Factor	5.7	5.8	5.8	5.7	*USBR Hydraulic Design of Stilling Basins and Energy Dissipators (Figure 12)
Type I Jump Length (feet)	16	13	13	10	
Type II L/D2 Factor	3.6	3.8	3.8	3.6	*USBR Hydraulic Design of Stilling Basins and Energy Dissipators (Figure 12)
Type II Jump Length (feet)	45	38	37	28	
Type III L/D2 Factor	2.0	2.1	2	2.1	*USBR Hydraulic Design of Stilling Basins and Energy Dissipators (Figure 12)
Type III Jump Length (feet)	25	21	19	17	
h_d/H_e	1.2	1.2	1.3	1.3	*(H_e+Y-TW)/H_e
Drop Number	0.123	0.112	0.100	0.099	*d_c/Y
Length Ratio	2.6	2.6	2.5	2.6	*Design of Small Dams (Figure 9-53)
Ld (feet)	**36.4**	**31**	**30**	**26**	
Ld + L2 =	81	69	67	54	
Ld + L3 =	61	52	49	43	*Minimum Basin Length
2/3 Ld + L3 =	41	35	33	28	*USBR Hydraulic Design of Stilling Basins and Energy Dissipators (Figure 18)
Baffle Pier Height, h3 (feet)	3.5	2.8	2.8	2.2	
End Sill Height, h4 (feet)	3.5	2.8	2.8	2.2	
Baffle Pier Top Width, 0.2h3 (feet)	0.71	0.55	0.55	0.44	
Baffle Pier Bottom Width, 1.2h3 (feet)	4.2	3.3	3.3	2.6	
Baffle Pier Width/Spacing, 0.75*h3 (feet)	2.6	2.1	2.1	1.6	
Baffle Pier Location, Ld + 0.8D2	46	39	38	32	*Design of Small Dams (Figure 9-53)

