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VA103-640/1-9

KLAMATH RIVER RENEWAL PROJECT

100% DESIGN REPORT

Rev	Description	Date
0	Issued in Final	May 27, 2022

Knight Piésold CONSULTING

EXECUTIVE SUMMARY

The Klamath River Renewal Project (KRRP) involves the removal of four existing hydroelectric facilities on the Klamath River to restore natural flow and volitional fish passage through the former dam and reservoir reaches. These facilities are J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate. The project is led by the Klamath River Renewal Corporation (KRRC) in partnership with the states of Oregon and California. Project implementation work will be performed primarily by the Dam Removal Contractor, Kiewit Infrastructure West Co. (Kiewit), referred to as the Project Company, and the Habitat Restoration Contractor, Resource Environmental Solutions (RES).

This 100% Design Report addresses the scope of work to be performed by the Project Company regarding removal of the four hydroelectric facilities, including construction access improvements, preparatory work for drawdown of the existing reservoirs, dam demolition and removal of other facility components, on-site disposal of earth and rubble materials, and grading of final river channels through the dam sites. The Project Company's scope and the scope of this Design Report with respect to the Klamath River is limited to the footprints of the existing dams and historic cofferdams.

This report was prepared by Knight Piésold (KP), in collaboration with Kiewit, and with specific chapter contributions by Kiewit Power (electrical facilities demolition) and Camas LLC (permitting). McMillen Jacobs Associates (MJA) provided input as the KRRC's representative, and RES provided input and assessment of the final river channel designs through the existing dam sites.

The 100% Design is built upon the concepts presented in the 90% Design Report (KP, 2020) and the preceding Value Engineering analyses, which are provided in Appendix L. Extensive design analyses and collaboration of the multi-disciplinary Project team throughout the design process have targeted reduced costs and construction risks.

Each hydropower facility removal can be categorized into three general periods:

- Pre-drawdown works: the period wherein temporary access, dam and tunnel modifications are constructed to facilitate reservoir drawdown.
- Drawdown: the period wherein reservoirs are lowered to facilitate dam removal works.
- Demolition and removal works: the period when dam and other hydropower facility infrastructure is deconstructed and the volitional fish passage channels are established.

Pre-drawdown works involve all construction activities required prior to drawdown, such as establishment of site access roads and construction of outlet works. Drawdown covers the opening of outlets and the lowering of the reservoirs which will begin on or about January 1 of the drawdown year. Removal of the hydropower facilities and other related work will occur during and after drawdown and involves all construction activities required to decommission and deconstruct the former dam and hydroelectric facilities.

All in-river works, and the establishment of the final river channels will be completed during the drawdown year.

Various road, bridge, and culvert improvements will be completed to support construction and long-term access. Temporary bridges and structures, and use of private roads, are incorporated into design to limit disturbances to public infrastructure.

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ABBREVIATIONS

ALSA	Amended License Surrender Application
BMP	best management practice
CA FEIR	California State Water Resources Control Board Final Environmental Impact Report
CDFW	California Department of Fish and Wildlife
CFD	computational fluid dynamics
cfs	cubic feet per second
CWA	Clean Water Act
DCD	Design Completion Documents
El.	elevation
FERC	Federal Energy Regulatory Commission
ft	feet, foot
GMP	guaranteed maximum price
HPU	hydraulic power unit
HVAC	heating, ventilation, and air conditioning
Kiewit	Kiewit Infrastructure West
KP	Knight Piésold Ltd
KRRC	Klamath River Renewal Corporation
KRRP	Klamath River Renewal Project (the Project)
kV	kilovolt
MMRP	Mitigation, Monitoring, and Reporting Plan
MOU	Memorandum of Understanding
NAVD88	North American Vertical Datum 1988
No.	Number
PacifiCorp	PacifiCorp Energy
PFMA	Probable Failure Modes Analysis
RES	Resource Environmental Solutions
RM	river mile
USBR	United States Bureau of Reclamation
VE	Value Engineering
WQC	Water Quality Certification

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The Klamath River Renewal Project (KRRP) involves the removal of four existing hydroelectric facilities on the Klamath River to restore natural flow and volitional fish passage through the former dam and reservoir reaches. These facilities are J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate. The project is led by the Klamath River Renewal Corporation (KRRC) in partnership with the states of Oregon and California. Project implementation work will be performed primarily by the Dam Removal Contractor, Kiewit Infrastructure West Co. (Kiewit), referred to as the Project Company, and the Habitat Restoration Contractor, Resource Environmental Solutions (RES).

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All in-river works, and the establishment of the final river channels will be completed during the drawdown year.

Various road, bridge, and culvert improvements will be completed to support construction and long-term access. Temporary bridges and structures, and use of private roads, are incorporated into design to limit disturbances to public infrastructure.

1.2 DRAWINGS AND SPECIFICATIONS

This report refers to the 100% Design Drawings and Project Technical Specifications which, along with this report, form the 100% Design Completion Documents (DCD). These additional documents are issued separately from this report. General drawings are shown in Table 1.1.

Table 1.1 List of General Project Drawings

Drawing Number	Drawing Title
G0001	Title Sheet
G0002	Index of Drawings - (Sheet 1 of 2)
G0003	Index of Drawings - (Sheet 2 of 2)
G0005	Legend, Symbols, and Abbreviations
G0006	General Notes
G0020	Project Location, Vicinity and Access
G0030	General Arrangement Plan - Key Map
G0031	J.C. Boyle Facility - General Arrangement Plan - (Sheet 1 of 2)
G0032	J.C. Boyle Facility - General Arrangement Plan - (Sheet 2 of 2)
G0033	Copco No. 1 and Copco No. 2 Facilities - General Arrangement Plan - (Sheet 1 of 2)
G0034	Copco No. 1 and Copco No. 2 Facilities - General Arrangement Plan - (Sheet 2 of 2)
G0035	Iron Gate Facility - General Arrangement Plan - (Sheet 1 of 2)
G0036	Iron Gate Facility - General Arrangement Plan - (Sheet 2 of 2)
G0050	Earthworks and Demolition - Material Gradations - (Sheet 1 of 2)
G0051	Earthworks and Demolition - Material Gradations - (Sheet 2 of 2)
E0001	General Arrangement - Electrical
E0002	General Transmission Network Diagram

Drawing lists for J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate are provided in Sections 2.1.2, 3.1.2, 4.1.2, and 5.1.2, respectively. Drawing lists for roads, bridges and culverts are presented in Sections 6, and recreation sites demolition are presented in Section 7.

The list of Project Technical Specifications is presented in Table 1.2.

Table 1.2 List of Technical Specifications

Section Number	Section Title
DIVISION 02	**Existing Conditions**
02 41 00	Demolition and Facility Removal
02 41 99	Electrical Distribution System Demolition
DIVISION 03	**Concrete**
03 10 00	Concrete Forming and Accessories
03 20 00	Concrete Reinforcement
03 30 00	Cast-in-Place Concrete
03 60 00	Grouting
DIVISION 05	**Metals**
05 12 00	Structural Steel
DIVISION 31	**Earthwork**
31 05 00	Materials for Earthwork
31 10 00	Clearing, Grubbing and Stripping
31 23 00	Excavation and Fill Placement
31 25 00	Erosion and Sedimentation Controls
31 60 00	Foundation Preparation
31 71 00	Tunnel Construction
31 80 00	Care of Water
DIVISION 32	**Road and Site Improvements**
32 50 00	Roads, Bridges, and Culverts
DIVISION 35	**Waterway and Marine Construction**
35 24 00	Dredging

1.3 EROSION AND SEDIMENT CONTROL

The construction and removal works required for the Project will be conducted in a manner that provides environmental protection and best management practices (BMPs) for erosion and sediment control. Appendix H and the Design Drawings provide the erosion and sediment control design measures for each Project area.

1.4 SCHEDULE

All construction, demolition, and removal activities associated with the Project have been scheduled by the Project Company with consideration of engineering design, permits, seasonal river flows, and other constraints. The current Implementation Work Schedule is provided in Appendix I.

The schedule is summarized below:

Pre-Drawdown Year (2023)

- Construction of access improvements: roads and bridges
- Site preparation, including staging areas and work pad construction, installation of erosion and sediment control BMPs

- Drawdown outlet preparation at Copco No. 1 and Iron Gate Dams
- Removal of Copco No. 2 dam and historic cofferdam from temporarily dewatered river

Drawdown Year (2024):

- Initiate reservoir drawdown on or about January 1
- Remove dams and other facility components, taking into account the state of reservoir drawdown and the seasonal flood risk, where applicable (criteria and timing varies by facility; see Sections 2.4, 3.4, 4.4, and 5.4 for details)
- The final breach of Iron Gate Dam is a critical activity that must be completed before flood risk increases in the Fall (see Section 5.4.3 for details)
- Establish final volitional fish passage river channels through the former dam sites before the onset of seasonal high flows in the Fall
- Install final permanent BMPs on upland areas

Coordination is in progress with water management agencies regarding opportunities to manage flows, within the normal range of operations, to ensure safe and timely implementation of certain activities such as the setting of charges for J.C. Boyle reservoir drawdown and preparation of the final breach at Iron Gate dam.

2.0 J.C. BOYLE HYDROPOWER FACILITY REMOVAL

2.1 GENERAL

2.1.1 EXISTING FACILITY COMPONENTS

The J.C. Boyle Hydroelectric Facility was constructed from 1957 to 1958 and is located between RM 234.1 and RM 220.4 in Oregon. The major components of the J.C. Boyle Facility include:

- A reservoir of approximately 3,495 acre-ft capacity at a reservoir elevation of 3,796.7 ft (NAVD88).
- A 68 ft high combination earth fill and concrete gravity dam that spans approximately 700 ft in length.
- A three-bay gated spillway with 36 ft wide bays.
- Two low-level diversion culverts with concrete stoplogs.
- A power intake structure and a fish ladder at the intake.
- A water conveyance system made up of a 600 ft syphon and pipeline, a 2.2-mile-long concrete power canal, a 1,600 ft long low-pressure tunnel and two 950 ft long surface mounted high-pressure steel penstocks.
- An eroded scour hole downstream of the canal forebay structure.
- A two turbine, at-surface 98 MW powerhouse and a tailrace channel.
- A switchyard, substation, and transmission lines.

The project design and construction are documented in the historic design drawings and construction photographs. Historic drawings are provided in Appendix K. Supporting Technical Information Documents (STID) are provided in Appendix J.

2.1.2 DESIGN DRAWINGS

Table 2.1 provides the J.C. Boyle removal plan drawing list.

Table 2.1 J.C. Boyle Facility Drawings List

Drawing Number	Drawing Title
G0031	J.C. Boyle Facility - General Arrangement Plan - (Sheet 1 of 2)
G0032	J.C. Boyle Facility - General Arrangement Plan - (Sheet 2 of 2)
C1000	J.C. Boyle Facility - Project Overview and Limits of Work - Key Map
C1001	J.C. Boyle Facility - Project Overview and Limits of Work - (Sheet 1 of 5)
C1002	J.C. Boyle Facility - Project Overview and Limits of Work - (Sheet 2 of 5)
C1003	J.C. Boyle Facility - Project Overview and Limits of Work - (Sheet 3 of 5)
C1004	J.C. Boyle Facility - Project Overview and Limits of Work - (Sheet 4 of 5)
C1005	J.C. Boyle Facility - Project Overview and Limits of Work - (Sheet 5 of 5)
C1050	J.C. Boyle Facility - Drawdown Stages - Average Inflow - Plan and Section
C1055	J.C. Boyle Facility - Hydrologic and Hydraulic Information - Post-Drawdown Water Surface Levels
C1056	J.C. Boyle Facility - Hydrologic and Hydraulic Information - Figures
C1210	J.C. Boyle Facility - Embankment, Intake and Fish Ladder Removal - Plan and Sections
C1220	J.C. Boyle Facility - Spillway and Intake Removal - Plan and Profile
C1221	J.C. Boyle Facility - Spillway and Intake Removal - Sections
C1230	J.C. Boyle Facility - Embankment Removal - Plan
C1231	J.C. Boyle Facility - Embankment Removal - Section and Details
C1232	J.C. Boyle Facility - Embankment Removal - Excavation Sections (Sheet 1 of 2)
C1233	J.C. Boyle Facility - Embankment Removal - Excavation Sections (Sheet 2 of 2)
C1234	J.C. Boyle Facility - Embankment Removal - Phase 1 and 2 Removal Sequence
C1235	J.C. Boyle Facility - Embankment Removal - Phase 3 Removal Sequence
C1236	J.C. Boyle Facility - Embankment Removal - Phase 4 Removal Sequence
C1237	J.C. Boyle Facility - Embankment Removal - Phase 5 Removal Sequence
C1238	J.C. Boyle Facility - Embankment Removal - Phase 6 and 7 Removal Sequence
C1239	J.C. Boyle Facility - Embankment Removal - Phase 8, 9 and 10 Removal Sequence
C1240	J.C. Boyle Facility - Disposal Sites - Grading Plan
C1241	J.C. Boyle Facility - Disposal Sites - Grading Sections
C1300	J.C. Boyle Facility - 14' Low Pressure Pipeline Demolition - Plan, Profile, and Detail
C1310	J.C. Boyle Facility - Power Canal Headgate Removal - Plans, Sections and Details
C1311	J.C. Boyle Facility - Power Canal Headgate Removal - Grading Plan and Sections
C1320	J.C. Boyle Facility - Power Canal Removal - Plan
C1321	J.C. Boyle Facility - Power Canal Removal - Sections
C1323	J.C. Boyle Facility - Power Canal Removal - Typical Animal Crossing
C1330	J.C. Boyle Facility - Forebay Demolition - Plan
C1331	J.C. Boyle Facility - Forebay Demolition - Profile, Sections and Details
C1334	J.C. Boyle Facility - Forebay Demolition - Grading Plan
C1335	J.C. Boyle Facility - Forebay Demolition - Grading Sections
C1339	J.C. Boyle Facility - Scour Hole Interim Access - Plan, Profile, and Sections
C1340	J.C. Boyle Facility - Scour Hole Regrading - Grading Plan

Drawing Number	Drawing Title
C1341	J.C. Boyle Facility - Scour Hole Regrading - Grading Profile and Sections
C1350	J.C. Boyle Facility - Penstock Demolition - Plan and Profiles
C1351	J.C. Boyle Facility - Penstock Demolition - Sections and Detail
C1400	J.C. Boyle Facility - Powerhouse Demolition - Plan
C1402	J.C. Boyle Facility - Powerhouse Demolition - Plan and Sections
C1410	J.C. Boyle Facility - Powerhouse Demolition - Grading Plan
C1411	J.C. Boyle Facility - Powerhouse Demolition - Grading Sections
C1500	J.C. Boyle Facility - Construction Access - Key Map
C1501	J.C. Boyle Facility - Construction Access - Reservoir Area Roads
C1511	J.C. Boyle Facility - Construction Access - Powerhouse Road Realignment
C1512	J.C. Boyle Facility - Construction Access - Penstock Access Roads
C1600	J.C. Boyle Facility - Temporary Erosion and Sediment Control - Embankment, Spillway, and Intake
C1601	J.C. Boyle Facility - Temporary Erosion and Sediment Control - Power Canal
C1602	J.C. Boyle Facility - Temporary Erosion and Sediment Control - Forebay and Scour Hole
C1603	J.C. Boyle Facility - Temporary Erosion and Sediment Control - Penstock and Powerhouse
C1620	J.C. Boyle Facility - Final Erosion and Sediment Control - Disposal Sites
C1621	J.C. Boyle Facility - Final Erosion and Sediment Control - Power Canal
C1622	J.C. Boyle Facility - Final Erosion and Sediment Control - Drainage Details
C1623	J.C. Boyle Facility - Final Erosion and Sediment Control - Forebay and Scour Hole
C1624	J.C. Boyle Facility - Final Erosion and Sediment Control - Penstock and Powerhouse
E1015	J.C. Boyle Facility Overhead Electrical Conditions of Removal
E1032	J.C. Boyle Facility Electrical Demolition Plan & Elevation of Substation (Sheet 1 of 7)
E1033	J.C. Boyle Facility Electrical Demolition Plan & Elevation of Substation (Sheet 2 of 7)
E1034	J.C. Boyle Facility Electrical Demolition Plan & Elevation of Substation (Sheet 3 of 7)
E1035	J.C. Boyle Facility Electrical Demolition Plan & Elevation of Substation (Sheet 4 of 7)
E1036	J.C. Boyle Facility Electrical Demolition Plan & Elevation of Substation (Sheet 5 of 7)
E1037	J.C. Boyle Facility Electrical Demolition Plan & Elevation of Substation (Sheet 6 of 7)
E1038	J.C. Boyle Facility Electrical Demolition Plan & Elevation of Substation (Sheet 7 of 7)
E1051	J.C. Boyle Facility Electrical Demolition One Line Diagram (Sheet 1 of 3)
E1052	J.C. Boyle Facility Electrical Demolition One Line Diagram (Sheet 2 of 3)
E1053	J.C. Boyle Facility Electrical Demolition One Line Diagram (Sheet 3 of 3)
E1060	J.C. Boyle Facility Electrical Demolition Oil Containment Plan
E1072	J.C. Boyle Facility Electrical Demolition Distribution
S1000	J.C. Boyle Facility - Security - General Layout

2.1.3 DESIGN DETAILS

Design criteria are provided in Appendix A. Design analyses completed to support the 100% Design of the J.C. Boyle facility removal are presented in Appendix B. Drawdown modelling is presented in Appendix G.

