4 ALTERNATIVES

4.1 Alternatives Selection/Overview

Section 15126.6 of the CEQA Guidelines requires that an EIR describe and evaluate a reasonable range of alternatives to the project, or to the location of the project, which could attain most of the basic project objectives but would avoid or substantially lessen any of the significant environmental effects of the project. The "rule of reason" governing the range of alternatives specifies that an EIR should discuss sufficient alternatives to allow a reasoned choice by the decision makers, but it does not require consideration of all possible alternatives to a project. Alternatives must be "feasible", meaning that they can be successfully implemented to accomplish the project's overall purpose and objectives in a reasonable amount of time, taking into account considerations including cost, existing technology, social factors, legal factors, and environmental issues. (CEQA Guidelines, section 15364.) Therefore, "an EIR need not consider an alternative whose effect cannot be reasonably ascertained and whose implementation is remote and speculative." (CEQA Guidelines, section 15126.6, subdivision (f)(3).) The EIR should include sufficient information about each alternative to allow meaningful evaluation, analysis and comparison.

The underlying project purpose is the timely improvement of water quality related to the Lower Klamath Project within and downstream of the current Hydroelectric Reach and the restoration of anadromous access upstream of Iron Gate Dam (the current barrier to anadromy). In furtherance of this underlying purpose, the State Water Board has identified the following project objectives (see also Section 1 *Introduction*):

In a timely manner:

1. Improve the long-term water quality conditions associated with the Lower Klamath Project in the California reaches of the Klamath River, including water quality impairments due to Microcystis aeruginosa and associated toxins, water temperature, and levels of biostimulatory nutrients.
2. Advance the long-term restoration of the natural fish populations in the Klamath Basin, with particular emphasis on restoring the salmonid fisheries used for subsistence, commerce, tribal cultural purposes, and recreation.
3. Restore volitional anadromous fish passage in the Klamath Basin to viable habitat currently made inaccessible by the Lower Klamath Project dams.
4. Ameliorate conditions underlying high disease rates among Klamath River salmonids.

4.1.1 Alternatives Selection

In determining a reasonable range of alternatives for the EIR, the State Water Board considered a wide range of potential alternatives. These included prior environmental analyses' alternatives—both accepted and rejected. The potential alternatives also included alternatives and adjustments to previously-analyzed alternatives raised by agencies, the applicant and the general public since release of the Notice of Preparation, as well as alternatives that arose by incorporating new information generated since completion of prior environmental analyses.

The 2007 FERC EIS analyzed five action alternatives: (1) PacifiCorp's Proposal at that time for continued operation; (2) FERC Staff Alternative for continued operation; (3) FERC Staff Alternative with Mandatory Conditions imposed through the licensing process by other federal agencies; (4) Retirement of Copco No. 1 and Iron Gate Developments; and (5) Retirement of J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate Developments. The 2007 FERC EIS considered, but decided not to move forward with, analysis of federal take-over of the dams and cessation of power generation at the facilities, but not requiring removal of the dam facilities themselves.

The 2012 KHSA EIS/EIR analyzed four action alternatives: (1) Dam Removal of Four Dams; (2) Partial Removal of Four Dams; (3) Fish Passage at Four Dams; and (4) Removal of Copco 1 and Iron Gate with Fish Passage at Copco 2 and J.C. Boyle. These were selected from the 17 action alternatives and the No Action/No Project Alternative in the initial alternatives screening process. The 13 rejected action alternatives were: (a) Three Dam Removal; (b) Sequenced Removal of Four Dams; (c) Full Facilities Removal of Four Dams without KBRA; (d) Trap and Haul; (e) Bogus Creek Bypass; (f) Bogus Creek Bypass – Alternative Tunnel Route; (g) Notching Four Dams; (h) Federal Takeover of Project; (i) Full Removal of Five Dams; (j) Full Removal of Six Dams; (k) Dredge Upper Klamath Lake; (l) Predator Control; and (m) Partition Upper Klamath Lake.

The State Water Board revisited the aforementioned listed alternatives, as well as three additional potential alternatives raised in Lower Klamath Project scoping (see also Appendix A). First, Siskiyou County and others proposed examining a fish passage alternative that looks at a combination of trap and haul, fish cannons (a new technology since 2012), and other mechanisms for fish passage without dam removal. The Siskiyou County proposal combines elements of other Lower Klamath Project scoping comments regarding methods of fish passage with dams in place. Second, Siskiyou County and Siskiyou Water Users Association scoping comments also suggested developing an alternative of additional water storage in the Scott and Quartz valleys to augment late summer and fall instream flows. Third, Siskiyou County and Siskiyou County Water Users Association scoping comments also suggested transferring 60,000 acre-feet of water from Iron Gate Reservoir (or J.C. Boyle Reservoir or Keno Reservoir) to the Shasta River sub-watershed as irrigation supply to allow Lake Shastina discharges to go directly into the Shasta River rather than being used as irrigation supply first.