Design Equations*

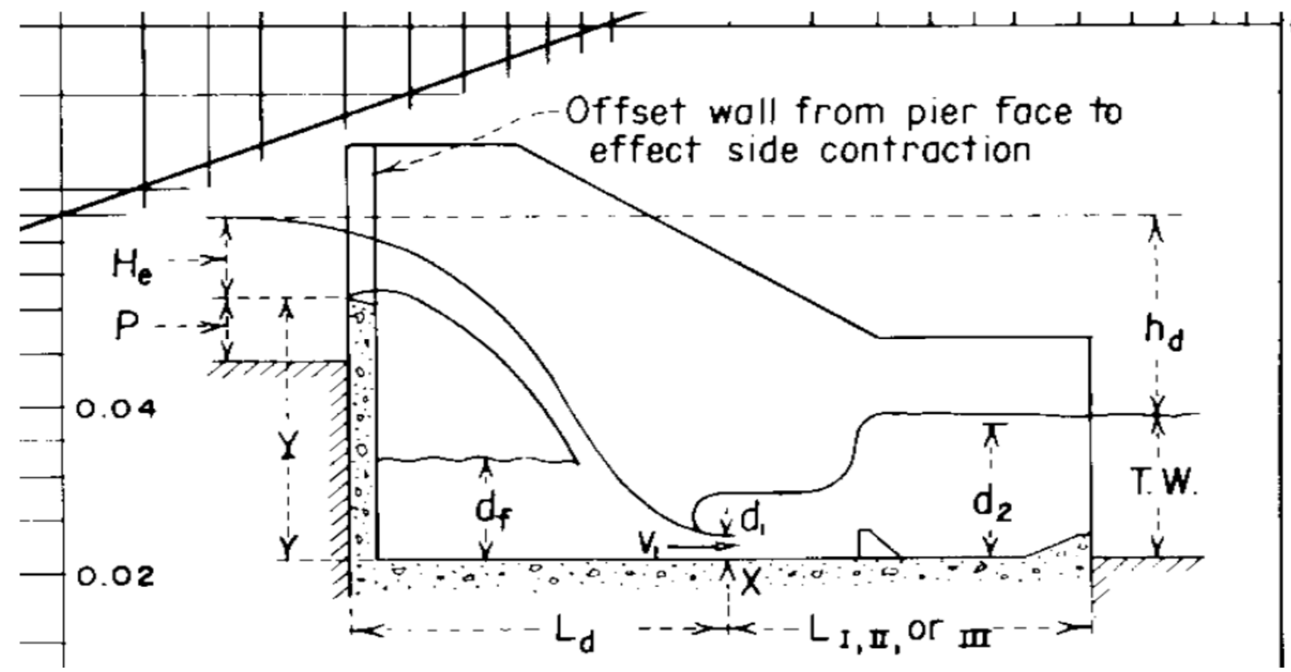
$$q = C(H_e)^{3/2}$$

$$d_C = \left(\frac{q^2}{g}\right)^{1/3}$$

$$d_n = \left(\frac{q\,n}{k\,s^{1/2}}\right)^{3/5}$$

$$F_r = \frac{V}{\sqrt{g\,d_1}}$$

$$\frac{d_c}{Y} = \frac{q^2}{g\,Y^3} = \bar{D}$$



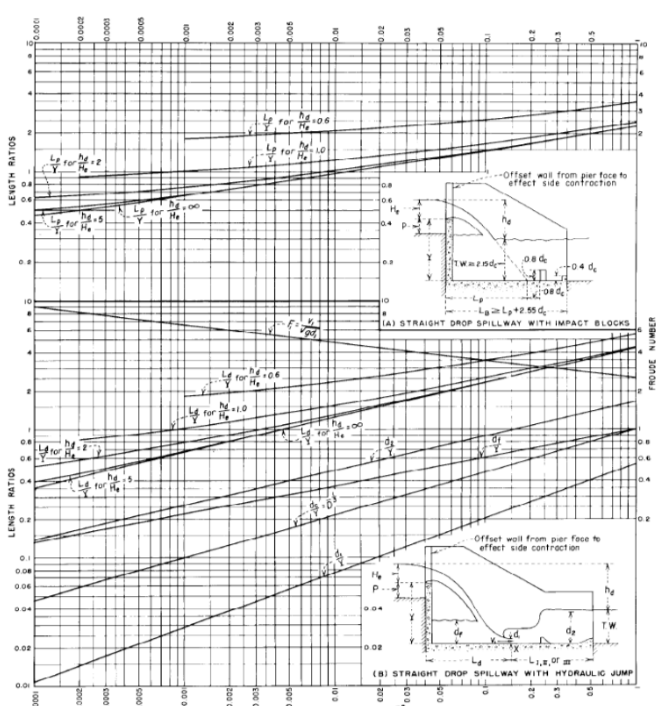


Figure 9-53.—Hydraulic characteristics of straight drop spillways with hydraulic jump or with impact blocks. 288-D-2437.

STILLING BASIN FOR HIGH DAM AND EARTH DAM SPILLWAYS 25

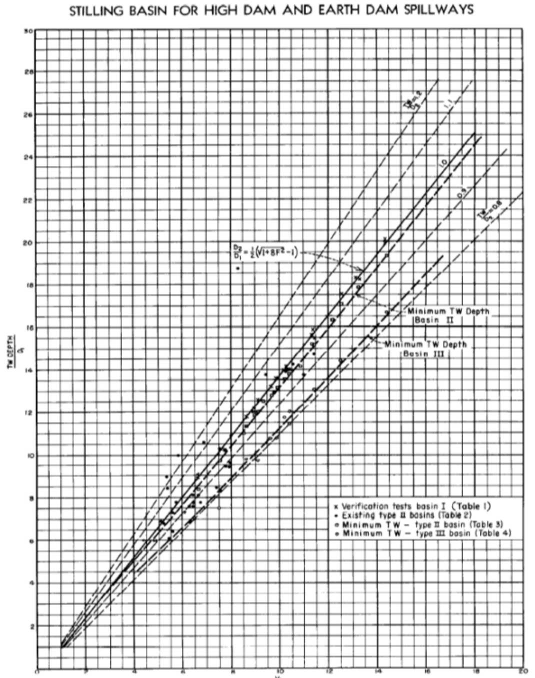


FIGURE 11.—Minimum tail water depths (Basins I, II, and III).

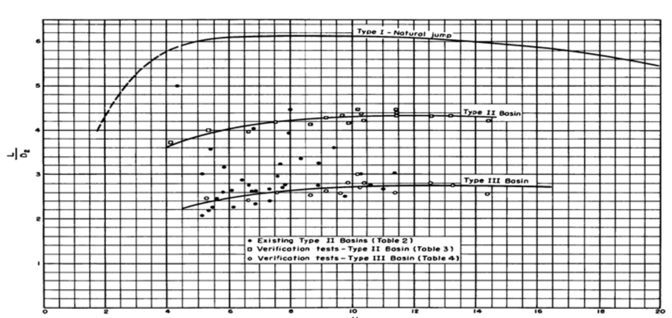


FIGURE 12.—Length of jump on horizontal floor (Basins I, II, and III).