2.2 PRE-DRAWDOWN WORKS

2.2.1 GENERAL

The J.C. Boyle facility pre-drawdown and drawdown works only use existing project features. The removal concept requires the use of the two diversion culverts to facilitate reservoir drawdown and flow passage during dam removal. The historic cofferdam and earthfill dam embankment will divert water into the diversion culverts.

The dam site is accessible without pre-drawdown road improvements. Site preparation, equipment mobilization, and construction access improvements at other areas of the facility may commence after drawdown is complete.

2.2.2 RESERVOIR OPERATIONS

The reservoir operation during the pre-drawdown period follows the PacifiCorp STID operating levels. The reservoir operational elevations are defined as follows:

- Normal Maximum Reservoir operation level: 3,796.7 ft (NAVD88)
- Normal Minimum Reservoir operation level: 3,791.7 ft (NAVD88)

The reservoir will be lowered and maintained at the normal minimum reservoir operation level by utilizing normal power operations and/or controlled spillway releases prior to the commencement of drawdown (January 1 of the drawdown year).

2.3 DRAWDOWN

2.3.1 GENERAL

The drawdown operation at J.C. Boyle will commence on or about January 1 of the drawdown year. No special provisions for pre-drawdown have been provided for J.C. Boyle; however, the reservoir will be drawn down to the normal minimum operating level prior to January 1 if inflows allow. Drawdown will occur in four stages, the first using the spillway gates and power facilities, the second using the power facilities only, and the third and fourth by a sequenced removal of the diversion culvert stoplogs. A summary of the drawdown staging is provided in Table 2.2.

Table 2.2 J.C. Boyle Drawdown Staging

Stage	Description	Water Level at Completion of each Stage (ft)[1]	Initiation Time Period
Pre-Drawdown	Normal Facility Operations	3,796.7 – 3,791.7	Prior to January 2024
1	Operation of Spillway and Power Intake	3,787.3	January 2024
2	Operation of Power Intake below Spillway Crest	3,785.2 (Min)	January 2024
3	Opening of first Diversion Culvert	3,771.9	January 2024
4	Opening of second Diversion Culvert	3,763.1	June 2024

NOTES:

1. WATER LEVELS ARE FOR STEADY-STATE AVERAGE MONTHLY INFLOWS EXCEPT FOR PRE-DRAWDOWN AND STAGE 2. PRE-DRAWDOWN WATER LEVELS ARE FROM OPERATIONAL STIDS AND THE STAGE 2 WATER LEVEL CORRESPONDS TO THE SPILLWAY INVERT ELEVATION.

Drawdown sequencing is shown on Drawing C1050, and steady state water surface elevations are provided on C1055. The reservoir area capacity curve, various rating curves, and drawdown modelling results from drawdown model runs of the 36 year period of record are summarized on Drawing C1056. Appendix G provides the detailed results of reservoir drawdown modelling.

The maximum rate of drawdown varies from stage to stage due to inflow, the geometry of the reservoir, and the nature of the outflow (free flowing) through the diversion culverts. A reservoir water surface level below the spillway invert is required to initiate both Stage 3 and Stage 4 to allow for worker safety and access to the downstream side of the diversion culverts. Sustained flows which result in higher reservoir water surface levels require delay of the initiation of these stages until water levels have receded. The hydraulic analysis compared steady-state inflows to culvert rating curves to determine the maximum flow allowable for crews to safely access the downstream side of the diversion culverts. During drawdown, hydrologic forecasting will be used to determine if coordination with the Upper Klamath River Basin is required to ensure water levels are kept below the spillway crest while crews are actively working on the downstream side of the diversion culverts. There are ongoing operational discussions being held with water management agencies to potentially store water in Klamath Lake to accomplish potential flow regulation. Although the storage of water in Klamath Lake cannot be guaranteed at this time, the agencies believe that this request can be accommodated, and may be included in the Upper Klamath River Basin planning for the proposed drawdown year.

2.3.2 STAGE 1 DRAWDOWN

Stage 1 drawdown will commence no earlier than January 1 of the drawdown year, with the reservoir at or above the minimum operating elevation of 3,791.7 ft. This stage of drawdown will be achieved using the gated spillway bays and power facilities to lower reservoir levels at a target rate of 5 ft per day. Control of the reservoir drawdown rate will be achieved by varying spillway openings and power flows according to actual reservoir inflow rates.

Stage 1 drawdown is anticipated to be completed within 48 hours of commencement, when the water level in the reservoir has stabilized above the spillway crest (spillway crest El. 3,785.2 ft). The stabilized elevation marking completion of Stage 1 will depend on the reservoir inflows at the time of drawdown.

2.3.3 STAGE 2 DRAWDOWN

Stage 2 drawdown will be initiated by continued power operations once Stage 1 is complete, with the use of the spillways if water levels rise as a result of wet year inflows. The diversion culverts will remain closed through this period.

Stage 2 drawdown will be complete when the water level in the reservoir has stabilized below the spillway crest (spillway crest El. 3,785.2 ft). The stabilized elevation marking completion of Stage 2 will depend on the reservoir inflows at the time of drawdown. A reservoir water level at the spillway crest elevation is associated with a reservoir inflow of approximately 1,600 cfs. Once the reservoir water level is below the spillway invert, the spillway gates can be closed to provide inflow attenuation capacity while works are carried out in the diversion culverts.

The explosives required to initiate Stage 3 can only be set when the spillways are closed and inactive. This work will be completed at the end of Stage 2 when reservoir outflows are occurring by power operations only. The spillway gates will be closed when work is being performed on the downstream side of the low-level diversion culverts. The first diversion culvert stoplog will be prepared and removed over a period of about 24 hours.

The diversion culvert and stoplogs are shown on Drawings C1220 and C1221.

2.3.4 STAGE 3 DRAWDOWN

Stage 3 drawdown will be initiated once Stage 2 is completed by removing one of the diversion culvert concrete stoplogs. The power intake wheel gate will be closed shortly after the removal of this stoplog, and once closed, it will remain closed for the remaining duration of drawdown. Once work is completed at the diversion culvert, the stoplog has been removed and the power intake is closed, the spillway gates can be reopened.

The diversion culvert stoplog will be removed by controlled blasting. The diversion culvert is located below the gated spillways and provides a 9.5 ft by 10 ft opening with an invert elevation of 3,755.2 ft. With the first diversion culvert opened, outflow rates will initially increase and then quickly subside as reservoir water levels recede.

The J.C. Boyle reservoir is narrow and does not have a large storage capacity below the spillway crest elevation. As a result, the culvert outflow rate will quickly equalize with the reservoir inflow rates over a 48-hour period, however initiation of Stage 4 may be delayed into May or June if wet year conditions occur, as modelled and described in Appendix B1. The maximum anticipated drawdown rate for Stage 3 is 10 ft per day. The stabilized elevation marking completion of Stage 3 will depend on the reservoir inflows at the time of drawdown.

Similar to Stage 3, a reservoir water level which is below the spillway crest is required for access to the downstream side of the second diversion culvert to prepare for Stage 4. This reservoir elevation is associated with a reservoir inflow of about 2,100 cfs.

2.3.5 STAGE 4 DRAWDOWN

Stage 4 drawdown can be initiated once Stage 3 is complete or can be extended as late as June 10 of the drawdown year by removing the second diversion culvert concrete stoplog. The exact timing of the removal of the stoplog for Stage 4 will take into consideration the drawdown efforts at the downstream projects and will be adjusted to best accommodate the inflow rates and water levels at the time.

The second diversion culvert stoplog will be removed by controlled blasting. Similarly to the first diversion culvert, the second diversion culvert is located below the gated spillways and provides a 9.5 ft by 10 ft opening with an invert elevation of 3,755.2 ft. The outflow rate will initially increase and then equalize with the reservoir inflow rates over approximately 12 to 24 hours as the reservoir water level drops. The maximum anticipated drawdown rate for Stage 4 is 10 ft per day. Completion of the Stage 4 drawdown will provide the lowest possible drawdown of the reservoir and the water surface level will vary with reservoir inflow thereafter.

Drawdown is considered completed when both diversion culverts are open, the J.C. Boyle reservoir has been substantially dewatered, and reservoir inflows and outflows equalize (water levels are relatively stable). The diversion culverts will remain open and will pass all river flows until the final embankment removal and historic cofferdam breach is conducted.

2.4 DEMOLITION AND REMOVAL WORKS

2.4.1 GENERAL

The demolition and dam removal works at J.C. Boyle will be undertaken following Stage 4 drawdown. The subsections below detail the post-drawdown decommissioning and removal activities. Water surface levels based on steady state flood flows and with both diversion culverts open are provided on Drawing C1055. The drawdown modelling presented in Appendix G provides simulated water surface levels through to October 1 of the drawdown year. Additional information can be obtained from the design drawings and the supporting details provided in Appendix B.

Removal of miscellaneous buildings, sheds, houses, asphalt, tanks, etc, are shown on the C1000 series.

2.4.2 CONSTRUCTION ACCESS

2.4.2.1 GENERAL

Construction access improvements of select roads and construction of new roads are required at the J.C. Boyle Facility as well as access from Highway 66 and Topsy Road. A facility road key map and construction access general arrangement are presented on Drawings C1500 and C1501, respectively.

The Project will require the construction of new temporary access roads to access some project locations. These new temporary access roads will start from existing J.C. Boyle facility access roads and are within permitted areas.

Two access roads are designed as part of the 100% DCD: the Powerhouse Road realignment at the scour hole, and the penstock access roads. The lower penstock access road rehabilitation is a temporary upgrade and is defined as road reconstruction. The Powerhouse Road realignment (permanent) is defined as new road construction. Road construction details are shown on Drawings C1500, C1501, C1511, and C1512.

2.4.2.2 POWERHOUSE ROAD

A 300 ft section of the road will be realigned upgradient of the scour hole maintaining a 20 ft offset from the edge of the final scour hole limit. The J.C. Boyle Powerhouse Road realignment is shown on Drawing

C1511. This construction access improvement will be maintained post-drawdown and following construction completion.

2.4.2.3 PENSTOCK ACCESS ROADS

The previously used, but currently abandoned, lower penstock access roads will be reused to access the center portions of the steel penstocks. The penstock access roads arrangement is shown on Drawing C1512. The penstock access roads will be decommissioned following penstock removal when construction is completed. This will involve minor grading and surface roughening.

2.4.3 DAM AND INTAKE CONCRETE REMOVAL

2.4.3.1 GENERAL

With the diversion culverts operating as described in Section 2.3, the concrete components at the dam and intake will be removed. Dam and intake structures removal is shown on the C1210 and C1220 Drawing series and is described in the subsections below.

2.4.3.2 CONCRETE REMOVAL

The spillway gates and hoisting equipment will be removed after drawdown is complete. Partial removal of the concrete spillway will occur in the low flow summer period coinciding with the decline in flood water surface levels. The fish ladder, concrete cutoff wall and power intake concrete will be removed in conjunction with dam embankment removal, to the phased removal elevations shown on Drawings C1234 to C1239. The final removal elevation at the intake is approximately 3,785.2 ft. The removal methods will include mechanical demolition, drilling and controlled blasting. The concrete will be placed in the scour hole as described in Section 2.5. Following use as an access road to the left bank, the concrete below this elevation will be buried in place as shown on Drawings C1240 and C1241.

The top-down concrete removal process will ensure structural stability criteria are met throughout the entire concrete structure removal process.

2.4.4 EARTHFILL EMBANKMENT REMOVAL

2.4.4.1 GENERAL

Removal and demolition work will commence following reservoir drawdown.

The removal plan allows for most of the dam removal to occur in the dry, by leaving the upstream portion of the dam embankment and historic cofferdam in place and progressively removing the dam embankment in phases. A portion of the left side of the embankment will be left in place, excavated to a 3H:1V slope and lined with riprap armouring. The embankment will be removed in Phases 1 to 7, the left bank final river channel will be lined with erosion protection materials in Phase 8, the historic cofferdam will be removed in Phase 9, and the diversion culvert channel and remaining concrete will be buried in Phase 10.

Embankment removal drawings are included as C1230 to C1233, and C1234 to C1239.

2.4.4.2 STABILITY, FREEBOARD, AND REMOVAL PHASES

Removal of the J.C. Boyle earthfill dam embankment and concrete structures has been planned in a manner that meets the current stability criteria. This is achieved by removing the embankment in a sequence that does not result in narrowing of the crest or steepening of the downstream embankment slopes. Appendix B provides a description of the geotechnical, civil and hydrotechnical details for the phased dam embankment removal. The embankment removal work is broken into multiple phases related to flood water surface levels. The phased embankment removal, downstream rockfill grading and historic cofferdam breach and removal are shown on the design drawings.

In addition to meeting the stability criteria discussed above, the dam will be removed in a manner that will provide freeboard for a 1% flood event, in accordance with the requirements of Appendix A7.

2.4.4.3 FINAL EMBANKMENT REMOVAL

The Phase 5 embankment crest will be at El. 3,770.7 ft. The majority of embankment dam fill removal will occur in the dry, as the historic cofferdam upstream will route flows to the diversion culverts. The final river channel footprint will be excavated to approximately 3,739 ft at the dam embankment centerline based on the anticipated bedrock depth. This river bottom elevation is lower than the diversion culvert invert elevation of 3,755.2 ft. Inspection of the historic cofferdam and remaining sediment is to be completed prior to removal of the Phase 6 embankment.

The riverbank slope erosion protection installation will occur after Phase 6 embankment removal, as shown on Drawing C1230.

2.4.5 HISTORIC COFFERDAM AND SEDIMENT REMOVAL

The J.C. Boyle facility removal plan includes the use of the historic cofferdam which is located about 450 ft upstream of the dam embankment centerline. Limited historic design or construction details are available. An engineering assessment of the historic cofferdam condition is required after the reservoir is lowered. This assessment will outline remedial repair measures which may include:

- Adding earthfill to the crest to restore original crest elevation and freeboard
- Lining the upstream portion of the cofferdam with impervious material
- Mechanically removing sediment from the diversion culvert approach channel

It is anticipated the historic cofferdam can be repaired to function as originally intended. Following use of the historic cofferdam to divert flows to the diversion culverts, and after the embankment and the accumulated sediment is removed, the cofferdam will be breached. This is required to restore the river channel and achieve volitional fish passage.

The cofferdam breach will be completed by cutting the cofferdam embankment from right to left. This will return flows to the historic channel and allow for in-water removal of the remaining cofferdam fill through a combination of mechanical removal with equipment and controlled erosion. At the time of breach in September of the drawdown year, the estimated water level will be 3,768 ft and the remaining reservoir volume will be 92 acre-ft. The cofferdam breach is shown on Drawing C1239.

2.4.6 FINAL RIVER CHANNEL

The embankment, historic cofferdam, and soft sediment will be removed to an elevation that provides channel width and grade suitable for volitional fish passage. The extent of material removal will be to the grading limits shown and will be constrained by bedrock at the channel bottom and sides. No bedrock will be excavated. Erosion protection rockfill armouring of the channel left bank, where embankment fills remain, will be installed prior to historic cofferdam breach. The final grading plan of the channel through the J.C. Boyle site is shown on Drawing C1230. Sections are shown on Drawing C1232.

2.4.7 POWER CANAL DEMOLITION

2.4.7.1 GENERAL

The intake wheel gate will be closed, and the power operation components will be permanently isolated from the reservoir, allowing for draining and decommissioning of the water conveyance system after Stage 3 of drawdown is initiated.

2.4.7.2 POWER CANAL CONCRETE REMOVAL

The canal concrete removal is shown on Drawings C1320 and C1321. The power canal is made up of three types of canal sections: single wall, double wall (backfilled), and double wall (free-standing). The front wall, regardless of power canal type, will be demolished, removed, and placed in the scour hole as shown on Drawings C1340 and C1341. The single wall shotcrete portion will be left-in place, while at both the two walled sections of the canal, the back concrete walls will be placed horizontally on the invert slab and buried in place. The cover material will be sourced locally or from the dam embankment fill and the area will undergo final stabilization consistent with Technical Specification 31 25 00. Stability and slope rock fall safety measures will be implemented during canal demolition to minimize worker safety risk.