From this initial pool of 24 alternatives, the State Water Board selected five feasible action alternatives that would reduce one or more potentially significant impacts of the Proposed Project and would meet the underlying purpose of the Proposed Project and most of the Proposed Project objectives. Consistent with CEQA Guidelines section 15126.6(e)(2), the State Water Board also included the No Project Alternative in the set of alternatives considered in this EIR. The six alternatives to the Proposed Project that were carried forward for more detailed analysis are introduced briefly in Section 4.1.1.1 and revisited in Sections 4.2 to 4.6 in comparison to existing conditions and the Proposed Project (CEQA Guidelines section 15126.6(d)). Alternatives that were eliminated from consideration because they would not meet the underlying purpose of the Proposed Project or most of the Proposed Project objectives, were substantially similar to other alternatives, would not avoid or substantially lessen significant environmental effects of the Proposed Project, or were otherwise infeasible, are discussed in Sections 4.1.1.2 through 4.1.1.5.

4.1.1.1 Alternatives Carried Forward for More Detailed Analysis

No Project Alternative

CEQA Guidelines section 15126.6(e)(2) states that the No Project analysis shall discuss the existing conditions at the time the Notice of Preparation is published, or if no Notice of Preparation is published, at the time environmental analysis is commenced, as well as what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services. In this instance, the No Project Alternative would be no change from the current management conditions, other than as noted below, with the dams remaining in place. There is significant uncertainty about the long-term results if the KRRC's Proposed Project does not proceed. It is recognized that future consultations with the NMFS and the USFWS on the USBR's operation of the Klamath Irrigation Project, adaptive management of existing projects, and planned restoration activities can significantly alter conditions in the Klamath Basin, but the extent that these and other future basin activities would modify conditions is speculative. In light of this uncertainty, the No Project Alternative analysis focuses on the reasonably foreseeable period of 1–5 years), as described in Section 4.2.1.1 *[No Project Alternative] Alternative Description*.

Partial Removal Alternative

This alternative involves removal of Lower Klamath Project facilities at all four dam complexes to the extent sufficient to allow a free-flowing river. This alternative would therefore meet the underlying purpose and all the objectives of the Proposed Project. However, it would leave in place certain facilities described in Section 4.3.1.1 *Alternative Description*, thereby reducing the construction footprint and potentially the impact to historic resources from implementation of the Proposed Project. The KRRC has requested analysis of this scenario, indicating its feasibility, despite a lack of clarity regarding responsibility for long-term maintenance of remaining facilities.

Continued Operations with Fish Passage Alternative

This alternative examines the impacts of leaving the existing J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate dam complexes in place and relicensing the dams before FERC for continued operations, but incorporating alterations to allow for anadromous fish passage. The Continued Operations of the Lower Klamath Project with Fish Passage Alternative is based on the 2007 FERC Staff Alternative with Mandatory Conditions (see Section 4.4 *Continued Operations with Fish Passage Alternative* for more details) and the 2012 KHSA EIS/EIR *Fish Passage at Four Dams Alternative*, but it has been updated based on the most recent requirements that would apply to fish passage at the dams. The alternative includes:

- Volitional, year-round upstream and downstream fish passage at J.C. Boyle, Copco No.1, Copco No. 2, and Iron Gate dams, consistent with the prescriptions from the DOI and U.S. Department of Commerce imposed during the FERC relicensing process (FERC 2007), and upheld in a trial-type administrative hearing;
- Changes to J.C. Boyle operations to increase minimum flows, limit peaking flows (and recreation flows) to once per week;
- Changes to Copco No. 2 operations to increase minimum flows;
- Flows specified in the NMFS and USFWS 2013 BiOp for the USBR Klamath Irrigation Project (see also 3.1.6.1 *Klamath River Flows under the Klamath Irrigation Project's 2013 BiOp*);

- Court-ordered flushing and emergency dilution flows downstream of Iron Gate Dam which became required after February 2017 (U.S. District Court 2017) (see also Section 4.2.1.3 *Summary of Available Hydrology Information for the No Project Alternative*); and
- Design and implementation of a Reservoir Management Plan.

Prior analyses of similar alternatives indicate a failure to meet the Proposed Project's underlying purpose of addressing project-related water quality impairments and its related objectives (FERC 2007, USBR and CDFG 2012). However, this alternative does further the underlying purpose of providing fish passage upstream of Iron Gate Dam and related objectives by providing volitional adult fish passage. A number of entities requested analysis of dams-in scenarios during Lower Klamath Project scoping: this scenario, with federal mandatory fish passage conditions and FERC-required modifications to operations to address some water quality impacts, fulfills that request and also describes a likely potential long-term condition should dam removal not occur. The Continued Operations with Fish Passage Alternative would reduce the potential impacts of the proposed project related to dam removal and restoration of a riverine environment and elimination of hydropower, and it would likely also reduce construction impacts.