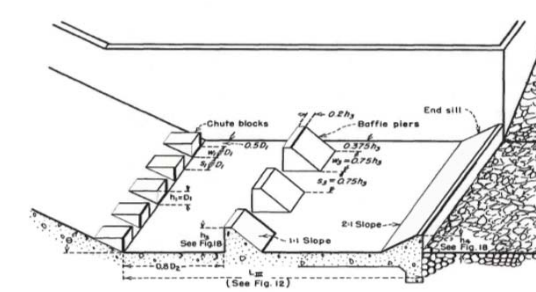
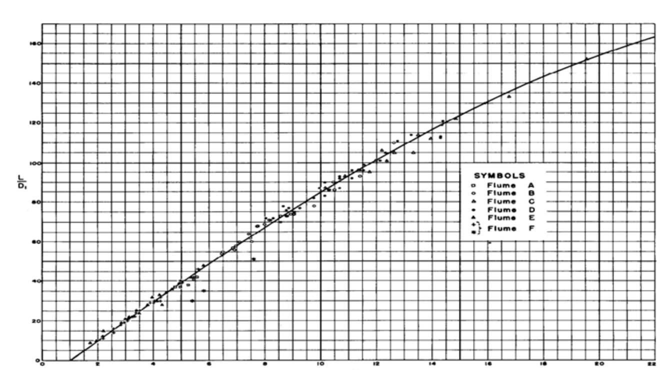


FIGURE 17.—Recommended proportions (Basin III).



SHORT STILLING BASIN FOR CANAL STRUCTURES, ETC. 37

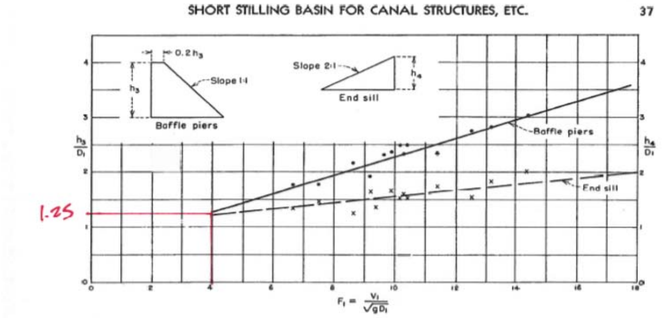


FIGURE 18.—Height of baffle piers and end sill (Basin III).