2.4.7.3 ANIMAL CROSSINGS

Three animal crossing locations are designated along the power canal. The crossings consist of additional fill placement in select areas and are detailed with 30 ft widths and 3H:1V sides slopes as shown on C1320. Sections are shown on C1323.

2.4.7.4 POWER CANAL ACCESS ROAD

A portion of the power canal access road is designated for non-vehicle future use. A portion of the concrete cover material will extend from the power canal slab down to the access road at a 3H:1V slope as shown on Drawing C1321. This access road will be about 40 ft or more from the toe of the upstream slopes to minimize any user safety issue from rock falls. The power canal access road location is shown on Drawing C1501.

2.4.8 FOREBAY REMOVAL AND GRADING

All features associated with the forebay are to be removed, excluding concrete and a communications tower, as shown on Drawing C1330 and C1331. The forebay concrete will be removed to elevation 3778.0 ft and placed in the scour hole. Concrete below this elevation will remain in place and be covered by a minimum of 2 feet of cover material. The forebay grading is designed as a cut/fill balance and is shown on Drawings C1334 and C1335. The grading is designed to convey direct precipitation to the scour hole drainage swale.

2.4.9 TUNNEL PORTAL CLOSURES

The conveyance tunnel portal openings must be closed after removal of the water conveyance infrastructure. The tunnel portal inlet will be buried while the tunnel portal outlet will be barricaded using concrete rubble, locally sourced overburden soils and bedding material. The tunnel portal inlet and outlet barriers are shown on Drawings C1335 and C1351, respectively. Fill material will be placed as specified in Technical Specification 31 23 00.

2.4.10 SCOUR HOLE BACKFILL

Demolished concrete materials removed from the canal and other areas are to be placed in the scour hole below the canal forebay spillway. The scour hole grading is shown on Drawings C1340 and C1341. Realignment of the Powerhouse Access Road is required for the grading work.

The proposed method of backfill is to push the fill into the hole from the top and is detailed in the Technical Specification 31 23 00. An interim acess (shown on Drawing C1339)will be cut from the top of the scour hole to allow limited mechanical shaping and layering of the fills. Once the fill is at the maximum designated elevation of 3,728 ft, the slopes will be cut back to the final grade design to remove the oversteepened slopes produced by the forebay spillway erosion. The fill slope will be graded at 1.7H:1V and the cut slopes will be flattened to 1.5H:1V. The fill will be contoured to drain towards one side and will be lined with erosion protection material as shown on Drawing C1623. A collection ditch will be installed upstream of the scour hole to divert runoff around the scour hole fill and the area will undergo final stabilization consistent with Technical Specification 31 25 00.

2.4.11 STEEL PENSTOCK REMOVAL

The steel penstocks will be removed and transported off-site for disposal. The concrete anchors will be partially removed to the spring line of the penstocks, and then buried using locally available overburden soils side cast from the original construction. The final grade will be contoured to meet long-term drainage objectives and the area will undergo final stabilization consistent with Technical Specification 31 25 00. . Access to the penstock will utilize historic access roads from the original construction. Penstock removal is shown on Drawings C1350 and C1351.

2.4.12 POWERHOUSE DEMOLITION AND GRADING

Powerhouse mechanical and electrical equipment will be removed and disposed as set out in Section 2.5 and the Technical Specifications 02 41 00 and 02 41 99. The PacifiCorp equipment register is provided in Appendix M.

Embedded oil lines and septic systems will be flushed, and surface mounted and exposed lines will be removed. Fill material will be placed in the tailrace to isolate the powerhouse from the Klamath River. The asphalt road portion and two electrical distribution towers on the west side of the substation will remain and the lowest penstock anchor area, formerly the connection into the powerhouse, will be filled to El. 3,350 ft as shown on Drawing C1410. All powerhouse concrete below El. 3,340 ft will be left in place and covered with a minimum 2 ft of overburden soil. The final grade will slope towards the Klamath River to promote drainage and the area will undergo final stabilization consistent with Technical Specification 31 25 00. . Granular fills will be used on the outside of the tailrace slope to mitigate the scour potential of the Klamath River.

The powerhouse demolition and grading are shown on Drawings C1400, C1402, C1410, and C1411.

2.4.13 REMOVAL OF ELECTRICAL COMPONENTS

Following the de-energization of the transmission lines in accordance with Technical Specification 02 41 99 – Electrical Distribution System Removal, removal and rebuild starting northeast of J.C. Boyle Dam to

J.C. Boyle Substation, approximately 1.75 miles between sites; no work will be performed on the 500 kV circuit. 69 kV circuit *Copco 2-Westside Tap To Klamath Falls* shares joint use structures with 12 kV distribution circuit underbuild east of J.C. Boyle Reservoir. Distribution circuit 5L56 *Mountain* shifts to single pole structures along the south side of the reservoir until it meets shared easement corridor with 230 kV circuit *Klamath Falls-Lone Pine.* All above ground equipment within the substation fence will be demolished and removed. The PacifiCorp equipment register is provided in Appendix M.We

2.5 MATERIAL DISPOSAL

2.5.1 GENERAL

Details of the disposal requirements are included in the Project Technical Specification 02 41 00 and Table A7.6 of Appendix A7. A basic overview is provided below.

2.5.2 BULK EARTHFILL AND CONCRETE RUBBLE DISPOSAL

There are four primary disposal sites that will be used for earthfill and concrete rubble from the J.C. Boyle demolition. The embankment fill material and remaining sediment will be spoiled into a disposal site located on the left bank of the J.C. Boyle reservoir, with an alternate disposal site on the right bank as shown on Drawings C1240 and C1241. The alternate disposal site will be used as needed to spoil fill material from the historical cofferdam if the left bank disposal site reaches its maximum capacity. Demolished concrete primarily from the power canal and overburden soils from the embankment and forebay area will be used to infill the scour hole, as shown on Drawings C1340 and C1341. Powerhouse concrete rubble will be filled into the powerhouse cavity as shown on Drawings C1410 and C1411.

2.5.3 MISCELLANEOUS DISPOSAL

Other items that will require disposal off-site as part of the J.C. Boyle Facility removal activities include:

- Steel penstocks
- Turbine and generator equipment
- Gates and valves
- Exposed and surface mounted pipes
- Exposed and surface mounted electrical conduits and cable trays
- Wiring and cabling
- Lighting and HVAC
- Miscellaneous mechanical and electrical components
- Transformers
- Transmission lines
- Building superstructures
- Septic systems

3.0 COPCO NO. 1 HYDROPOWER FACILITY REMOVAL

3.1 GENERAL

3.1.1 EXISTING FACILITY COMPONENTS

The Copco No. 1 hydroelectric facility was constructed from 1911 to 1922 and is located at RM 198.6 in California. The site is approximately 25 miles east of the Interstate 5 Highway. The facility is accessed by the public Copco Road.

The major components of the Copco No. 1 facility include:

- A reservoir of 40,700 acre-ft capacity at a reservoir elevation of 2,611 ft (NAVD88)
- A 126 ft high (maximum height) 415 ft long concrete arch dam
- A 182 ft long ogee crest overflow spillway, controlled with thirteen spillway gates
- An abandoned and concrete-plugged diversion tunnel and concrete inlet control structure
- A power intake structure and surface mounted steel penstocks
- An at-surface two-unit 20 MW powerhouse
- A switchyard, substation, and transmission lines

The project design and construction are documented in the historic design drawings and construction photographs. Historic drawings are provided in Appendix K. STIDs are provided in Appendix J.

3.1.2 DESIGN DRAWINGS

Table 3.1 provides the Copco No. 1 facility drawing list.

Table 3.1 Copco No. 1 Facility Drawings List

Drawing Number	Drawing Title
G0033	Copco No. 1 and Copco No. 2 Facilities - General Arrangement Plan - (Sheet 1 of 2)
G0034	Copco No. 1 and Copco No. 2 Facilities - General Arrangement Plan - (Sheet 2 of 2)
C2000	Copco No. 1 Facility - Project Overview and Limits of Work - Key Plan
C2001	Copco No. 1 Facility - Project Overview and Limits of Work - Plan
C2010	Copco No. 1 Facility - Existing Condition - Klamath River Channel - Plan and Profile
C2055	Copco No. 1 Facility - Hydrologic and Hydraulic Information - Water Surface Elevations
C2056	Copco No. 1 Facility - Hydrologic and Hydraulic Information - Figures
C2057	Copco No. 1 Facility - Hydrologic and Hydraulic Information - Tables
C2100	Copco No. 1 Facility - Diversion Tunnel Modifications - Plan and Profile
C2101	Copco No. 1 Facility - Diversion Tunnel Intake Removal - Elevation and Profile
C2160	Copco No. 1 Facility - Diversion Tunnel Approach Channel Excavation - Plan, Profile and Section
C2175	Copco No. 1 Facility - Diversion Tunnel Portal - Plan and Sections
C2200	Copco No. 1 Facility - Dam Modifications - General Arrangement - Plan
C2201	Copco No. 1 Facility - Dam Modifications - General Arrangement - Profile and Section
C2205	Copco No. 1 Facility - Drawdown - General Arrangement - Plan and Section
C2210	Copco No. 1 Facility - Pre-Drawdown Works - Approach Channel Excavation - Plan and Sections
C2225	Copco No. 1 Facility - Pre-Drawdown Works - Low-Level Outlet - Tunnel Excavation - Plan and Sections
C2226	Copco No. 1 Facility - Pre-Drawdown Works - Low Level Outlet - Concrete Details - Elevation, Sections and Details
C2227	Copco No. 1 Facility - Pre-Drawdown Works - Low-Level Outlet - Outlet Pipe - Typical Section
C2228	Copco No. 1 Facility - Pre-Drawdown Works Low-Level Outlet - Pipe Fittings - Plan, Section and Details
C2230	Copco No. 1 Facility - Final River Channel Grading - Plan and Profile
C2231	Copco No. 1 Facility - Final River Channel Grading - Typical Sections
C2232	Copco No. 1 Facility - Final River Channel Grading - Cross Sections
C2250	Copco No. 1 Facility - Dam Removal - General Arrangement - Plan
C2255	Copco No. 1 Facility - Dam Removal - Spillway Crest - Plan, Detail and Section
C2256	Copco No. 1 Facility - Dam Removal - Profile and Section
C2257	Copco No. 1 Facility - Dam Removal - Intake - Plan and Sections
C2258	Copco No. 1 Facility - Dam Removal - Final Grade - Plan and Sections
C2259	Copco No. 1 Facility - Dam Removal - Final Grade - Sections
C2260	Copco No. 1 Facility - Dam Removal - Removal Lift Sequence - Overall Elevation and Section
C2261	Copco No. 1 Facility - Dam Removal - Removal Lift 1 - Elevation and Sections
C2262	Copco No. 1 Facility - Dam Removal - Removal Lift 2 - Elevation and Sections
C2263	Copco No. 1 Facility - Dam Removal - Removal Lift 3 - Elevation and Sections
C2264	Copco No. 1 Facility - Dam Removal - Removal Lift 4 and 7 - Elevation and Sections
C2265	Copco No. 1 Facility - Removal of Historical Cofferdam - Plan and Sections
C2270	Copco No. 1 Facility - Disposal Site - Plan and Profile

Drawing Number	Drawing Title
C2271	Copco No. 1 Facility - Disposal Site - Sections
C2272	Copco No. 1 Facility - Open-Water Disposal Site - Plan
C2275	Copco No. 1 Facility - Borrow Site - Plan and Section
C2300	Copco No. 1 Facility - Penstock Removal - General Arrangement - Plan
C2305	Copco No. 1 Facility - Penstock Removal - General Arrangement - Sections
C2310	Copco No. 1 Facility - Penstock Removal - Final Grade - Plan and Section
C2400	Copco No. 1 Facility - Powerhouse Removal - General Arrangement Plan
C2405	Copco No. 1 Facility - Powerhouse Removal - General Arrangement - Sections
C2410	Copco No. 1 Facility - Powerhouse Removal - Final Grade - Plan
C2411	Copco No. 1 Facility - Powerhouse Removal - Final Grade - Sections
C2500	Copco No. 1 Facility - Construction Access - Key Plan
C2501	Copco No. 1 Facility - Left Bank Access Track - Plan, Profile and Typical Section
C2502	Copco No. 1 Facility - Spillway Apron - Plan and Typical Sections
C2503	Copco No. 1 Facility - Right Bank Access Track to El. 2511 ft - Plan, Profile and Typical Section
C2510	Copco No. 1 Facility - Construction Access Roads - General Notes, Legend and Symbols, and Road Section Typicals
C2511	Copco No. 1 Facility - Construction Access Roads - Site Plan
C2512	Copco No. 1 Facility - Construction Access Roads - Road Profiles
C2513	Copco No. 1 Facility - Construction Access Roads - Road Sections
C2530	Copco No. 1 Facility - Copco Road Realignment - Plan, Profile and Typical Section
C2600	Copco No. 1 Facility - Temporary Erosion and Sediment Control - Pre-Drawdown Year - Plan
C2605	Copco No. 1 Facility - Temporary Erosion and Sediment Control - Drawdown Year - Plan
C2620	Copco No. 1 Facility - Final Erosion and Sediment Control - Access Roads and Disposal Site - Plan
C2621	Copco No. 1 Facility - Final Erosion and Sediment Control - Powerhouse Buttress - Plan and Typical Section
C2700	Copco No. 1 Facility - Miscellaneous Facility Removal - Plan
E2015	Copco No. 1 Facility Overhead Electrical Conditions of Removal
E2022	Copco No. 1 Facility Electrical Demolition Line 3 Fall Creek 69kv
E2023	Copco No. 1 Facility Electrical Demolition Line 15
E2033	Copco No. 1 Facility Electrical Demolition Plan & Elevation of Substation (Sheet 1 of 4)
E2034	Copco No. 1 Facility Electrical Demolition Plan & Elevation of Substation (Sheet 2 of 4)
E2035	Copco No. 1 Facility Electrical Demolition Plan & Elevation of Substation (Sheet 3 of 4)
E2036	Copco No. 1 Facility Electrical Demolition Plan & Elevation of Substation (Sheet 4 of 4)
E2051	Copco No. 1 Electrical Demolition One Line Diagram
S2000	Copco No. 1 Facility - Security - General Layout

3.1.3 DESIGN DETAILS

Design criteria are provided in Appendix A. Design analyses completed to support the 100% Design of the Copco No. 1 facility removal are presented in Appendix C. Drawdown modelling is presented in Appendix G.

3.2 PRE-DRAWDOWN WORKS

3.2.1 GENERAL

Pre-drawdown works at Copco No. 1 involve the construction of a new low-level outlet tunnel under spillway bay 3 which will be used to draw down the reservoir. The construction of the outlet will require temporary construction access from the left riverbank to develop a work platform beside the spillway plunge pool and access to the historic diversion tunnel outlet. The works will also include dredging of the low-level outlet tunnel approach channel and the historic diversion tunnel approach channel.

The sections below describe the pre-drawdown construction activities at Copco No. 1. Additional detail can be found on the design drawings and in Appendix C.

3.2.2 CONSTRUCTION ACCESS IMPROVEMENTS

3.2.2.1 GENERAL

Improvements to existing roads and development of new temporary access routes are required to support the construction activities at Copco No. 1, both to improve access safety and to facilitate movement of construction equipment and traffic. This includes the existing network of local roads with access to the Operator's residences, Copco No. 2 dam, and Copco No. 1 powerhouse. A facility road key plan and construction access general arrangement are presented on Drawing C2500.

3.2.2.2 SPILLWAY PLUNGE POOL WORK PLATFORM

The spillway plunge pool work platform will be required for the pre-drawdown construction of the low-level outlet tunnel. It will be accessed via the low-water left bank access route from Copco No. 2 and will be built by pushing coarse fill into a portion of the plunge pool to create a platform at El. 2,490 ft that can be used to accommodate construction equipment, vehicles, and spoil during outlet tunnel construction. To establish access, the reach will be fully dewatered during the low-flow season using the storage capacity of Copco No. 1 to allow construction of in-river works to be done in the dry. The Iron Gate reservoir will provide the required downstream environmental flows during this period, and flow from Copco No. 1 will be periodically released on a prescribed schedule to replenish the Iron Gate Reservoir.

Construction of the work platform at El. 2,511 ft will be completed after the steel pipe of the low-level outlet is installed and has been backfilled to provide cover and protection from construction vehicle and equipment loading and the impacts of concrete rubble that will be experienced during dam removal.