Prior environmental analyses and/or Lower Klamath Project scoping have also raised trap and haul and fish cannons as methods that could allow fish passage with dams remaining in place (FERC 2007, State Water Board 2017). These methods are likely infeasible. Federal mandatory conditions specify volitional fish passage[178], and neither of these proposals have a project proponent. There are few specifics regarding where such facilities would be located and whether the use of the passage method is physically possible at various facilities. Fish cannons (e.g., Whooshh Innovations) present several implementation challenges for the Lower Klamath Project. Even if it is assumed that passage at J.C. Boyle Dam would be provided by a separate facility, the distance separating Iron Gate Dam and Copco 1 Dam (6 miles), along with the height of Iron Gate Dam (173 feet) are prohibitive to current fish cannon technology. To date, the longest distance and height of successful transport using fish cannon technology was 1,700 feet in length and 165 feet in height in a temporary demonstration implementation at Cle Elum Dam in Washington. If fish cannons were to be used at one or more Lower Klamath Project dams, it would most likely have to be in combination with other fish passage facilities at the remaining Lower Klamath Project dams; resulting in similar habitat access and migration mortality as for volitional fishways. In addition, a range of sizes of fish would need to be transported around the dams using the fish cannon technology, to account for fish ranging from relatively small Pacific lamprey or steelhead, to adult Chinook salmon. To date, a passive sorting system has not been developed for fish cannons. Passage of multiple sizes of fish would require multiple sizes of transport tubes, as well as an active sorting system, which has yet to be developed. Furthermore, NMFS considers fish cannons an experimental device. As fish cannons are not identified as a type of conventional fish passage facility by NMFS (2011), their use at the Lower Klamath Project dams would be experimental in nature and, consistent with Section 16.5 of NMFS (2011), would require design and development of conventional fish passage facility at each dam where experimental fish cannons would be used. To date, no implementation of fish cannon technology has successfully demonstrated safe,

[178] Fish passage made continuously available without trap and transport (NMFS 2011).

timely, or effective passage for listed anadromous species, and NMFS has not approved a design. Therefore, there is no evaluation or monitoring data of fish cannons from which to estimate potential mortality or injury to migrating fish if this technology were to be implemented at the Lower Klamath Project under the Continued Operations with Fish Passage Alternative. Thus, fish cannons are considered to be infeasible as a method for fish passage for the Lower Klamath Project in this and other alternatives involving fish passage. However, in light of strong public interest in analysis of alternative fish passage methods, and in light of the similarities among fish passage scenarios, this EIR provides information regarding where the impacts and mitigations for trap and haul would differ from those for fish ladders for the Continued Operations with Fish Passage Alternative, as well as other alternatives involving fish passage.

Two Dam Removal Alternative

In this alternative, the Copco No. 1 and Iron Gate dam complexes in California would be fully removed, while the J.C. Boyle dam complex in Oregon and Copco No. 2 dam complex in California would remain in place (see Section 4.5 *Two Dam Removal Alternative* for more details). This alternative assumes that the J.C. Boyle and Copco No. 2 dam complexes would be relicensed by FERC for continued operations under federal mandatory conditions, with changes to J.C. Boyle operations to increase minimum flows, eliminate peaking and/or recreational flows, and allow for a seasonal high flow event in late winter/spring, as well as fishway prescriptions to allow for volitional year-round upstream and downstream fish passage. Leaving the two dams in place would reduce the amount and duration of sediment release, reduce construction and waste disposal, and retain some level of hydropower production, thus reducing the associated potentially significant impacts. The extent of the reduction in impacts would be slightly greater for this two dam removal alternative compared to the three dam removal alternative described above. This alternative would further all the underlying purposes and project objectives, but not to the same extent as the Proposed Project. Objective 3 would not be met as completely under this alternative since anadromy would continue to be inhibited to some extent by the J.C. Boyle Dam and Reservoir, and to a lesser degree by the Copco No. 2 Dam and Reservoir. This could, in turn, affect the extent to which the alternative achieves Objective 2. This alternative was analyzed because it eliminates the reservoirs with the largest contributions to water quality impairment and with the tallest dams for fish ladder construction, while allowing for continued power generation.

Three Dam Removal Alternative

This alternative considers the potential impacts of removing the three California Lower Klamath Project dams, with J.C. Boyle operating under Mandatory Conditions, except that peaking flows would be completely eliminated (see Section 4.6 *Three Dam Removal Alternative* for more details). This alternative assumes that the J.C. Boyle facility would be relicensed by FERC for continued operations under federal mandatory conditions, with changes to J.C. Boyle operations to increase minimum flows, eliminate peaking and/or recreational flows, and allow for a seasonal high flow event in late winter/spring, as well as fishway prescriptions to allow for volitional year-round upstream and downstream fish passage. Retaining one dam would potentially reduce the amount and duration of sediment release, reduce construction and waste disposal and to retain some level of hydropower production, thus reducing associated significant impacts. The alternative would further all the underlying purposes and project objectives, but not to the same extent as the Proposed Project. It would not meet Objective 3 as completely because J.C. Boyle Dam and Reservoir would continue to inhibit anadromy to some

extent. This could, in turn, affect the extent to which the project achieves Objective 2. Evaluation of this scenario was undertaken in light of the separate authority of the states of Oregon and California to issue water quality certification for the Proposed Project. Oregon issued water quality certification for the Proposed Project in September 2018, making this alternative unlikely. However, in light of the significant progress made in evaluating the scenario, and the analysis regarding the extent to which it meets project alternatives and avoids potential impacts, the State Water Board has determined to include the alternative in order to provide decisionmakers and the public with the information developed.