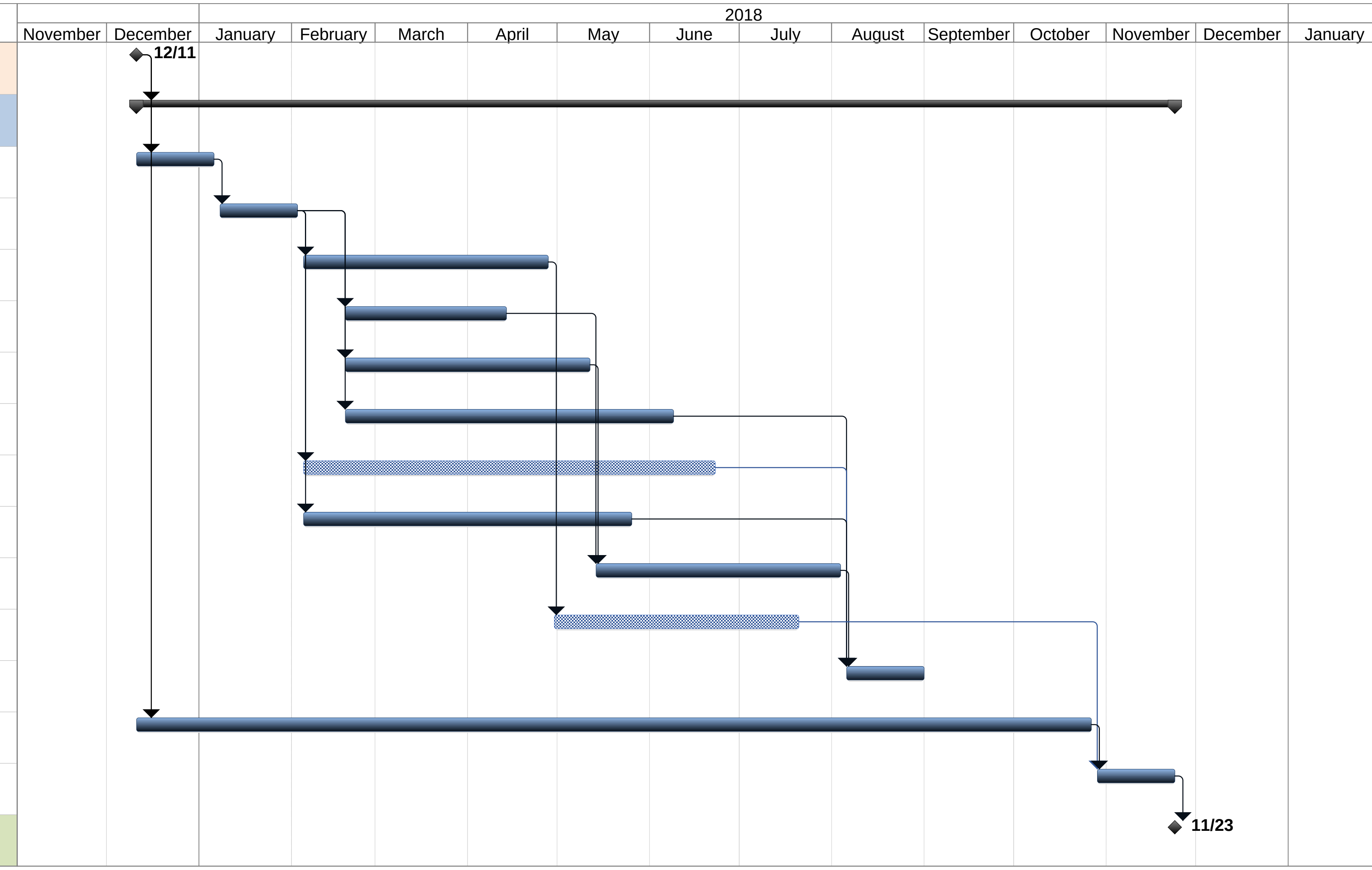
APPENDIX C PRELIMINARY CONSTRUCTION SCHEDULE

CONSTRUCTION SCHEDULE
PRELIMINARY DESIGN

SAN JUAN BASIN WATERSHED
SANTA MARGARITA WATER DISTRICT

Updated: Mon 12/19/16

ID	Task Name	Duration	Start	Finish
1	**CONTRACT AWARD AND NTP**	0 days	Mon 12/11/17	Mon 12/11/17
2	**SAN JUAN BASIN RUBBER DAMS**	**250 days**	**Mon 12/11/17**	**Fri 11/23/18**
3	CONTRACTOR MOBILIZATION	20 days	Mon 12/11/17	Fri 1/5/18
4	SITE CLEARING AND DEWATERING	20 days	Mon 1/8/18	Fri 2/2/18
5	CHANNEL EXCAVATION	60 days	Mon 2/5/18	Fri 4/27/18
6	CONCRETE DAM FOUNDATIONS	40 days	Mon 2/19/18	Fri 4/13/18
7	DAM ABUTMENT STRUCTURES	60 days	Mon 2/19/18	Fri 5/11/18
8	FISH PASSAGE STRUCTURES	80 days	Mon 2/19/18	Fri 6/8/18
9	DAM CONTROL HOUSES	100 days	Mon 2/5/18	Fri 6/22/18
10	AIR HEADER PIPING	80 days	Mon 2/5/18	Fri 5/25/18
11	RUBBER DAM INSTALLATION	60 days	Mon 5/14/18	Fri 8/3/18
12	EROSION AND SCOUR CONTROL	60 days	Mon 4/30/18	Fri 7/20/18
13	START UP AND TESTING	20 days	Mon 8/6/18	Fri 8/31/18
14	MISCELLANEOUS CONSTRUCTION ACTIVITIES	230 days	Mon 12/11/17	Fri 10/26/18
15	DEMOBILIZATION	20 days	Mon 10/29/18	Fri 11/23/18
16	**PROJECT COMPLETION**	0 days	Fri 11/23/18	Fri 11/23/18



Legend: Task | Milestone ◆ | Summary