The spillway work platform is shown on Drawings C2501 and C2502.

3.2.3 LOW-LEVEL OUTLET TUNNEL

3.2.3.1 OVERVIEW

A low-level outlet tunnel will be excavated through the center of the concrete dam during the pre-drawdown construction works period to allow for reservoir drawdown.

The outlet will be excavated as a 10.5 ft wide D-shaped tunnel with a 10 ft concrete plug orifice to the reservoir and a 10.5 ft diameter steel outlet conduit. The tunnel will have an upstream invert elevation of approximately 2,492.5 ft and an outlet invert elevation of 2,477.3 ft. When opened, the outlet will connect the reservoir to the spillway plunge pool and drain the reservoir.

Tunnel dimensions have been designed to allow for an approximate targeted drawdown rate for average hydrologic conditions, but actual drawdown rates will depend on reservoir inflows during the drawdown period. The sizing of the low-level outlet, geometry, cross sections, and entrance orifice diameter are shown on Drawings C2205, C2210, C2225, C2226, and C2227.

Computational fluid dynamic (CFD) simulation of the discharge capacity and flood routing confirm the design to be valid for the required drawdown discharges. The drawdown modelling results are provided in Appendix G.

The dam structure modifications are designed to meet dam safety requirements. Structural and hydrotechnical analyses are used to assess the stability of the dam modification works and are presented in Appendix C.

3.2.3.2 TUNNEL PLUG

The outlet will be excavated leaving a concrete tunnel plug in place at the upstream cutoff wall. The tunnel plug allows normal power operations to continue until reservoir drawdown. To initiate reservoir drawdown, the concrete plug will be removed by blasting to connect the outlet to the reservoir. Drilling and blasting of the concrete plug will be conducted in accordance with the Project Company's Blasting Plan.

3.2.3.3 STEEL OUTLET CONDUIT

The low-level outlet terminates in a narrow canyon with an existing spillway plunge pool. A 10.5 ft diameter steel pipe will be embedded into the concrete tunnel section to extend the outlet into the spillway plunge pool. The purpose of the outlet pipe is to direct outflow into the spillway plunge pool and allow access to a spillway work platform while flow is discharging through the outlet and pipe. Reservoir drawdown under flow years exceeding the 75th percentile will limit the access to the plunge pool and downstream diversion tunnel portal.

The hydraulic modelling of the low-level outlet has determined non-pressurized flow conditions will occur in the steel outlet pipe. The steel conduit is designed for the hydrostatic head pressure associated with the maximum reservoir operating level.

A manhole also acts as a vent shaft and provides necessary air flow. The manhole will achieve the following objectives:

- Allow personnel access into the tunnel for plug removal
- Allow air to escape during initial filling of the outlet conduit

- Allow air venting to prevent sub-atmospheric pressure conditions in the outlet pipe during and after drawdown

The details of the outlet conduit are shown on Drawings C2205 and C2227.

The hydraulic model indicates that the reservoir drawdown is not affected by the inclusion of the steel outlet conduit in the low-level outlet works. The Project Company may opt to not install the steel outlet and develop modified construction access, as described in Section 3.2.3.5.

3.2.3.4 CONSTRUCTION METHODOLOGY

Development of the outlet tunnel will involve precision drill and blast excavation. A remaining plug section of dam concrete located within the upper cutoff wall will be left in place to temporarily isolate the tunnel from the reservoir until drawdown is initiated. During the drilling for the plug removal, a location probe survey of reinforcement steel will be conducted to develop the drill and blast design pattern to ensure that the reinforcement steel will be removed with the concrete plug.

The Project Company will develop the drill and blast tunneling procedures to construct the tunnel. Probe drilling is required before each drill and blast round to investigate the upstream conditions and ultimately confirm the distance to the upstream dam face at all locations of the tunnel. Probe drilling and coring is carried out for the following reasons:

- To identify the location of construction joints, embedded reinforcing steel and water-bearing fissures
- To ensure sufficient cover between the advancing tunnel heading and the Copco Reservoir
- To plan precautions based on an evaluation of such probing, e.g. grouting, reduced round length, etc.
- To accurately survey the upstream face of the dam within the plug area
- To ensure the plug is sited where a plug blast can be successful

Probe holes will be plugged with packers and sealed with cement grout.

Precision blasting techniques will be used in the tunnel excavation to prevent blast damage and overbreak.

Existing construction joints may require grouting to limit seepage through the joints. Evaluation of the concrete excavated faces during tunnel excavation is required. Scaling to remove loose concrete, thin concrete sections adjacent to existing construction joints, or installation of temporary concrete support will be evaluated by the Project Company once the concrete excavation debris is removed and the concrete faces are cleaned.

3.2.3.5 PROJECT COMPANY ALTERNATIVE – REMOVAL OF STEEL CONDUIT

The base case design shows a steel conduit as part of the low-level outlet design. The Engineer confirms that the hydraulics of the low-level outlet function acceptably with and without the steel conduit. The steel conduit affords the ability to access the downstream historic diversion tunnel portal during the pre-drawdown year and during reservoir drawdown. The Project Company at its option may implement an alternate which involves not installing the steel conduit and reducing the downstream work platform height provided construction access is maintained.

3.2.4 UPSTREAM DREDGING

Dredging of deposited sediment and debris in the reservoir at the low-level outlet tunnel approach channel is required to ensure that the outlet is unobstructed and to facilitate the safe passage of river flows and sediment during drawdown. Dredging of the historic diversion tunnel approach channel is also required to facilitate its usage during dam demolition and removal. Fine and coarse sediment will be cleared from these locations by dredging, and the spoils will be relocated to a disposal site within the Copco No. 1 reservoir. Drawings C2160, C2210 and C2272 show the extents of the dredging location and material disposal.

3.2.5 RESERVOIR OPERATIONS

3.2.5.1 GENERAL

During the pre-drawdown construction period, the Copco No. 1 facility will be operated to comply with the procedures set out below.

3.2.5.2 NORMAL CONDITION

The Copco No. 1 reservoir level will be kept at or below the spillway ogee crest level (El. 2,597.1 ft), to as low as the minimum operating level (El. 2,596 ft) during and after pre-drawdown construction. This will be achieved by bypassing reservoir inflows through the powerhouse turbine generator units #01 and #02 which provide a combined discharge capacity of 3,000 cfs.

The spillway gates will be locked out in the closed position to satisfy dam safety requirements during construction. Reservoir operation under this procedure will provide a freeboard height of 14 ft or greater to the normal maximum reservoir operating level (2,611 ft), equal to at least 6,900 acre-ft of storage capacity. This will provide attenuation capacity and time to monitor inflows and vacate the downstream area in the event of large reservoir inflows that exceed the powerhouse capacity and cause reservoir levels to rise.

Maintenance of the operating water level describedabove will be possible for reservoir inflow rates up to 3,000 cfs, which greatly exceeds the average flow conditions during the pre-drawdown dam modification construction works period.

3.2.5.3 FLOOD CONDITION

Average flow rates and flood risks increase through the fall, and by November and December average flows are 1,230 cfs and 1,490 cfs, respectively. To mitigate against the increasing flood risks, tunnel adit construction works are planned to be completed before the end of September of the pre-drawdown year. Hydrology design criteria are provided in Appendix A6.

Reservoir inflow rates greater than 3,000 cfs exceed the powerhouse flow capacity and will cause reservoir water levels to rise. A work stoppage at the downstream construction area will be triggered when reservoir water levels exceed the minimum freeboard criteria of 3 ft.

The work stoppage may require the removal of all personnel from the downstream construction area and the unlocking of the spillway gates. Operation of the facility will continue with discharge through powerhouse units #1 and #2. Work will be resumed when water levels recede below the trigger level. In the event that water levels rise to above the spillway ogee level (2,597.1 ft), lowering of the reservoir level by release of water through the spillway gates may be implemented. Damage to the temporary spillway downstream work platform is expected if spillway operation occurs. In this event, the work area will need to be re-established to facilitate ongoing construction of the outlet works after flood water levels have receded.

3.3 DRAWDOWN

3.3.1 GENERAL

The lowered Copco No. 1 reservoir level implemented for pre-drawdown construction will be maintained until drawdown begins on or around January 1 of the drawdown year.

The drawdown operation will be governed by two main events: opening of the low-level outlet for primary reservoir lowering, and subsequent opening of the historic diversion tunnel to divert flows around the dam and facilitate dam removal works.

Drawdown drawings are included as C2055, C2056, and C2057. The drawdown process is discussed below and detailed results of drawdown modelling, including a range of hydrologic conditions, are presented in Appendix G.

3.3.2 OPENING OF THE LOW-LEVEL OUTLET TUNNEL

Drawdown will commence on or about January 1 of the drawdown year when the low-level outlet is opened to the reservoir. This will be achieved by precision blasting of the remaining concrete plug.. The low-level outlet is designed to lower the reservoir without the additional capacity of power operations.

The outlet tunnel has an orifice inlet diameter of 10 ft to provide an initial discharge capacity of approximately 3,940 cfs at a reservoir elevation of 2,596 ft. The outflow capacity will decrease to approximately 2,215 cfs at a reservoir elevation of 2,530 ft., which is the water level at or below which the historic diversion tunnel will be opened. The rating curve for the low-level outlet tunnel is provided on Drawing C2056.

The large diameter tunnel orifice and high discharge velocity (maximum 80 ft per second) of the outlet is designed to facilitate the passage of sediment and, in conjunction with the upstream dredging, reduce the risk of blockages. Concentrated flow velocities upstream of the dam will promote sediment mobilization in the original river channel and sediment transport downstream. The energy of the outflowing water will be largely dissipated within the spillway plunge pool.

The low-level outlet tunnel is an uncontrolled hydraulic structure and drawdown rates and the overall drawdown period will depend on the reservoir inflow rates during the drawdown period. Partial reservoir refilling may occur due to large inflow events exceeding outlet capacity.

3.3.3 LEFT BANK ACCESS TRACK

Access to the historic diversion tunnel inlet structure and the downstream diversion tunnel will be required to open the historic tunnel during the late stages of drawdown when water levels have receded to 2,530 ft or lower. This will require equipment to be lowered down the left bank to the concrete inlet structure on the upstream side of Copco No. 1 dam.

3.3.4 OPENING OF THE HISTORIC DIVERSION TUNNEL

Opening of the historic diversion tunnel will be completed when reservoir water surface elevations have subsided to 2,530 ft or lower. The initial step for the opening of the diversion tunnel is to remove the concrete inlet structure to elevation 2,505.8 ft or lower, under balanced hydrostatic head conditions. This includes removing the three existing 72-inch valves, steel pipe sleeves and upstream trashrack piers. Once removal is complete to elevation 2,505.8 ft and the approach channel is unobstructed the concrete plug will be removed from the dry downstream end of the tunnel. Re-establishing flow in the historic diversion tunnel results in the lowering of water levels to at or below the historic cofferdam crest elevation (2,515 ft), thereby routing most river flows around the dam site and facilitating dam demolition and removal. Removal of the remaining intake structure and embedded items to elevation 2,494.8 ft will be completed once the reservoir level is lowered to approximately elevation 2,515 ft to fully open the diversion tunnel. The additional diversion capacity will also reduce the risk of reservoir refilling during the dam removal period.

The historic diversion tunnel will provide a flow capacity of 4,200 cfs when water levels are at approximately 2,515 ft, which exceeds normal flows during the summer period when dam removal will occur.

The reopening of the diversion tunnel is shown on Drawing C2100. The rating curve for the diversion tunnel is provided on Drawing C2056. Geotechnical and hydrotechnical design analyses are provided in Appendix C.

3.4 DEMOLITION AND REMOVAL WORKS

3.4.1 GENERAL

The demolition and removal works will include removal of the dam, water conveyance, powerhouse, and electrical infrastructure. It will also involve establishment of the final river channel for volitional fish passage through the former dam and reservoir inundation area.

Water surface levels based on steady state flows and with the low-level outlet tunnel and historic diversion tunnel open are provided on Drawings C2056 and C2057 and are discussed in Appendix C. The drawdown modelling provides simulated water surface elevations for variable flow conditions and water years.

3.4.2 CONSTRUCTION ACCESS

Construction access for dam removal will use the spillway plunge pool work platform as well as upgraded access through the powerhouse. Temporary access routes and tracks to the dam deconstruction areas and the left bank will be constructed as required to meet the construction methodologies and schedule of the Project Company.

3.4.3 WATER CONVEYANCE SYSTEM

The penstocks will be isolated and dewatered during drawdown. Following dewatering, the penstocks will be removed, and the Penstock #3 tunnel portal will be blocked with earthfill as shown on Drawing C2310.

3.4.4 POWERHOUSE AND ANCILLARY COMPONENTS

Demolition and removal of the powerhouse will be staged to accommodate its use for access to the dam for loading and disposal of the concrete rubble. Following the initiation of drawdown and the water conveyance system being isolated and drained, all mechanical and electrical equipment of the powerhouse will be removed and disposed of, and walls will be demolished to allow vehicle and equipment access. These activities will be carried out in accordance with the Project technical specifications 02 41 00 and 02 41 99. The PacifiCorp equipment register is provided in Appendix M.

Embedded oil lines and septic systems will be flushed, and surface mounted and exposed lines will be removed. The powerhouse superstructure will be demolished except for the north wall. Powerhouse concrete will be removed to El. 2,488.0 ft, the basement level that is flush with the penstock spiral case, as shown on Drawing C2405. The void spaces within the powerhouse structure will be backfilled with general fill and the area will undergo final stabilization consistent with Technical Specification 31 25 00.. The tailrace channel will also be infilled and will form part of the finished river channel grading.

Once the plunge pool access is no longer required for dam removal the remaining powerhouse north wall and foundation will be covered with earthfill and graded to blend into the natural slopes.

The general arrangement of the powerhouse removal is shown on Drawings C2410 and C2411.

3.4.5 CONCRETE DAM REMOVAL

3.4.5.1 GENERAL

When the Klamath River flows are routed through the historic diversion tunnel, the concrete dam will be demolished and removed. Dam removal is shown on Drawings C2250, C2255, C2256, and C2258, and is described in the subsections below.

3.4.5.2 CONCRETE REMOVAL (CREST TO EL. 2,515 FT)

Removal of the concrete dam will occur after the reservoir is substantially lowered during reservoir drawdown. The Project Company will take precautions to not block the intake of the low-level outlet during concrete demolition and removal operations. The concrete removal methods will include mechanical demolition, drilling and controlled blasting to break up and remove the concrete in lifts from the top down. The blasted concrete rubble will be moved to the downstream face of the spillway and on to the spillway work platform. The concrete will be loaded at the base of the spillway and hauled to the right bank disposal area described in Section 3.5.

The top-down concrete removal will ensure that the dam can be removed in a stable manner. The work platform level is always above the 5% probable flood level during the dam removal period.

3.4.5.3 CONCRETE FOUNDATION REMOVAL (EL. 2,515 FT TO 2,472 FT)

Dam concrete will be removed to establish the final river channel configuration through the former dam footprint, as shown on Drawing C2256 and C2258. The removal sequence is shown on Drawings C2260 to C2265.

Removal of the concrete foundation should occur (depending on the water year) in August or September when river flows will be at seasonal lows. Bypass of inflows through the diversion tunnel and seepage reduction at the existing cofferdam will limit the need to dewater the work site once the dam removal line progresses lower than El. 2,515 ft.

The condition of the existing cofferdam is unknown, and the Project Company will evaluate the cofferdam's ability to act as a water retaining structure and evaluate potential need for dewatering of the upstream area of the dam.

This work will be completed by constructing work platforms into the former dam footprint area (above the dam foundation) and drilling, blasting, and excavating riverbed concrete. The work platforms will elevate the construction equipment to above water level and allow for much of this work to be conducted in the dry.

3.4.6 FINAL RIVER CHANNEL

Establishment of the final river channel will involve final riverbed and foundation concrete excavation and shaping to ensure future scour and migration of the riverbed does not create a fish barrier at the former Copco No. 1 dam site..

Staged excavation will be required to remove the historic spoil material on the right bank upstream of the Copco No. 1 dam. Excavation and removal of material will be completed by developing temporary tracks to permit transportation of the historic spoil to the Disposal Site. Water levels within the Klamath River will be lower once flows are diverted through the Diversion Tunnel. Temporary construction of thalwegs may be required to complete the final river channel shape and placement of riverbed material, The final grading plan of the channel through the Copco No. 1 site and the erosion protection lining is shown on Drawing C2230. Additional information on river channel grades is provided in Appendix A7.