No Hatchery Alternative

This alternative is the Proposed Project, except with no hatchery operation during or after dam removal (see Section 4.7 *No Hatchery Alternative* for more details). The alternative would further the underlying purpose and most of the project objectives, although it is not clear at a screening level the extent to which the alternative would meet Objective 2. The alternative would reduce construction-related impacts of reopening Fall Creek Hatchery and making modifications at Iron Gate Hatchery. The alternative emerged from scoping concerns regarding the water source for the Iron Gate Hatchery, and in light of uncertainty regarding whether the Fall Creek Hatchery could be timely reopened.

4.1.1.2 Elimination of Potential Alternatives for Failure to Meet Underlying Project Purpose

A number of the potential alternatives fail to meet the basic underlying purpose of the Proposed Project because they (1) fail to address project-related water quality impairments within and downstream of the Lower Klamath Project; and/or (2) fail to expand anadromous fish habitat upstream of Iron Gate Dam. Potential alternatives eliminated based upon this criterion are described below.

2007 FERC PacifiCorp's Proposal (for Continued Operation of the Klamath Hydroelectric Project)

This alternative in the 2007 FERC EIS proposes removing Keno and Link River facilities from the Klamath Hydroelectric License, and continuing operation of other facilities with implementation of a Reservoir Management Plan, improvement of existing fish passage facilities at J.C. Boyle Dam, and other operational changes. The 2007 FERC EIS found that PacifiCorp's Proposal failed to address the project's water quality impairments within and downstream of the hydroelectric reach (FERC 2007). Additional studies since 2007 have indicated that proposed reservoir management techniques can improve some of the project impacts to water quality (e.g., transport of nuisance and/or noxious blue-green algae downstream of Iron Gate Dam), but the various techniques have not been shown to sufficiently improve project impacts to water quality (e.g., dissolved oxygen) to meet all the water quality requirements (Carlson and Foster 2008, 2009; Deas et al. 2009; Horne et al. 2009; PacifiCorp 2008, 2011, 2013a, 2013b, 2014, 2015, 2017, 2018; Deas et al. 2012; CH2M HILL 2013, 2015; Austin et al. 2016). Because the proposal does not include fish passage, it also fails to extend anadromous fish habitat upstream of Iron Gate Dam. In addition to failing to meet either underlying project purpose, PacifiCorp is not currently pursuing this alternative, having asked for and received a stay in FERC proceedings to allow consideration of the KRRC's Proposed Project. The alternative also does not appear to be legally feasible, even if FERC were to lift the stay

in the relicensing proceeding, as it does not include federal mandatory relicensing conditions.

2007 FERC Staff Alternative

This potential alternative, analyzed in FERC's 2007 EIS, modifies PacifiCorp's Proposal detailed in FERC (2007) to include fish disease studies, turbine venting, limited trap and haul with associated studies, and other improvements to Klamath Hydroelectric Project operations that would reduce ongoing impacts. The FERC 2007 EIS found that the alternative failed to meet water quality standards within and downstream of the Hydroelectric Reach (FERC 2007). Thus, this alternative would not achieve the project's underlying purpose of addressing project-related water quality impairments. The alternative also does not appear to be legally feasible, even if FERC were to lift the stay in the relicensing proceeding, as it does not include federal mandatory relicensing conditions.

Bogus Creek Bypass

This proposed alternative envisions a fish bypass reach from below Iron Gate to above Copco 1 Dam, using primarily the natural waterways of Bogus Creek, Cold Creek, and Little Deer Creek, with a constructed canal that would connect to Copco No. 1 Reservoir. The alternative proposes upstream fish passage via Bogus Creek, upstream into Cold Creek, through a constructed canal from Cold Creek to Deer Creek on the other side of a ridgeline, and moving downstream from Deer Creek into Copco No. 1 Reservoir. It assumes downstream fish passage for outmigrating juveniles is possible from Copco No. 1 Reservoir to the Klamath River below Iron Gate in the reverse direction, but it does not provide any examples of similar projects where this occurs to demonstrate its feasibility. This alternative fails to meet the underlying purpose of addressing project-related water quality impairments. Additionally, it would be extremely unlikely to meet the underlying objective of extending anadromous fish habitat above Iron Gate Dam since key elements of the alternative do not comport with known behavioral traits of adult salmonids preventing their usage of the bypass; the steep gradient and low flow in streams involved in the bypass would restrict migration; and it does not address the needs of outmigrating juvenile salmonids (CDFG 2009; White 2011). The migratory behavior of adult salmon to swim upstream to spawn would lead to spawning in the highest reaches of the bypass route rather than migration through the tunnel and spawning upstream of Copco No. 1 Reservoir (White 2011). The alternative also is not viable because the amount of water required to provide passage for salmonids through the bypass exceeds the amount of water currently available in Cold Creek or Deer Creek and no alternative source has been currently identified. Additionally, the alternative does not meet screening-level indications of feasibility, as there is no funding, no project proponent with the authority to implement it, and no indication that the project could be implemented in a timely manner.

Bogus Creek Bypass with Alternative Tunnel Route

This proposed alternative is a modification of the Bogus Creek Bypass above, that would use Bogus Creek and a five-mile tunnel to Copco No. 1 Reservoir. In this alternative, upstream fish passage would occur with fish in the Klamath River entering Bogus Creek, swimming from Bogus Creek into a constructed 4.75-mile tunnel, and moving downstream through the tunnel into Copco No. 1 Reservoir. Downstream fish passage from Copco No. 1 Reservoir to the Klamath River downstream of Iron Gate would occur in the reverse direction. The alternative addresses some of the constraints of the Bogus Creek Bypass alternative related to the underlying purpose of fish passage above Iron

Gate Dam, in that it avoids the concern about requiring adult salmonids to swim downstream during their upstream migration. Additionally, it addresses flow constraints in Cold Creek. However, a review of the alternative concluded that the tunnel alternative would be a very high risk option that may not provide effective fish passage because substantial data on the migratory behavior of adult salmon show the tunnel would eliminate many of the natural stimuli for fish migration and salmon have a general, although not absolute, avoidance of movement through culverts and short tunnels. Predicting fish movement through the 4.75-mile tunnel proposed in this alternative would be risky and there would be little flexibility in the alternative if fish avoided using the tunnel for migration (Mefford 2011). Additionally, because the tunnel would not maintain the ecological function of the stream to promote fish passage and it would not adhere to NMFS conventional fish passage design guidelines (NMFS 2011), its use would be experimental in nature and, consistent with Section 16.5 of NMFS (2011), would require design and development of a conventional fish passage facility at any location where it would be used. Further, the alternative does not include provisions for collecting and bypassing outmigrating juvenile fish. As proposed, it is expected only a small portion of juvenile fish would follow the low flows into the tunnel rather than the high flows downstream through the reservoir, so fish passage effectively would not be achieved (Mefford 2011; White 2011). The project's underlying purpose of addressing project-related water quality impairments would also not be achieved, with the tunnel providing no ecological benefit to the river and potentially further degrading the ecology of the river within this reach by diverting water from the river for the tunnel (Mefford 2011). Additionally, the alternative does not meet screening-level indications of feasibility, as there is no funding, no project proponent with the authority to implement it, and no indication that the project could be implemented in a timely manner.

Federal Takeover

This alternative entails a federal agency assuming control over the dams. That entity would then determine the fate of the facilities. Because this alternative does not involve particular operational or structural changes, it does not further the underlying project purposes of addressing project-related water quality impairments or expanding anadromous fish habitat. There is also no indication that this alternative is feasible, as no federal agency has indicated an interest in federal takeover. Further, because the alternative is a change in ownership, rather than in outcome, it fails to reduce the potentially significant impacts of the Proposed Project in a manner different from the evaluated alternatives. This EIR evaluates a reasonable range of alternatives that could be the outcome of the proposed process by the KRRC, or of ownership and management by a different entity.

Cessation of Power Production with Dams in Place

This alternative would end power production at the facilities, but not remove or modify them. Ceasing power production would not meet the underlying project purposes of addressing water quality impairments or expanding anadromous fish habitat beyond Iron Gate Dam. Additionally, this alternative does not meet screening-level indications of feasibility. Maintenance of the facilities would be costly, and eliminating power production would remove the facilities' primary earnings potential. No entity has stepped forward to operate the dams as non-power facilities.

Dredge Upper Klamath Lake

This alternative involves removing sediments from Upper Klamath Lake in Oregon, in order to reduce nutrients and to increase storage capacity of the lake. This action would

not address the underlying project purpose of expanding anadromous fish habitat. The extent of required dredging to affect the phosphorus balance in Upper Klamath Lake is unclear, and the process would not remove nitrogen from the system. Thus, it is not clear the extent to which it would achieve a nutrient reduction sufficient to improve water quality in the hydroelectric reach. The alternative does not address facility-related water quality impairments that do not depend on phosphorus input in Upper Klamath Lake, such as the seasonal shift in water temperature, hydromorphology impacts, sediment starvation of the reach downstream of Iron Gate Dam, nuisance and/or noxious blue-green algae blooms within the reservoirs and potential transport of blue-green algae from the reservoirs into the Klamath River downstream of the reservoirs, and the contribution of these impacts to fish disease. Thus, it fails in large part to achieve the project's underlying purpose of addressing project-related water quality impacts. Additionally, the project does not meet screening level indications of feasibility because expansive dredging is high-cost, creates a large amount of dredged material for disposal (Stillwater Sciences et al. 2013), and there is no identified proponent to take on this activity. The location of the action outside of California creates additional barriers to feasibility from a CEQA perspective.