3.4.7 HISTORIC COFFERDAM REMOVAL

After the dam foundation has been removed at the dam site and the final channel has been established downstream, the historic rock filled wood crib cofferdam will be removed to restore flow through the former dam site. The cofferdam will only be accessible in periods of low flow and will be removed during the excavation and grading of the upstream portion of the river channel. Concrete and spoil from the cofferdam will be disposed at the disposal area described in Section 3.5. The final grade of the river channel after removal of all dam waste material is shown on Drawing C2230.

3.4.8 DIVERSION TUNNEL CLOSURE

Following the removal of the concrete dam and foundation concrete, including the historic cofferdam and diversion tunnel inlet structure, the diversion tunnel will be permanently blocked by backfilling and burying the inlet and outlet portals with rockfill barriers. This will prevent public access and the possibility of Klamath River flows passing through the historic tunnel. The portal barriers will be comprised of rockfill with sufficient length to satisfy the allowable hydraulic gradient to prevent piping and downstream erosion of the tunnel plug and erosion protection on the exposed face of the earth fill plug. The inlet portal plug is designed with an impermeable elementto prevent seepage and erosion of the tunnel plugs. The outlet portal plug is designed with a filter layer at the base to allow drainage and prevent hydrostatic pressure build-up.

Access to the two portals will be by temporary fords to allow equipment crossing during the low-flow period (currently planned in September) when the river flows can be managed to approximately 500 cfs and 2 ft flow depth. Tracked equipment and construction materials will be transferred from the right bank to the left bank at the tunnel inlet and outlet portal locations. Closure of the diversion tunnel will require the construction of the rockfill inlet portal plug to above the monthly river water level, then the impermeable barrier will be constructed before the rockfill portal plug can be completed. Once all flows are diverted by the main channel, the downstream tunnel inlet portal rockfill plug will be constructed with a similar sequence. Once the work is complete at the inlets the crossing location will be shaped to the final grade of the channel.

The portal barriers are shown on Drawing C2175.

3.4.9 REMOVAL OF ELECTRICAL COMPONENTS

Following de-energization of transmission lines in accordance with Technical Specification 02 41 99 – Electrical Distribution System Removal, removal and rebuild of distribution/service drop circuits between Copco No. 1 Hydroelectric Plant and Copco No. 1 Dam (*Copco 1-Copco 1 SW LN #26-1* and *Copco 1-Copco 1 SW LN #26-2)*, distribution poles to village houses (*5G6 Daggett)*, production poles in the area, 1.7 miles of 69 kV to Fall Creek Hydroelectric Plant (*Fall Creek-Copco 1)*, and 1.3 miles of 69 kV between Copco No. 1 and Copco No. 2 (*Copco 1-Copco 2)*. Some poles around Copco No. 1 Substation, as well as between Copco No. 1 and Copco No. 2 are shared structures with 69 kV transmission lines above and distribution lines underbuilt. When the distribution underbuild span cannot be supported at the same length as the 69 kV, single wood pole structures are in-set in the right-of-way. Prior to Copco No. 2 the distribution leaves the 69 kV right-of-way to enter and bypass Copco No. 2 The PacifiCorp equipment register is provided in Appendix M.

3.5 MATERIAL DISPOSAL

Details of the disposal requirements are included in the Project Technical Specification 02 41 00 and Table A7.6 of Appendix A7. A basic overview is provided below.

3.5.1 CONCRETE RUBBLE AND EARTHFILL DISPOSAL

The concrete rubble from both the Copco No. 1 facility and the Copco No. 2 gravity diversion dam, as well as any earthfill spoil generated during removal, will be placed in the Copco No. 1 disposal site located on the right bank at the site of the operators' residences. The residences will be demolished to develop a suitable disposal area. The disposal site is shown on Drawings C2270 and C2271.

Various areas on the project site will be used for localized concrete and earthfill spoil. These sites have limited material disposal capacities. The local sites include:

- Powerhouse and tailrace;, infilling is required and is shown on Drawings C2410 and C2411
- Penstock No. 3 portal
- Diversion tunnel portals (inlet and outlet)

An open water disposal site located on the right bank of the reservoir will be established to place materials removed by dredging. The open water disposal site is shown on Drawing C2272.

All final grade surfaces of the disposal sites will undergo final stabilization consistent with Technical Specification 31 25 00.

3.5.2 MISCELLANEOUS DISPOSAL

Other items that will require disposal off-site as part of the Copco No. 1 facility removal activities include:

- Steel penstocks
- Turbine and generator equipment
- Gates and valves
- Exposed and surface mounted pipes
- Exposed and surface mounted electrical conduits and cable trays
- Wiring and cabling
- Lighting and HVAC
- Miscellaneous mechanical and electrical equipment
- Transformers
- Transmission lines
- Building superstructures
- Septic systems

4.0 COPCO NO. 2 HYDROPOWER FACILITY REMOVAL

4.1 GENERAL

4.1.1 EXISTING FACILITY COMPONENTS

The Copco No. 2 hydroelectric facility was constructed from 1924 to 1925 and is located between RM 196.8 and RM 198.3 in California. The site is approximately 25 miles east of the Interstate 5 Highway. The facility is accessed by the public Copco Road.

The major components of the Copco No. 2 facility include:

- A reservoir of 57 acre-ft capacity at a reservoir elevation of 2,486.5 ft (NAVD88).
- A 33 ft high concrete gravity diversion dam, and a 148 ft long earth fill embankment section. This structure is classified as a low hazard dam.
- A 130 ft long overflow spillway with five 26- by 11-ft radial (Tainter) gates.
- An intake and 5,215 ft long water conveyance system with a 2,440 ft concrete lined tunnel, 1,313 ft wood-stave penstock, a second 1,110 ft concrete lined tunnel, and two surface mounted high-pressure steel penstocks approximately 408 ft long.
- An at-surface two-unit 27 MW powerhouse with a capacity of 3,250 cfs.
- A switchyard, substation, and transmission lines.
- Daggett Road bridge.
- Houses, maintenance buildings, and a schoolhouse.

The project design and construction are documented in the historic design drawings and construction photographs. Historic drawings are provided in Appendix K. STIDs are provided in Appendix J.

4.1.2 DESIGN DRAWINGS

Table 4.1 provides the Copco No. 2 drawing list.

Table 4.1 Copco No. 2 Facility Drawings List

Drawing Number	Drawing Title
G0033	Copco No. 1 and Copco No. 2 Facilities - General Arrangement Plan - (Sheet 1 of 2)
G0034	Copco No. 1 and Copco No. 2 Facilities - General Arrangement Plan - (Sheet 2 of 2)
C3000	Copco No. 2 Facility - Project Overview and Limits of Work - Key Map
C3001	Copco No. 2 Facility - Project Overview and Limits of Work - (Sheet 1 of 4)
C3002	Copco No. 2 Facility - Project Overview and Limits of Work - (Sheet 2 of 4)
C3003	Copco No. 2 Facility - Project Overview and Limits of Work - (Sheet 3 of 4)
C3004	Copco No. 2 Facility - Project Overview and Limits of Work - (Sheet 4 of 4)
C3056	Copco No. 2 Facility - Hydrologic and Hydraulic Information - Contingency Removal Method - Spillway Bay No. 1 Removal - Water Surface Levels
C3057	Copco No. 2 Facility - Hydrologic and Hydraulic Information - Reservoir and Tailwater Surface Elevations - Figures and Table
C3200	Copco No. 2 Facility - Diversion Dam and Intake Removal - General Arrangement - Plan and Profile
C3201	Copco No. 2 Facility - Diversion Dam and Intake Removal - General Arrangement - Sections
C3210	Copco No. 2 Facility - Diversion Dam Contingency Removal Method - Pre-Drawdown Works - Plan
C3211	Copco No. 2 Facility - Diversion Dam Contingency Removal Method - Pre-Drawdown Works - Sections
C3216	Copco No. 2 Facility - Diversion Dam Contingency Removal Method - Spillway Bay No. 1 Removal - Plan
C3217	Copco No. 2 Facility - Diversion Dam Contingency Removal Method - Spillway Bay No. 1 Removal - Sections
C3220	Copco No. 2 Facility - Diversion Dam Removal - Plan
C3221	Copco No. 2 Facility - Diversion Dam Removal - Excavation Plan
C3232	Copco No. 2 Facility - Intake Concrete Removal and Backfill Limits - Plans and Sections
C3233	Copco No. 2 Facility - Intake Concrete Plug - Sections
C3234	Copco No. 2 Facility - Diversion Dam Removal - Channel Grading Plan and Profile
C3235	Copco No. 2 Facility - Diversion Dam Removal - Channel Grading Sections
C3240	Copco No. 2 Facility - Historic Diversion Dam Removal - Plan and Removal Notes
C3300	Copco No. 2 Facility - Wood-Stave Penstock Demolition - Plan and Section
C3303	Copco No. 2 Facility - Wood-Stave Penstock Demolition - Grading Plan
C3310	Copco No. 2 Facility - Tunnel #1 Outlet and Tunnel #2 Inlet Portals - Closure Barrier - Section and Details
C3330	Copco No. 2 Facility - Penstock Demolition - Plan
C3331	Copco No. 2 Facility - Penstock Demolition - Profile and Section
C3332	Copco No. 2 Facility - Penstock and Powerhouse Demolition - Excavation Plan and Section
C3334	Copco No. 2 Facility - Penstock Demolition - Grading Plan and Section
C3340	Copco No. 2 Facility - Surge Vent Closure Barrier - Plan and Sections
C3350	Copco No. 2 Facility - Tunnel #2 Outlet Portal - Closure Barrier - Section and Details
C3360	Copco No. 2 Facility - Overflow Spillway Outlet Portal - Closure Barrier - Section and Details
C3400	Copco No. 2 Facility - Powerhouse Demolition - General Arrangement - Plan
C3401	Copco No. 2 Facility - Powerhouse Demolition - Sections
C3420	Copco No. 2 Facility - Tailrace Disposal Site - Grading Plan

Drawing Number	Drawing Title
C3510	Copco No. 2 Facility - Construction Access - Right Bank Access Roads - Plan
C3511	Copco No. 2 Facility - Construction Access - Right Bank Access Roads - Profiles
C3520	Copco No. 2 Facility - Diversion Dam Contingency Removal Method - Construction Access - Temporary Spillway Apron - Access Track and Work Platform
C3530	Copco No. 2 Facility - Optional Construction Access - Left Bank Access Road - Plan
C3531	Copco No. 2 Facility - Optional Construction Access - Left Bank Access Road - Profile and Sections
C3532	Copco No. 2 Facility - Optional Construction Access - Left Bank Access Road - Sections - (Sheet 1 of 3)
C3533	Copco No. 2 Facility - Optional Construction Access - Left Bank Access Road - Sections - (Sheet 2 of 3)
C3534	Copco No. 2 Facility - Optional Construction Access - Left Bank Access Road - Sections - (Sheet 3 of 3)
C3600	Copco No. 2 Facility - Temporary Erosion and Sediment Control - Pre-Drawdown Year - Dam Removal
C3601	Copco No. 2 Facility - Temporary Erosion and Sediment Control - Pre-Drawdown Year - Copco Village
C3605	Copco No. 2 Facility - Temporary Erosion and Sediment Control - Drawdown Year - Wood-Stave Penstock Removal
C3606	Copco No. 2 Facility - Temporary Erosion and Sediment Control - Drawdown Year - Powerhouse and Penstock Removal
C3620	Copco No. 2 Facility - Final Erosion and Sediment Control - Final River Channel
C3622	Copco No. 2 Facility - Final Erosion and Sediment Control - Wood-Stave Penstock
C3623	Copco No. 2 Facility - Final Erosion and Sediment Control - Powerhouse and Penstock
C3624	Copco No. 2 Facility - Final Erosion and Sediment Control - Copco Village
C3700	Copco No. 2 Facility - Copco No. 2 Village Removal - Plan
E3015	Copco No. 2 Facility Overhead Electrical Conditions of Removal
E3022	Copco No. 2 Facility Electrical Demolition Iron Gate-Copco 2 69kv (Sheet 1 of 2)
E3023	Copco No. 2 Facility Electrical Demolition Iron Gate-Copco 2 69kv (Sheet 2 of 2)
E3032	Copco No. 2 Facility Electrical Demolition Plan & Elevation of Substation (Sheet 1 of 4)
E3033	Copco No. 2 Facility Electrical Demolition Plan & Elevation of Substation (Sheet 2 of 4)
E3034	Copco No. 2 Facility Electrical Demolition Plan & Elevation of Substation (Sheet 3 of 4)
E3035	Copco No. 2 Facility Electrical Demolition Plan & Elevation of Substation (Sheet 4 of 4)
E3051	Copco No. 2 Electrical Demolition One Line Diagram
S3000	Copco No. 2 Facility - Security - General Layout

4.1.3 DESIGN DETAILS

Design criteria are provided in Appendix A. Design analyses completed to support the 100% Design of the Copco No. 2 facility removal are presented in Appendix D. Drawdown modelling is presented in Appendix G.

4.2 PRE-DRAWDOWN WORKS

4.2.1 GENERAL

The removal of the Copco No. 2 concrete diversion dam and historic diversion dam, the installation of the intake concrete plug, and the final channel grading will occur during the pre-drawdown year. The Copco No. 2 reach will be fully dewatered during the low-flow season using the storage capacity of Copco No. 1 to allow construction of in-river works to be done in the dry. The Iron Gate reservoir will provide the required downstream environmental flows during this period, and flow from Copco No. 1 will be periodically released on a prescribed schedule to replenish the Iron Gate Reservoir. The elements of the diversion dam and intake structure that will be removed are shown on Drawings C3200, C3201, and C3220 to C3232. The concrete plug design is shown on Drawing C3232 and C3233. The final channel grading is shown on C3234 and 3235, which includes the excavation of material directly upstream of the Copco No. 2 dam to widen the final channel for volitional fish passage. The historic diversion dam removal is shown on Drawing C3240.

A contingency removal method for the concrete diversion dam is presented in the drawing package on Drawings C3210 to C3217, and C3520, in the event Copco No. 1 cannot be used to dewater the reach during the pre-drawdown year. The contingency removal method utilizes the existing diversion dam structure to pass the river flows through a single removed spillway bay. The method involves removal of a portion of a spillway bay and preparation of the remaining spillway ogee section during drawdown. After drawdown, the dam will be progressively removed laterally to the limits shown on Drawing C3220.

4.2.2 CONSTRUCTION ACCESS

Construction access improvements of select roads are necessary at the Copco No. 2 facility. Primary access to the Copco No. 2 Diversion Dam will be from the existing Right Bank access road, shown on Drawing C3510. An access road to the Left Bank of the diversion dam is an option for the mobilization of some equipment to facilitate work on the left abutment. If used, this small existing access road will facilitate mobilization and demobilization of construction equipment, and will not be used as a haul road or be heavily trafficked. The Left Bank access road is shown on Drawings C3530 to C3534. A temporary access track down to the spillway apron will be constructed to facilitate the removal of the concrete dam, as shown on Drawing C3510. Another minor temporary access track will be constructed to assist in the removal of the historic diversion dam and is shown on Drawing C3510.

The wood-stave penstock and Powerhouse areas will be accessed using the existing road networks. Minor improvements to the roads may be required.

4.2.3 DAM MODIFICATION FOR CONTINGENCY REMOVAL METHOD

The primary removal method does not involve any dam modifications and will instead rely on the use of the Copco No. 1 reservoir for flow regulation and dewatering during the in-river works. An alternate dam removal concept is presented herein to provide for a contingency removal method that can be implemented without flow control at Copco No. 1.

The contingency removal method for the diversion dam involves three main activities:

- Pre-drawdown modifications as shown on Drawing C3210
- Concrete spillway ogee sections removal to initiate drawdown, as shown on Drawing C3216

- Demolition and dam removal as shown on Drawing C3220

Pre-drawdown works comprises removing the downstream portion of the left-most spillway bay (Spillway Bay No. 1). Concrete removal for Pre-Drawdown will extend down to the concrete apron and will remove all concrete except for the upstream 17 ft of the ogee spillway which will be left in place as a concrete section, as shown on Drawing C3211. A structural analysis is used to ensure the final concrete section is adequate to keep the facility in compliance with all applicable stability requirements and is discussed in Appendix D. The Project Company may construct the Temporary Downstream Excavation during this period, as shown on Drawing C3520.

A temporary construction work platform will be built from the right bank onto the spillway apron, which will function as a work platform for the pre-drawdown works, as shown on Drawing C3210. The spillway apron work platform will be built using General Fill (E9b) Material to El. 2,462.5 ft above expected tailwater elevations, as shown on Drawing C3211, to provide a competent dry working surface.