Predator Control

This alternative proposes controlling sea lion, seal, and cormorant populations on the coast, in order to reduce predation of adult and juvenile salmonids. It has been suggested that predation of anadromous salmonids by these marine species is having a major effect on the salmonid population as they return to the Klamath River to spawn. A number of seal and sea lion haul outs and sea bird colonies exist in the vicinity of the mouth of the Klamath River, but no studies have been conducted to determine the impact of these predators on Klamath River populations. Observations of sea lion and seal predation on salmonids in the Columbia or Willamette rivers have estimated approximately 0.3 to 5.5 percent of the adult return is consumed by sea lions or seals (NOAA 2006), with 2014 to 2017 data from the Willamette River showing the average percent of potential escapement eaten be sea lions ranging from 6 to 9 percent of Chinook and 3 to 25 percent of steelhead (ODFW 2017). Analysis of Chinook salmon consumption from California to Alaska shows an increasing trend in salmonid predation by sea lions and seals from 1975 to 2015 as their populations increase (Chasco et al. 2017). The impact of avian predators, such as gulls, cormorants, and certain species of ducks, on out-migrating smolts in the Columbia River at reservoirs concluded that avian predators in the reservoirs accounted for the mortality of less than one percent of the juvenile salmonid population (Wiese et al. 2008). Similar percent reductions in the salmonid populations in the Klamath River may occur. This alternative would not meet the underlying purposes of expanding anadromous fish habitat beyond Iron Gate Dam. Additionally, it would not address downstream project-influenced water quality conditions, including the seasonal shift in water temperature, hydromorphology impacts, sediment starvation of the reach downstream of Iron Gate Dam, nuisance and/or noxious blue-green algae blooms within the reservoirs and potential transport of blue-green algae from the reservoirs into the Klamath River downstream of the reservoirs, and the contribution of these impacts to fish disease. Additionally, the alternative does not meet screening-level indications of feasibility, as there is no funding, no project proponent with the authority to implement it, and no indication that the project could be implemented in a timely manner.

Partition Upper Klamath Lake

This alternative would create an "inner lake" in Upper Klamath Lake, which would reduce residence time in the lake, and potentially improve water quality (Herald and News 2010). This action would not meet the underlying purpose of expanding anadromous fish habitat beyond Iron Gate Dam. Additionally, it would not address downstream project-influenced water quality conditions, including the seasonal shift in water temperature, hydromorphology impacts, sediment starvation of the reach downstream of Iron Gate Dam, nuisance and/or noxious blue-green algae blooms within the reservoirs and potential transport of blue-green algae from the reservoirs into the Klamath River downstream of the reservoirs, and the contribution of these impacts to fish disease. There is no indication that there is available funding for this project, or that there is an entity capable of and interested in performing it, so it does not meet initial screening indicators for feasibility. Additionally, it is outside of California, further casting doubt on the alternative's feasibility for CEQA purposes.

Water Storage Development in the Scott and Quartz Valleys

This alternative would involve constructing additional storage facilities in the Scott and/or Quartz Valley and releasing stored water into the Scott River to improve conditions in the Scott and Klamath rivers. In a previous study, two potential reservoir sites with a 20,000 acre-feet capacity per reservoir were identified in the East Fork Scott River sub-watershed (DWR 1991), with releases from these reservoirs potentially improving water quality downstream in the Scott River and eventually the Klamath River. However, the alternative does not meet the underlying project purpose of extending anadromous fish habitat above Iron Gate Dam. Additionally, there has been no quantification of the amount of water needed to sufficiently improve water quality in the Klamath River. A previous study of environmental water releases in the Scott River highlighted that current water temperatures in portions of the Scott River are too warm for anadromous fish, and there is significant uncertainty about whether environmental water releases would adequately improve water temperature (DWR 1991). The alternative also would not address water quality impacts upstream of the Scott River (e.g., the Hydroelectric Reach of the Klamath River) or other impacts of the dam, including the seasonal shift in water temperature, hydromorphology impacts, sediment starvation of the reach downstream of Iron Gate Dam, nuisance and/or noxious blue-green algae blooms within the reservoirs and potential transport of blue-green algae from the reservoirs into the Klamath River downstream of the reservoirs, and the contribution of these impacts to fish disease. The alternative does not meet screening levels of feasibility: there is no project proponent with the authority to implement it, no analysis of water quantity needed to sufficiently improve the mainstem Klamath River water quality, and no indication that the two identified reservoir sites would have sufficient storage to meet the water quantity needed.

Transfer Water from Klamath River to Shasta River

This alternative would involve constructing a canal to transfer 60,000 acre-feet of water from Iron Gate Reservoir (or J.C. Boyle Reservoir or Keno Reservoir) to the Shasta River sub-watershed as irrigation supply to allow Lake Shastina discharges to go directly into the Shasta River rather than being used as irrigation supply first. This alternative does not meet the underlying project purpose of extending anadromous fish habitat above Iron Gate Dam. While releasing water from Lake Shastina directly into the Shasta River may improve water quality in the reaches downstream of the releases, there has been no quantification of the impact of flow releases from Lake Shastina on water quality in the Klamath River or whether sufficient water is available to be released from Lake

Shastina to sufficiently improve water quality in the Klamath River. Additionally, this alternative does not have the potential to address water quality impacts upstream of the Shasta River (e.g., the Hydroelectric Reach of the Klamath River) or other impacts of the dam, including the seasonal shift in water temperature, hydromorphology impacts, sediment starvation of the reach downstream of Iron Gate Dam, nuisance and/or noxious blue-green algae blooms within the reservoirs and potential transport of blue-green algae from the reservoirs into the Klamath River downstream of the reservoirs, and the contribution of these impacts to fish disease. The alternative does not meet screening levels of feasibility: there is no project proponent with authority to implement it, no analysis the impact of flow releases from Lake Shastina on improving Klamath River water quality, and no analysis of water quantity and availability needed to sufficiently improve the mainstem Klamath River water quality.