Concrete between the two piers of the Spillway Bay No. 1 will be removed using blasting techniques or mechanical demolition. The concrete will only be removed to El. 2,459.5 ft during the pre-drawdown works to match the top of the spillway apron. The spillway apron, sill, and left bank retaining wall will be left in place to provide erosion protection for the riverbed, since high flows may pass through the confined opening during the drawdown year. After the concrete has been removed to the target elevation, the work platform material will be removed.

4.2.4 RESERVOIR OPERATIONS FOR CONTINGENCY REMOVAL METHOD

The diversion dam contingency removal method requires work to occur in-river during the Pre-drawdown year. To complete the construction works, the spillway gates will be closed, and all water will be diverted through the intake to the powerhouse. The reservoir will be operated at the minimum operating level while work is completed on the downstream face. The power facilities conveyance system has a maximum capacity of 3,250 cfs. This exceeds the 5% probable flood for the June 16 to June 30 period, and the 1% probable flood for the July to September period, which coincides with the expected dam modification works at Copco No. 2.

For the contingency removal method, after dam modifications are complete, the Copco No. 2 facility will continue to operate as a power generating station under normal operating conditions until the drawdown begins the following year. The hydraulic and hydrologic conditions throughout the pre-drawdown, drawdown, and post-drawdown period until diversion dam removal for Copco No. 2 are shown on Drawing C3057.

4.3 DRAWDOWN

Drawdown of the Copco No. 2 reservoir will either occur during the Pre-Drawdown or the Drawdown year, depending on whether the primary or the contingency diversion dam removal method is employed, respectively. The drawdown plan for both removal methods is described below.

4.3.1 DRAWDOWN FOR PRIMARY REMOVAL METHOD

The Copco No. 1 reservoir will be lowered during the Pre-Drawdown year, prior to commencing the removal of the Copco No. 2 concrete diversion dam, to provide inflow attenuation capacity and the ability to eliminate flows to Copco No. 2. Drawdown of the Copco No. 2 reservoir will be initiated by opening the spillway gates and increasing the flow through the conveyance system to the powerhouse. Once the reservoir has reached equilibrium between the incoming flow and the capacity of the open spillway and conveyance system, the flow from Copco No. 1 will be stopped. All remaining water below the ogee spillway will be drained through the conveyance system. Demolition of the concrete dam can occur once the reservoir is dewatered, and an opening for water flow through the footprint of the concrete dam will be created. Thereafter, impoundment of water in the Copco No. 2 reservoir will no longer be possible and flows from Copco No. 1 will pass freely through the dam site to the natural river channel. The planned work may take longer than the storage and flow release capacity of the Copco No. 1 and Iron Gate reservoirs, respectively. Accordingly, the drawdown of Copco No. 1 reservoir and filling of Iron Gate reservoir to accommodate the dewatering of the Copco No. 2 reach, as described above, may occur more than once to accommodate the construction schedule.

4.3.2 DRAWDOWN FOR CONTINGENCY REMOVAL METHOD

For the contingency removal method, Drawdown will occur in January of the Drawdown year. Drawdown of the reservoir will be initiated by opening the spillway gates and increasing the flow through the conveyance system to the powerhouse. The average monthly flow at Copco No. 2 is less than 2,000 cfs in January, as shown on Drawing C3057, and the capacity of the conveyance system and turbines is 3,250 cfs. The drawdown below the spillway crest can therefore be completed entirely through the intake, provided inflows to Copco No. 2 are not substantially higher than average during drawdown. The drawdown of the reservoir and the spillway bay removal will occur over a short timeframe that can be fit into a period of favourable flows, so high flow events are not anticipated to affect the drawdown plan. The drawdown will reduce the head pond to a minimum level below the spillway crest that is controlled by the hydraulics of the tunnel and the inflows from the river, as outlined in Appendix D. By using the conveyance system to lower the head pond to the lowest possible level, removal of the final 17 ft of dam at Spillway Bay No. 1 can occur under a lower head.

The Spillway Bay No. 1 concrete plug will be removed to El. 2,459.5 ft through a controlled blast or by mechanical methods. The intake caterpillar gate will be closed permanently after Spillway Bay No. 1 is opened and the reservoir level will then become limited by the constriction at the spillway bay. The rating curve for the reservoir with Spillway Bay No. 1 excavated to El. 2,459.5 ft and the four remaining spillway gates open is shown on Drawing C3057.

4.4 DEMOLITION AND REMOVAL WORKS

4.4.1 GENERAL

Construction works after the reservoir is drawn down will involve dam removal and other facility removal activities. The subsections below detail the decommissioning and removal activities. The drawdown modelling presented in Appendix G provides simulated water surface elevations for variable flow conditions and water years. Additional information can be obtained from the design drawings and the supporting analyses provided in Appendix D.

4.4.2 DAM REMOVAL

The concrete dam removal will occur during the Pre-Drawdown year, when the Copco No. 2 reach is fully drained by temporarily stopping all flow from Copco No. 1. Concrete will be removed down to El. 2,453.5

ft. The excavation will remove the spillway apron, the ogee crest, both abutment wing walls, and part of the intake structure. The limits of the excavation are shown on Drawing C3221 and C3232. The Project Company will determine the removal sequence.

If the contingency diversion dam removal method is employed, the dam removal will occur with the river initially flowing through the removed Spillway Bay No. 1 as described in Section 4.3.2. A temporary work platform will be constructed to El. 2,465.0 ft on the spillway apron to elevate the construction equipment above the river diversion flow level, as shown on Drawing C3520, to commence the removal of the remainder of the dam. The elevation of the work platform shown is dependent on the construction of a temporary channel excavation, as shown on Drawing C3520, which will reduce water levels adjacent to the work platform. The Project Company may elect not to perform this excavation, in which case the work platform at the dam deconstruction site will need to be raised. The temporary channel excavation may need to be regraded after the dam has been removed to maintain the desired final channel geometry.

4.4.3 HISTORIC DIVERSION DAM REMOVAL

Removal of the historic diversion dam upstream of the Copco No. 2 dam will be completed during the Pre-Drawdown low-flow summer period when the reach is dewatered using the Copco No. 1 reservoir inflow attenuation capacity to temporarily stop flows to Copco No. 2. The historic diversion dam will be removed to the surrounding natural river grade, as shown on Drawing C3240.

If the historic diversion dam cannot be removed when the reach is dewatered, a removal method that can occur during the low-flow summer period with the river still flowing is prescribed on Drawing C3240. For this method an excavator will ford the river from the right bank and notch out a portion of the left bank side of the historic diversion dam at a natural low point in the riverbed to provide an alternative river flow path that will allow for the current opening to be backfilled to facilitate construction equipment access for the removal of the entire diversion dam. A discussion of the water levels in the river during removal for this scenario is included in Appendix D1.

4.4.4 EARTHFILL EMBANKMENT REMOVAL

The earthfill embankment will be partially removed with 1.5H:1V excavation side slopes. The partial removal of the right abutment retaining wall is shown on Drawing C3220. This temporary excavation will be backfilled to the final channel grade. The portion of the earthfill embankment and gunite wall that is not within the footprint of the temporary excavation will be left in place permanently.

4.4.5 FINAL RIVER CHANNEL

The final grading plan of the channel through the Copco No. 2 site is shown on Drawing C3234, and requires both backfilling of the diversion dam excavation, and excavation of the upstream channel to meet volitional fish passage requirements. The channel banks at the diversion dam and intake will be backfilled with a combination of erosion protection material and ‘Riverbed Material’. The erosion protection design is summarized in Appendix D. The ‘Riverbed Material’ specification is unique to Copco No. 2 and is described on Drawing C3234. Material excavated upstream of the diversion dam is assumed to be suitable for direct placement as ‘Riverbed Material’, as it originates from the historic diversion dam excavation. Material sourced from elsewhere will comprise a well graded material with an upper particle size of approximately 36 inches and15% maximum of material smaller than 6 in (by volume).. The material will be similar to the natural material found in the river between Copco No. 1 and Copco No. 2. It can be sourced from the in-river excavation required immediately upstream of the diversion dam, the historic diversion cofferdam, or one of the erosion protection borrow sources at the Copco area shown on drawing C3530.

4.4.6 WATER CONVEYANCE SYSTEM

Deconstruction of the water conveyance system can begin after drawdown, when the caterpillar gate has been permanently closed and the conveyance system is isolated from the river. The conveyance system will be permanently drained and prepared for decommissioning.

With the conveyance system isolated from the river, there are no anticipated work restrictions, and the order and timing of the water conveyance removal and tunnel closures can be adjusted to best fit the Project Company's schedule.

4.4.6.1 INTAKE STRUCTURE

The intake structure at the diversion dam (Tunnel #1 inlet) will be partially removed and buried in place, as shown on Drawing C3232. Since this recess will have to be backfilled for the final river channel, it was deemed more efficient and safe to leave the concrete intake structure below the adjacent grade of the left bank and bury it with appropriate backfill that will resist erosion. The concrete structures above grade will be removed and buried to ensure no concrete is visible in the future. The inlet portal to Tunnel #1 will be sealed from the river by a reinforced concrete plug with a waterstop that is anchored to the intake concrete walls, as shown on Drawings C3232 and C3233. The caterpillar gate will be permanently lowered in place to initially isolate the conveyance tunnel and act as a sacrificial formwork for the intake concrete plug. After the concrete plug has been constructed, the intake will be backfilled using either concrete rubble and soil from the diversion dam removal or riverbed material. If concrete rubble is used, it will be covered with a minimum of 2 ft of General Fill (E9).

4.4.6.2 WOOD-STAVE PENSTOCK REMOVAL

The wood-stave penstock comprises timber planks, steel cradles, and concrete footings. The concrete footings and steel cradles will be laid down in-place and buried, as shown on Drawings C3300 and C3303. The steel bands will be removed to an offsite disposal site. The Project Company will have the option of removing the steel cradles to an offsite disposal site at its discretion. The fill required to bury the demolished material will be sourced from a borrow site adjacent to the wood-stave penstock, as shown on Drawing C3300. The timber planks are treated with creosote and will be disposed offsite at an appropriate facility.

4.4.6.3 STEEL PENSTOCK REMOVAL

The steel penstock will be removed from the slope above the powerhouse. The concrete anchors will be partially removed to the levels shown on Drawings C3331 and C3332. The concrete from the anchor blocks can be placed within the penstock recess or powerhouse recess and then buried using material available directly adjacent to the penstocks, or from a borrow source adjacent to the powerhouse, as shown on Drawings C3332 and C3334. The rockfill bedding surrounding the penstock will only be removed as required to remove the penstock, and then used to backfill and regrade the area. All concrete will be backfilled with a minimum cover of 2 ft of General Fill (E9) and the area will undergo final stabilization consistent with Technical Specification 31 25 00.

4.4.7 TUNNEL PORTAL CLOSURES

The conveyance tunnels portal openings will be permanently closed after removal of the water conveyance infrastructure.

Closure of the Tunnel #1 inlet is addressed in Section 4.4.6.1. The Tunnel #1 outlet, and Tunnel #2 inlet will be closed with a General Fill (E9) backfill, as shown on Drawing C3310. The Tunnel #1 outlet will include a geotextile wrapped drain that will allow seepage to escape without eroding the fill. The Tunnel #2 inlet does not require a drain due to the grade of the tunnel. The Tunnel #2 outlet will be closed with a free-draining backfill, as shown on Drawing C3350. The tunnel portal backfills will be compacted as prescribed in Technical Specification 31 23 00. The backfills are designed with additional fill above the portal crowns to maintain the portal barricade if settlement occurs.

The Spillway Overflow outlet and the Surge Vent will be closed using steel plates as shown on Drawings C3340 and C3360. Standard bat openings will be cut into the steel plates.

4.4.8 POWERHOUSE AND ANCILLARY COMPONENTS

Powerhouse mechanical and electrical equipment will be removed and disposed as set out in Section 4.5 and the Project technical specifications 02 41 00 and 02 41 99. The PacifiCorp equipment register is provided in Appendix M.

Embedded oil lines and septic systems will be flushed, and surface mounted and exposed lines will be removed. Removal of the powerhouse electrical, mechanical, and hazardous waste material, the switchyard, transmission lines, and ancillary buildings around the powerhouse and Copco Village, may occur at any time after the water conveyance system has been isolated and drained.

The powerhouse structure will be demolished after its mechanical and electrical equipment have been removed. Powerhouse concrete will be removed to El. 2,344.5 ft. In the basement level that is flush with the penstock spiral case, as shown on Drawing C3401, the void spaces below will be backfilled with General Fill (E9) Material through the draft tube and the tailrace as prescribed in the Project technical specification 31 23 00. The tailrace right wing wall will be removed, while the remainder of the tailrace concrete will remain in place. Concrete Rubble (CR2) Material will be placed into the tailrace as described in Section 4.5.1, and shown on Drawing C3420.

The area will undergo final stabilization consistent with technical specification 31 25 00.

4.4.9 REMOVAL OF ELECTRICAL COMPONENTS

Copco No. 2 Village Removal following de-energization of the lines at Copco No. 2 in accordance with Technical Specification 02 41 99 – Electrical Distribution System Removal, removal and rebuild of distribution/service drop circuits between Copco No. 1 Hydroelectric Plant and Copco No. 1 Dam (*Copco 1-Copco 1 SW LN #26-1* and *Copco 1-Copco 1 SW LN #26-2)*, distribution poles to village houses (*5G6 Daggett)*, production poles in the area. The PacifiCorp equipment register is provided in Appendix M.

4.4.10 COPCO NO. 2 VILLAGE REMOVAL

Components of the Copco No. 2 village that are to be removed are shown on Drawing C3700. The buildings, waste and underground utilities will be removed in accordance with Technical Specification 02 41 00. The maintenance building adjacent to the river will be temporarily retained for restoration work. The Restoration Contractor will be responsible for the demolition of the maintenance building.

4.5 MATERIAL DISPOSAL

Details of the disposal requirements are included in the Project Technical Specifications and Table A7.6 of Appendix A7. A basic overview is provided below.

4.5.1 CONCRETE RUBBLE AND EARTHFILL DISPOSAL

There are three primary disposal sites proposed for Copco No. 2: the Copco No. 1 disposal site as discussed in Section 3.5.1, the concrete intake structure, and the powerhouse tailrace disposal site. These sites are shown on Drawings C2270, C3232, and C3420, respectively.

Earthfill and concrete rubble from the diversion dam and intake structure removal will be placed at the Copco No. 1 disposal site. Concrete rubble from the removal may also be placed in the intake structure up to the maximum concrete backfill limit, as shown on Drawing C3232. Earthfill material that is removed during the excavation of the concrete diversion dam may be used to backfill the river channel provided it meets the 'Riverbed Material' specification, as detailed on Drawing C3234 and in Section 4.4.5.

The tailrace, powerhouse, and the recesses created by penstocks will be backfilled to match the surrounding grade. Concrete rubble from the demolition of the structures may be placed into the tailrace to the limits shown on Drawing C3420. The tailrace disposal site will be protected from river erosion with Bedding (E8) Material after the final grading of the area has been completed, as detailed in Appendix D1 and the area will undergo final stabilization consistent with Technical Specification 31 25 00. The final grading plan is shown on Drawing C3420.

4.5.2 MISCELLANEOUS DISPOSAL

Other items that will require disposal off-site as part of the Copco No. 2 facility removal activities include:

- Wood-stave penstock creosote treated timber planks
- Wood-stave penstock steel bands
- Steel penstocks
- Turbine and generator equipment
- Gates and valves
- Exposed and surface mounted pipes
- Exposed and surface mounted electrical conduits and cable trays
- Wiring and cabling
- Lighting and HVAC
- Miscellaneous mechanical and electrical equipment
- Transformers
- Transmission lines
- Building superstructures
- Septic systems

5.0 IRON GATE HYDROPOWER FACILITY REMOVAL

5.1 GENERAL

5.1.1 EXISTING FACILITY COMPONENTS

The Iron Gate hydroelectric facility was constructed from 1960 to 1962 and is located at RM 190 in California. The site is located approximately 10 miles east of the Interstate 5 Highway. The facility is accessed by the public Copco Road.

The major components of the Iron Gate facility include:

- A reservoir of 58,794 acre-ft capacity at a reservoir elevation of 2,331.3 ft (NAVD88).
- A 173 ft high, 740 ft long earth fill embankment dam.
- A sheet pile wall at the dam crest to increase reservoir flood attenuation capacity.
- A 685 ft long side-channel flip-bucket spillway.
- A diversion tunnel that functions as a low-level outlet and is comprised of:
  - The upstream tunnel from intake to control gate.
  - The downstream tunnel from control gate to outlet portal.
- A power intake structure and steel penstock.
- An at-surface single unit 18 MW powerhouse.
- A switchyard, substation, and transmission lines.
- Various fish related pipes, a fish ladder, and six collection ponds.