4.1.1.3 Removal or Consolidation of Substantially Similar Alternatives

CEQA requires an EIR to examine a reasonable range of alternatives to foster informed decision-making, rather than to evaluate all possible alternatives or permutations thereof (CEQA Guidelines section 15126.6, subd. (a).) Therefore, when identified alternatives provided only minor variations of the same primary elements, the State Water Board either eliminated the closely-linked alternatives from consideration or analyzed an alternative that combines various aspects of the slightly different potential alternatives.

Alternatives Similar to Removal of Four Dams

The Proposed Project is substantially similar to the 2007 FERC Four-Dam Removal alternative; the rejected KHSA EIS/EIR Dam Removal of Four Dams Without KBRA alternative; and the KHSA EIS/EIR Project Full Facilities Removal of Four Dams. Because all of these alternatives analyze the major impacts of removing four major dam facilities, the State Water Board has moved forward only the analysis of the Proposed Project, rather than analyzing all four variations. The Proposed Project, as it is currently being proposed, has funding and has the backing of a range of stakeholders under the Klamath Hydroelectric Settlement Agreement. Additionally, it incorporates additional studies and information on feasible methods of dam removal vis-à-vis the other potential alternatives. The Proposed Project is therefore more feasible than the other similar four-dam removal scenarios.

The alternatives of Notching Four Dams, and Partial Removal of Four Dams have a significant overlap: both reduce the extent of facilities removal as compared to the Proposed Project. Therefore, the potential alternatives will likely both reduce construction-related impacts vis-à-vis the Proposed Project. Both alternatives would also require some sort of monitoring or other actions regarding the remaining project facilities. Here, the KRRC has proposed Partial Removal as an alternative, indicating potential feasibility of the alternative, but it has not proposed evaluation of notching. A notching alternative would be highly dependent on successful dam demolition and notching during winter months, with the following identified constructability and schedule risks: safety of construction workers operating on narrow, steep access roads during winter months with wet and icy conditions; weather delays that are likely to be worse in the wettest years when reservoir drawdown would rely on notching more than in dry years; and incomplete reservoir drawdown during wet years if notching is not complete. Additionally, Iron Gate Dam is an earthen dam that cannot be notched. Therefore, the State Water Board has elected to review Partial Removal of Four Dams as the more feasible and reasonable alternative between the two reduced-construction proposals.

Alternatives Similar to Retaining All Facilities

A number of alternatives contemplate retaining existing facilities and continuing power generation, but undertaking facility modifications to allow for passage of anadromous fish. All of these alternatives would reduce the Proposed Project's potentially significant impacts to a range of resources affected by removal of the facilities, including impacts from changes to hydrology, sediment release, elimination of reservoirs, and removal of facilities of potentially historic significance. Additionally, maintaining the dams has the potential to reduce the intensity of construction-related impacts, as construction of fish passage facilities requires less activity than dam deconstruction. The proposals also contain a significant weakness in meeting the habitat expansion purpose in that the technologies are better suited to accommodating upstream migration of spawning salmonids than they are to downstream migration of juveniles. They also have similar weaknesses in meeting the water quality and fisheries improvement purposes and objectives because they maintain the reservoirs, with associated water quality problems.

The EIR evaluates the most well-developed dams-in alternative which comports with federal mandatory conditions and includes FERC staff's proposed corresponding operational and physical modifications to the existing project. There are also proposals to use different technologies than those described in federal mandatory conditions in the Klamath Hydroelectric Project's relicensing process. For example, the 2007 FERC Staff Alternative included a testing protocol for determining whether trap and haul between various locations would be able to successfully expand anadromous fish habitat (FERC 2007). Scoping comments in this process have recommended evaluation of trap and haul, but they have also recommended evaluation of a new technology that has emerged in recent years—the use of fish cannons to lift fish over dams. However, trap and haul and other alternative technologies would not meet federal mandatory conditions and fish cannons are considered experimental (Section 16.5 of NMFS [2011]), so NMFS guidelines for experimental technologies would be needed, including construction of a conventional back-up fish passage design (see also Section 4.1.1.1 *Alternatives Carried Forward for More Detailed Analysis – Continued Operations with Fish Passage*). Additionally, no concrete plans or proponents for undertaking fish passage through trap and haul or other alternate measures exist. In light of the above, these proposals are likely infeasible. However, in light of the public's high degree of interest in fish passage alternatives, the EIR notes where the environmental impacts of trap and haul would differ from the fishways required under federal mandatory conditions.