The existing low-level outlet control at Iron Gate Dam consists of a hydraulically actuated, gravity-close, reinforced concrete bulkhead gate. It is installed at the bottom of a 160 ft high shaft and is comprised of two sections of concrete bulkhead, the lower of which has not been moved since original construction. The gate slot and concrete bulkheads close a waterway opening that is horseshoe-shaped and is 15 ft - 6 in wide by 16 ft - 9 in high. A concrete collar and 9 ft diameter blind flange were installed downstream of the control gate during a 2007 construction program, to allow isolation and underwater inspection of the control gate.

The downstream tunnel from the control gate to the outlet portal currently features a concrete-lined segment for approximately 90 ft immediately downstream of the gate. The rest of the tunnel downstream of the gate (approximately 500 ft long) is unlined, except for a 25 ft long concrete-lined segment at the outlet.

The project design and construction are documented in the historic design drawings and construction photographs. Historic drawings are provided in Appendix K. STIDs are provided in Appendix J. Additionally, a downstream tunnel survey was completed by the Yurok Tribe from November 17 to 20, 2020, and is the basis for updated hydraulic modelling for drawdown design. The survey is provided as Attachment 2 to Appendix E1 in a Technical Memo titled *Iron Gate Low-Level Outlet Survey Data Acquisition and Processing*.

5.1.2 DESIGN DRAWINGS

Table 5.1 provides the Iron Gate drawing list.

Table 5.1 Iron Gate Facility Drawings List

Drawing Number	Drawing Title
G0035	Iron Gate Facility - General Arrangement Plan - (Sheet 1 of 2)
G0036	Iron Gate Facility - General Arrangement Plan - (Sheet 2 of 2)
C4000	Iron Gate Facility - Project Overview and Limits of Work - Key Map
C4001	Iron Gate Facility - Project Overview and Limits of Work - (Sheet 1 of 2)
C4002	Iron Gate Facility - Project Overview and Limits of Work - (Sheet 2 of 2)
C4050	Iron Gate Facility - Hydrologic and Hydraulic Information - Drawdown - Figures
C4051	Iron Gate Facility - Hydrologic and Hydraulic Information - Drawdown - Water Surface Flood Levels - Reservoir Plan
C4052	Iron Gate Facility - Hydrologic and Hydraulic Information - Drawdown - Water Surface Flood Levels - Dam Section
C4055	Iron Gate Facility - Hydrologic and Hydraulic Information - Tables
C4100	Iron Gate Facility - Pre-Drawdown Works - General Arrangement Plan and Sequence
C4120	Iron Gate Facility - Diversion Tunnel Pre-Drawdown Works
C4121	Iron Gate Facility - Diversion Tunnel Pre-Drawdown Works - Profile, Section and Detail
C4122	Iron Gate Facility - Diversion Tunnel Pre-Drawdown Works - Sections and Details - (Sheet 1 of 2)
C4123	Iron Gate Facility - Diversion Tunnel Pre-Drawdown Works - Sections and Details - (Sheet 2 of 2)
C4124	Iron Gate Facility - Diversion Tunnel Venting - Plan and Profile
C4125	Iron Gate Facility - Diversion Tunnel Venting - Section and Details
C4130	Iron Gate Facility - Diversion Tunnel - Sections (Sheet 1 of 4)
C4131	Iron Gate Facility - Diversion Tunnel - Sections (Sheet 2 of 4)
C4132	Iron Gate Facility - Diversion Tunnel - Sections (Sheet 3 of 4)
C4133	Iron Gate Facility - Diversion Tunnel - Sections (Sheet 4 of 4)
C4170	Iron Gate Facility - Gate Shaft - Closure Plan
C4175	Iron Gate Facility - Tunnel Intake - Closure Plan
C4176	Iron Gate Facility - Tunnel Outlet - Closure Plan
C4190	Iron Gate Facility - Diversion Tunnel Pre-Drawdown Works – Baffled Option
C4191	Iron Gate Facility - Diversion Tunnel Pre-Drawdown Works – Baffled Option - Profile, Typical Section and Detail
C4192	Iron Gate Facility - Diversion Tunnel Pre-Drawdown Works – Baffled Option – Typical Sections
C4193	Iron Gate Facility - Diversion Tunnel Pre-Drawdown Works – Baffled Option – Baffle Details
C4194	Iron Gate Facility - Diversion Tunnel Venting – Baffled Option - Plan and Profile
C4195	Iron Gate Facility - Diversion Tunnel Venting – Baffled Option - Section and Details
C4200	Iron Gate Facility - Embankment and Spillway - Site Plan and Removal Notes
C4201	Iron Gate Facility - Embankment and Spillway - Sheet Pile Crest Removal Notes
C4203	Iron Gate Facility - Embankment Removal - General Arrangement Sequence - (Sheet 1 of 7)
C4204	Iron Gate Facility - Embankment Removal - General Arrangement Sequence - (Sheet 2 of 7)
C4205	Iron Gate Facility - Embankment Removal - General Arrangement Sequence - (Sheet 3 of 7)
C4206	Iron Gate Facility - Embankment Removal - General Arrangement Sequence - (Sheet 4 of 7)
C4207	Iron Gate Facility - Embankment Removal - General Arrangement Sequence - (Sheet 5 of 7)

Drawing Number	Drawing Title
C4208	Iron Gate Facility - Embankment Removal - General Arrangement Sequence - (Sheet 6 of 7)
C4209	Iron Gate Facility - Embankment Removal - General Arrangement Sequence - (Sheet 7 of 7)
C4210	Iron Gate Facility - Embankment Removal - Grading General Arrangement Plan
C4211	Iron Gate Facility - Embankment Removal - Grading General Arrangement Sections
C4212	Iron Gate Facility - Embankment Removal - Grading Channel Profile, Section and Detail
C4220	Iron Gate Facility - Embankment and Spillway - Spillway Infill - Final Grade and Profile
C4221	Iron Gate Facility - Embankment and Spillway - Spillway Infill - Final Grade Sections
C4230	Iron Gate Facility - Disposal Site - General Arrangement Plan and Profile
C4231	Iron Gate Facility - Disposal Site - Sections
C4235	Iron Gate Facility - Temporary Construction Access Roads - Site Plan
C4236	Iron Gate Facility - Temporary Construction Access Roads - Profile
C4237	Iron Gate Facility - Temporary Construction Access Roads - Sections (1 of 2)
C4238	Iron Gate Facility - Temporary Construction Access Roads - Sections (2 of 2)
C4239	Iron Gate Facility - Temporary Construction Access Roads - Section and Typicals
C4250	Iron Gate Facility - Embankment Removal - Final Breach Plan
C4255	Iron Gate Facility - Embankment Removal - Final Breach - Breach Plug Details
C4300	Iron Gate Facility - Penstock Removal - Removal Notes - Plan and Profile
C4301	Iron Gate Facility - Intake Structure Removal - Removal Notes
C4400	Iron Gate Facility - Powerhouse and Fish Facilities - Removal and Grading - (Sheet 1 of 2)
C4401	Iron Gate Facility - Powerhouse and Fish Facilities - Removal and Grading - (Sheet 2 of 2)
C4402	Iron Gate Facility - Powerhouse and Fish Facilities - Final Grade Sections - (Sheet 1 of 2)
C4403	Iron Gate Facility - Powerhouse and Fish Facilities - Final Grade Sections - (Sheet 2 of 2)
C4405	Iron Gate Facility - Powerhouse and Fish Facilities - Structure Removal Limits
C4500	Iron Gate Facility - Construction Access - Downstream Tunnel Portal - Overview Plan
C4515	Iron Gate Facility - Construction Access - Left Bank Tunnel Access Plan
C4520	Iron Gate Facility - Construction Access - Fish Ladder Crossing Plan and Sections
C4521	Iron Gate Facility - Construction Access - Fish Ladder Crossing Concrete and Reinforcement
C4600	Iron Gate Facility - Temporary Erosion and Sediment Control - Pre-Drawdown Year
C4601	Iron Gate Facility - Temporary Erosion and Sediment Control - Berm and Check Dam Sections
C4605	Iron Gate Facility - Temporary Erosion and Sediment Control - Drawdown Year
C4610	Iron Gate Facility - Final Erosion and Sediment Control - Disposal Sites Stabilization Plan - (Sheet 1 of 2)
C4615	Iron Gate Facility - Final Erosion and Sediment Control - Disposal Sites Stabilization Plan - (Sheet 2 of 2)
E4015	Iron Gate Facility Overhead Electrical Conditions of Removal
E4032	Iron Gate Facility Electrical Demolition Plan & Elevation of Substation (Sheet 1 of 3)
E4033	Iron Gate Facility Electrical Demolition Plan & Elevation of Substation (Sheet 2 of 3)
E4034	Iron Gate Facility Electrical Demolition Plan & Elevation of Substation (Sheet 3 of 3)
E4051	Iron Gate Facility Electrical Demolition One Line Diagram
E4061	Iron Gate Facility Electrical Demolition Production Pole P514
S4000	Iron Gate Facility - Security - General Layout

5.1.3 DESIGN DETAILS

Design criteria are provided in Appendix A. Design analyses completed to support the 100% Design of the Iron Gate facility removal are discussed in Appendix E. Drawdown modelling is presented in Appendix G.

5.2 PRE-DRAWDOWN WORKS

5.2.1 GENERAL

Pre-drawdown works at Iron Gate will involve the development of access to the low-level outlet tunnel, installation of a new concrete liner system in a portion of the tunnel, and installation of an air vent to improve the hydraulic conditions for drawdown. The sections below describe the pre-drawdown construction activities at Iron Gate. Additional detail can be found on the design drawings and in Appendix E1.

5.2.2 CONSTRUCTION ACCESS

5.2.2.1 TUNNEL ACCESS

Access to the tunnel outlet will be required during the pre-drawdown construction works period to allow for the installation of the concrete liner and tunnel ventilation. Two access routes will be developed for this purpose: the left bank access road, and the right bank access road. These access roads are shown on the C4500 drawing series.

The right bank access road will provide access from the existing operator’s residences, extending upstream across the spillway outlet during the low flow months of the pre-drawdown construction period. Water seepage from the spillway will be passed through three corrugated metal pipe culverts as shown on drawing C4510. This road will not be available when river flows are high and there is a possibility of flow releases over the spillway.

The left bank access road will utilize the existing access to the powerhouse and fish facilities. This road will be extended to the tunnel outlet using a small bridge across the fish ladder. Use of the left bank access road requires that three of the six fish collection ponds be decommissioned early in the pre-drawdown construction year to construct a ramp down to the tunnel outlet. Use of this road will be minimized when it is possible to use the right bank access, to limit congestion in and around the fish facilities and powerhouse. Outside of the months of June to November, the left bank access road is subject to overtopping due to backwater from the spillway outflows. This risk can be mitigated with construction scheduling and water level/flow rate monitoring. Operation of the fish ladder and the remaining collection ponds will continue until December 15 of the pre-drawdown year or a date authorized by the California Department of Fish and Wildlife (CDFW).

Access to the tunnel will also be required for demolition of the existing weir and tunnel outlet structure.

5.2.2.2 EMBANKMENT AND UPLAND DISPOSAL SITE

Access to the embankment crest will be via the existing Lakeview Road. As the reservoir is drawn down and the embankment materials are removed, two haul roads will be constructed along the left bank valley side slope to transport material to the upland disposal site. These two haul roads will approximately utilize the alignment of the historic construction roads. The upland disposal site haul roads are discussed further in Section 5.5.1 and shown on drawings C4235 through C4239.

5.2.3 EXISTING CONTROL GATE

5.2.3.1 ASSESSMENT OF EXISTING HOISTING EQUIPMENT

The existing diversion tunnel reinforced concrete bulkhead control gate will be utilized as the main drawdown control mechanism. A preliminary assessment of the gate and hoist system has been completed and the results are included in Appendix E1 along with a summary of the testing that has been performed by PacifiCorp. The existing capacity of the hoist is adequate to operate the gate during drawdown. During pre-drawdown works it is recommended that testing and recommissioning of the gate be performed by the Project Company to become familiar with the operation of the existing gate.

The current PacifiCorp operational procedure recommends the gate not be opened further than 24 inches except in the case of an emergency. The drawdown operation of the gate requires it to be opened to the full open position (57 inches). Test records from 2019, submitted by PacifiCorp, demonstrate that the gate can be opened to 4 ft, or 48 inches, under balanced head conditions. Test records from 2010 indicate that the gate can be slightly opened under unbalanced conditions. The gate was not opened further than 2.25 inches during the 2010 unbalanced head conditions testing due to the effect on downstream river flows. The drawdown operations require the gate to be fully open to 57 inches under unbalanced head conditions. While outside the current operating parameters, a review of the control gate operating systems indicates that the gate can be opened to 57 inches. Pre-drawdown operation and testing is required to confirm that the hoist can be used to achieve the fully open condition.

5.2.3.2 MODIFICATIONS AND UPGRADES TO EXISTING HOISTING EQUIPMENT

An upgrade to the hoist capacity is not expected, but replacement or back-up components may be required to achieve the desired reliability. This will be assessed and implemented prior to pre-drawdown construction works.

5.2.4 DOWNSTREAM DIVERSION TUNNEL MODIFICATIONS

Downstream tunnel modifications will be required to facilitate safe discharge and maintain the tunnel's structural integrity during drawdown operations. The modifications are:

- Construction of a reinforced concrete liner or baffle walls, depending on the selected tunnel modification concept
- Installation of an air vent
- Removal of existing components

The tunnel modifications discussed in this section are shown in the C4100 drawing series.

5.2.4.1 BEST FIT LINER OPTION

The diversion tunnel downstream of the control gate currently features an existing concrete-lined segment for approximately 90 ft immediately downstream of the gate. The rest of the tunnel downstream of the gate (approximately 500 ft long) is currently unlined, except for a 25 ft long concrete-lined segment at the outlet.

During drawdown, flow downstream of the control gate and the 9 ft flanged orifice is characterized as a supercritical to subcritical flow conduit with a hydraulic jump that fills the tunnel. The hydraulic jump is found to form and be maintained downstream of the existing concrete-lined tunnel segment. Under the best fit liner modification option, a new reinforced concrete liner is proposed for the tunnel side walls and invert for approximately 150 ft immediately downstream of the existing concrete-lined segment of the tunnel as a protective measure against scour due to high velocity flows from the control gate.

The concrete liner is shown on Drawings C4120 to C4123. Figure 5.1 presents the concept of the tunnel modifications related to the side wall and invert concrete liner and ventilation (see Section 5.2.4.3). Additional design information is provided in Appendix E.

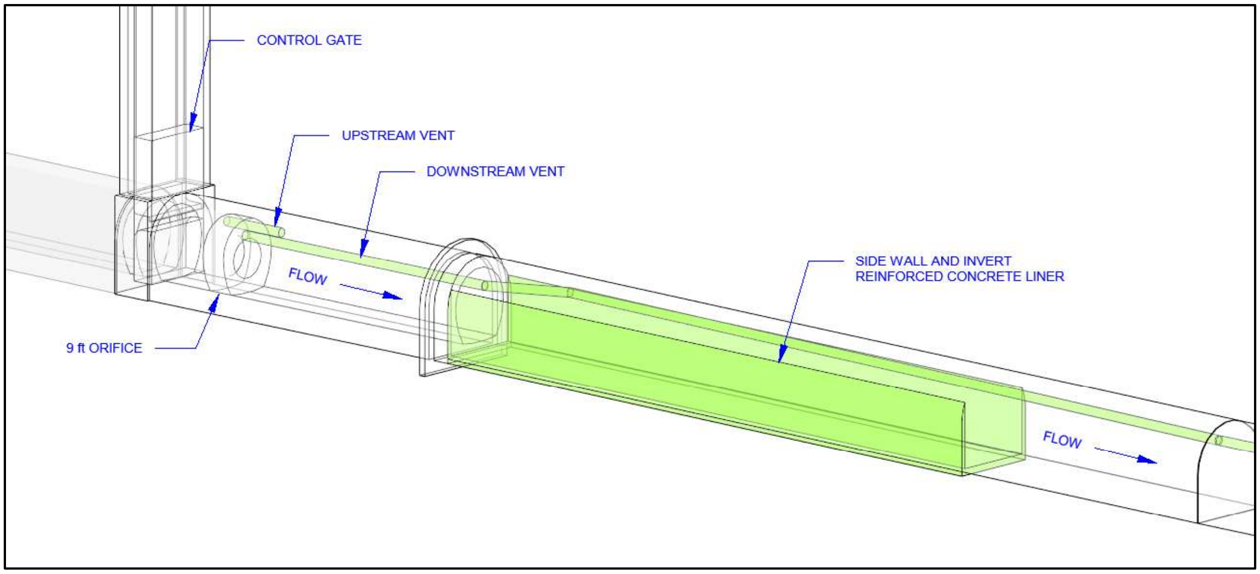

Figure 5.1 Diversion Tunnel Drawdown Modifications - Best Fit Liner Option

5.2.4.2 BAFFLED OPTION

A value alternative option eliminates the need for the concrete lining concept by instead installing baffles downstream of the 9 ft orifice within the existing concrete lined portion of the tunnel. These will be steel wrapped, post tensioned concrete blocks anchored to the existing concrete that will interrupt the high velocity flow before it leaves the existing reinforced concrete liner.