Alternatives Similar to Removal of Fewer Facilities

Both the 2007 FERC EIS and the 2012 KHSA EIS/EIR analyzed an alternative of removing Iron Gate and Copco No. 1 dams, while leaving Copco No. 2 and J.C. Boyle dams in place with fish passage. The 2012 KHSA EIS/EIR also rejected the potential alternative of Three Dam Removal, removing all three California facilities and leaving J.C. Boyle Dam in place. Removing fewer facilities would allow for hydropower production, reduce the amount of construction and disposal of waste, and reduce the amount and duration of sediment releases, with potential reductions to the associated Project impacts. These alternatives would further both the water quality and fish habitat underlying project purposes, and would further all project objectives, but not to the same extent as the Proposed Project. Water quality under these alternatives would likely show improvement in the Hydroelectric Reach and downstream of Iron Gate Dam, with the elimination of the seasonal shift in water temperature, reduction in the

hydromorphology impacts, decreased sediment starvation of the reach downstream of Iron Gate Dam, elimination of nuisance and/or noxious blue-green algae blooms within the Iron Gate and Copco No. 1 reservoirs and potential transport of blue-green algae from the reservoirs into the Klamath River downstream of the reservoirs, and the contribution of these impacts to fish disease. However, the remaining dam(s) and reservoir(s) in these potential alternatives may limit the improvements and achievement of Objective 1 due to power production operations altering flow and potentially water temperature and the reservoir(s) retaining some sediment. The remaining dam(s) and reservoir(s) in these potential alternatives also would continue to inhibit adult and juvenile migration to some extent, limiting achievement of Objective 3. This, in turn, has the potential to affect the ability to meet Objective 2.

Copco No. 2 is a relatively small facility, with a dam only 33 feet high and a reservoir approximately 0.25-mile long with a storage capacity of 73 acre-feet (FERC 2007). Therefore, keeping the facility in place and building fish passage would not significantly reduce the sediment releases and associated water quality impacts from those releases or the construction and disposal impacts compared to the Proposed Project. Hydropower production is possible at this facility absent the presence of Iron Gate Dam to moderate peaking downstream, although production would be considerably less than under existing conditions. No party is proposing operation of J.C. Boyle Dam or Copco No. 2 Dam independent of any other Lower Klamath Project facilities.

In light the above, this EIR reviews the Three Dam Removal and Two Dam Removal scenarios as alternatives that analyze removal of fewer facilities than proposed.

4.1.1.4 Elimination of Potential Alternatives that Would Not Avoid or Substantially Lessen Significant Environmental Effects of the Proposed Project

Alternatives for Removing Additional Facilities

Scoping comments in this process have suggested analysis of alternatives that would remove not only the Lower Klamath Project facilities, but also additional facilities in Oregon—Keno and Link River Dams. The 2012 KHSA EIS/EIR and the 2007 FERC EIS noted, but they did not analyze these alternatives. Proponents of these alternatives emphasize the potential habitat expansion benefits of these alternatives. However, the proposed Five and Six Dam Removal alternatives would not reduce the potential significant impacts of removing the four lower facilities under the Proposed Project. Additionally, these upstream facilities are not part of the Lower Klamath Project. Keno and Link River Dams are components of the Klamath Irrigation Project as well as being part of the Klamath Hydroelectric Project, and the facilities provide water for consumptive use in Southern Oregon and Northern California. PacifiCorp has proposed removing the facilities from hydroelectric production, but neither USBR, nor the water users that rely on these facilities have put forth a proposal to remove them. Comments have identified no funding mechanism, water replacement, or concrete proposal for removal. Thus, in addition to not reducing the potential impacts of the Proposed Project, these alternatives are not feasible.

Sequenced Removal of Four Dams

Sequenced Removal of Four Dams contemplates an alternate method of dam removal than that in the Proposed Project. Rather than removing all four facilities in an overlapping timeframe in a single season, sequenced removal would remove facilities

one at a time. This would reduce the concentration of sediment released, as sediments would be released over an extended period of time. Additionally, depending on the amount of time between removals, it could allow for evaluation of model assumptions and restoration methods. Analysis of sequenced removal indicates that the reduced concentration of sediment from removing a single facility at once would not significantly reduce mortality during removal. The Proposed Project's timing is proposed to minimize the duration of sediment release, and to have the high concentrations of sediment occur at a time that interferes least with the life stages of the different fish populations in the Klamath system. Sequenced removal over three to five years likely would result in drawdown and repeated refills of reservoirs, based on modeling of more rapid drawdown during individual water year types for the Proposed Project showing some refill occurring under all water year types except Dry (Appendix B: *Definite Plan*). Sequenced removal would result in elevated suspended sediment concentrations over a longer time than the Proposed Project impacting additional life stages of fish, additional year-classes of fish, or both (Stillwater Sciences 2011). Elevated suspended sediments would be sufficiently high that the adverse impacts to water quality and fish would still occur during the sequenced removal even though the maximum suspended sediment concentration likely would be reduced compared to the Proposed Project. As such, sequenced removal would extend, rather than reduce, the impacts to fish species. Because of the increased duration of impact over more life stages and/or additional year-classes, it is unclear whether sequenced removal would fulfill Objective 2 of advancing the long-term restoration of the natural fish populations in the Klamath Basin. Additionally, sequenced removal would extend the time before other objectives would occur, so they would not be achieved in as timely a manner as under the Proposed Project.

4.1.1.5 Alternatives With Other Feasibility Concerns

The 2012 KHSA EIS/EIR included implementation of the Klamath Basin Restoration Agreement (KBRA) as a coordinated action for alternatives that implemented the KHSA. The KBRA has expired, and stakeholders have not reached a similar agreement. While negotiations regarding such an agreement are ongoing, it is speculative at this point to assume whether agreement will be reached, when, and what such an agreement would look like. Therefore, the EIS does not analyze any KBRA-implementation alternatives.