It was observed in the CFD simulations, once the detailed survey was incorporated, that the natural geometric roughness of the tunnel has adequate energy-dissipating capacity to induce a hydraulic jump, thus subjecting majority of the unlined portion of the tunnel to low velocity flows. Given the proximity of the hydraulic jump to the existing heavily reinforced lined section of the tunnel, it is proposed in the baffled option that the new concrete liner be eliminated by pulling the jump further upstream with the addition of baffles inside the existing reinforced concrete liner.

With the combination of the unlined geometry and the use of baffles, the unlined portion of the tunnel downstream of the existing liner and grout curtain sees maximum flow velocities of 10 to 15 ft/s once the hydraulic jump has stabilized. This concept eliminates the need for additional concrete lining in the tunnel. The design option is presented in the C4190 Drawing Series. Additional design information is provided in Appendix E.

Figure 5.2 below shows the tunnel configuration near the existing liner for the baffled option.

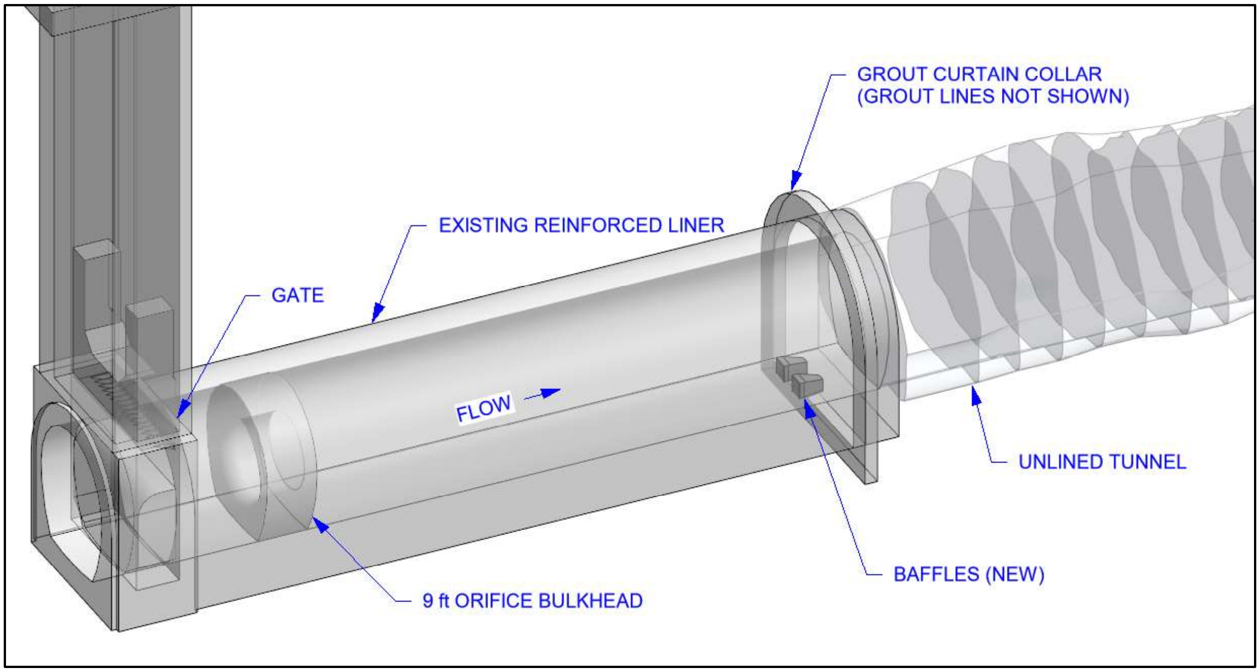

Figure 5.2 Divresion Tunnel Drawdown Modifications – Baffled Option

5.2.4.3 VENTILATION

Based on CFD hydraulic analysis as presented in Appendix E, the control gate flow in the tunnel during drawdown causes unsteady variations in the air space within the tunnel. Vent pipes will be installed and placed as close to the tunnel crown as possible to allow proper air ventilation and prevent adverse, sub-atmospheric pressures from developing.

Two vent pipes will be installed:

- Upstream Vent.
  - The upstream vent targets the area between the control gate and the 9 ft orifice.
  - The ventilation is composed of an opening near the tunnel crown, drilled through the reinforced concrete bulkhead that surrounds the orifice.
- Downstream Vent.
  - The downstream vent targets the area downstream of the 9 ft orifice.
  - The vent line is composed of an HDPE pipe suspended from the tunnel crown. It spans the length of the tunnel downstream of the 9 ft orifice with its outlet located at the downstream tunnel portal.

5.2.4.4 EXISTING COMPONENT REMOVAL

The following existing tunnel components will be removed as part of the pre-drawdown works:

- Steel hinged blind flange, currently attached to the concrete bulkhead of the 9 ft orifice, and its associated fittings and components. This includes the drainage pipe, located near the invert of the orifice bulkhead.
- Weir and stoplogs near the tunnel outlet portal.
- Rock pile within the downstream tunnel.

The existing components listed above will be removed during the pre-drawdown works period in a sequence that best facilitates tunnel access and work site dewatering, and prevents damage to the new tunnel modifications discussed above.

5.2.5 RESERVOIR OPERATIONS

During the pre-drawdown construction period, the Iron Gate facility will need to be operated at minimum levels. This will be achieved by directing maximum flows through the powerhouse whenever possible. The discharge capacity of the powerhouse (single Francis unit) is 1,735 cfs (PacifiCorp, 2016). The minimum operating water level is 2,327.3 ft, as shown in Appendix A7 – Table A7.2.

Average flow rates and flood risks increase through the fall and by December average flows are estimated to be 1,580 cfs. The construction risk for in-water work increases due to increased flows. Hydrology design criteria are provided in Appendix A6.

5.3 DRAWDOWN

The drawdown of Iron Gate reservoir will be initiated by opening the existing outlet control gate to its maximum opening height of 57 inches. The penstock and powerhouse bypass valve will be used to supplement initial drawdown flows. The maximum outflow rate, at full reservoir with the control gate fully open, is estimated to be 3,500 cfs through the tunnel and the flow rate will decrease as the reservoir level lowers. The gate will remain fully open for the period of reservoir drawdown. The tunnel modifications will allow the tunnel to safely pass outflows throughout drawdown and dam removal. The use of the existing gate in the fully open position is an acceptable drawdown method and considers:

- Embankment stability
- Reservoir rim stability
- Downstream erosion
- Tunnel integrity

Reservoir pre-drawdown operations will begin in November or December to bring the reservoir water surface level to the normal minimum operating surface level of 2,327.3 ft, as permitted by inflows at the time. Drawdown will commence on or about January 1 of the drawdown year. The penstock and powerhouse bypass may be used to supplement drawdown flows while the reservoir level remains high enough to allow for flow through the penstock. Drawdown will continue concurrently with embankment removal until water levels are low enough to initiate the final dam breach, as discussed further in Section 5.4.3.

Drawdown of the Iron Gate reservoir is analyzed using CFD modelling, which is presented in Appendix E2. Drawdown modelling results for various hydrologic conditions are presented in Appendix G.

5.4 DEMOLITION AND REMOVAL WORKS

5.4.1 GENERAL

The demolition and removal activities at Iron Gate will involve the decommissioning and removal of the dam and all facility components. The subsections below detail the deconstruction activities. Water surface levels based on steady state flows are provided on Drawings C4050 and C4051. The drawdown modelling presented in Appendix G provides simulated water surface levels. Additional information can be obtained from the design drawings and Appendix E.

5.4.2 EMBANKMENT REMOVAL

5.4.2.1 REMOVAL LIMITS AND FREEBOARD REQUIREMENTS

After reservoir water levels have been lowered, the embankment dam will be removed at a rate that will provide a required 3 ft of freeboard above the monthly or semi-monthly 1% probable flood event until the extended work platform at the upstream toe of the dam is established. The maximum removal limits that provide the required freeboard are shown on the removal sequence drawings C4203 through C4209.

The crest of the extended cofferdam will be established at 3 ft above the controlling 1% probable flood from July 16 to August 31 and above the 5% probable flood for September 1-15. The final breach will occur when the reservoir level corresponds to expected average monthly flows. The planned breach avoids downstream flood impacts and public risk and is discussed in more detail below.

The removal limits as shown on the embankment removal sequence drawings depict the maximum extent of allowable dam removal prior to the indicated date. These extents are controlled by the water levels that result from the diversion tunnel rating curve, monthly hydrology, and freeboard requirements. Actual construction methods may remove a footprint less than shown, at the Project Company’s option for construction scheduling and efficiency.

5.4.2.2 INTERIM STABILITY REQUIREMENTS

The stability requirements for the embankment through drawdown and embankment removal are provided in Table A7.2 of Appendix A7. Minimum factor of safety requirements for drawdown and dam removal are 1.2 and 1.5, respectively.

5.4.2.3 EMBANKMENT MATERIAL CLASSIFICATION FOR DISPOSAL

The constructed embankment zones, assumed to be correctly represented in the Historic Drawing, G-8853, are approximately classified into the disposal site material specifications presented in Table 5.2 below. These classifications are made with the goal of providing flexibility to the disposal site construction and hauling while maintaining long term stability.

Table 5.2 Disposal Site Material Classifications for Embankment Zones

Iron Gate Embankment Zone Classification	Description	Disposal Site Material Classification	Design Specification Notes
Zone I	Compacted Pervious Fill	E9, E9a, General Fill	• Wide gradation band with lift thickness and compaction requirements. • May also be disposed of in E10, Random Fill areas of the disposal sites if there is excess.
Zone I A	Graded Talus		
Zone II	Compacted Pervious Fill, Semi-pervious		
Zone III	Compacted Clay Impervious Fill	E10, Random Fill	• No gradation requirements and negligible long-term stability requirements and consequences. • Where Zone III material has been mixed and moved with Zone I and II material, it may be disposed of in E9a areas of the disposal site, provided the lift and compaction requirements of E9 are adhered to.
Zone IV and IV A	Filter	E9, E9a, General Fill	• Wide gradation band with lift thickness and compaction requirements. • Also can be disposed of in E10, Random Fill areas of the disposal sites if there is excess.
Zone V	Drain		
Riprap	Riprap	Erosion Protection, E7a, E7b, E7c	• Specified as appropriate for final channel design flow velocities. • May also be disposed of in E9, General Fill areas of the disposal sites if there is excess.

5.4.2.4 REMOVAL SEQUENCE

The embankment removal sequence is shown on Drawings C4203 to C4209 and demonstrates removal limits according to the flood hydrology described above.

Initial embankment fill removed from the dam will be placed in the spillway disposal site shown on Drawings C4220 and C4221. This will be achieved by establishing short haul roads and end dump sites both upstream and downstream of the crest parallel to the spillway. Once enough material has been placed into the spillway, an equipment access ramp will be constructed to allow construction equipment access required to safely move and compact the material being permanently disposed of in the spillway. The spillway disposal site is estimated to provide approximately 250,000 cubic yards of disposal volume. The embankment removal process will have progressed such that the crest elevation will be between Sequence 4 at elevation 2,297.5 ft and Sequence 5 at elevation 2,243 ft when the spillway fill has been completed.

As per Drawings C4220 and C4221, the existing core zone material, classified as Random Fill (E10), will be disposed in the upstream half of the spillway where it will be contained on 3 sides by bedrock and with a minimal slope to the foundation. The downstream half of the spillway disposal site where it slopes away, will be constructed of General Fill (E9) where stability requirements dictate.

As the spillway disposal site is nearing completion, some of the Zone I & II material, classified as General Fill (E9) will be used to construct the haul roads shown on Drawing C4215, thereby establishing access to the upland Disposal Site where most of the remaining embankment materials will be disposed. Design criteria information for this road is provided in Appendix F6.

5.4.3 FINAL DAM BREACH

5.4.3.1 FINAL BREACH GOALS AND TARGET OUTFLOWS

Flow rates in the Klamath River are anticipated to decrease through the dam removal period, which will result in the lowest possible reservoir levels occurring around the time of the final dam breach (August/September), in line with the normal hydrologic cycle. The primary goal of the final breach design is to maintain bankfull flows during the release of the remaining pond volume without causing overbank flooding or property damage in the downstream reaches. The target for peak outflow discharge is approximately 6,000 cfs, as measured at USGS Gaging Station No. 11516530, Klamath River below Iron Gate Dam.

Understanding that the risk of higher peak outflows increases if the construction schedule extends from the summer months into late September and October, the breach design also aims to eliminate complexity and time consuming construction techniques such as grout stabilization in order to mitigate the construction schedule risk.

Throughout the final breach, a minimum of 1,000 cfs, or the flow in the Klamath River if it is less than 1,000 cfs at the time, will be maintained. The diversion tunnel will remain open throughout and continue to pass flows. As the water level drops and the capacity of the tunnel is reduced, those flows will be augmented by the outflows resulting from the breach formation. At the completion of the final breach, natural flow in the Klamath River will be restored with all flows diverted through the breach channel while the remaining embankment materials in the extended cofferdam are removed.

5.4.3.2 BREACH MODELLING RECOMMENDATIONS

A detailed dam breach analysis is used to understand the range of possible peak outflows that could be expected for an earthfill embankment overtopping event. Various dam breach scenarios have been investigated using Monte Carlo probability analysis, as recommended by the Federal Energy Regulatory Commission (FERC, 2014). The details of this analysis are presented in Appendix E. The following represents a summary of the conclusions that inform the final breach plug and channel design.

Considering the uncertainties in selecting and identifying expected breach parameters, especially given the unknown properties of the in-site native materials such as erodibility, a full range of breach parameters consistent with the FERC recommendations (FERC, 2015) is included in the initial analysis. Breach parameters are evaluated using probabilistic breach analysis to identify the range of breach parameters that would result in acceptable peak outflows. Peak outflows are then confirmed with additional simulations using predefined breach parameters to bracket the worst-case conditions.

The findings of this assessment indicate the following:

- A 10 to 20 ft. wide breach channel would sufficiently constrict the breach outflows such that the maximum peak outflows do not exceed 6,000 cfs at the USGS gauge 11516530 if the final breach is initiated at reservoir WSLs at below 2,200 ft.
- The riprap sizing on the sides of the breach channel should be designed not to be mobile under breach outflow conditions to prevent unplanned widening of the breach channel.
- Extending the breach formation time in addition to controlling the breach width would further decrease the peak breach outflows. This could be achieved through designing riprap for the breach channel bed to be marginally mobile, such that breach downcutting would still be possible, but limited.

5.4.3.3 BREACH CHANNEL DESIGN

Once the extended cofferdam has been established at El. 2,231.2 ft, a breach channel will be excavated along the right rock abutment, with a breach plug retaining the remaining reservoir at the upstream end of the breach channel. As discussed above, the breach channel and plug are designed to initiate progressive erosion once notched, but limit the breach widening and slow the rate of erosion such that the risk of peak outflows that could lead to overbank flooding is considered negligible. This will be achieved with the following channel design characteristics, consistent with the recommendations above:

1. The excavated breach channel along the right abutment of the extended cofferdam will have a base channel width of 20 ft. The excavated side slopes of the channel will be at a slope of 2H to 1V, which are shallower than the slopes typically seen in a breach when a dam fails by overtopping.
2. The breach pug will have a crest of 2,202 ft, which is 4 ft above the water level of 2,198 ft for flows that are exceeded 25% of the time in the first half of September. This will limit the amount of stored volume to approximately 465 acre-ft that could possibly be released in the event of an unplanned breach.
3. The downstream slope of the breach plug will be excavated, at a slope of 5H:1V, from the native materials within the footprint of the historical cofferdam. This slope is consistent with USBR recommendations (USBR, 1998 and 2010) for downstream embankment slopes where riprap may be considered suitable for overtopping protection. This is done to limit the energy of the overtopping flows.
4. The side boundary of the downstream face of the plug that leads to a 20 ft base width will be protected with riprap (Minimum D50 = 34 inch) to limit the breach channel widening beyond 20 ft. This is sized according to the “Riprap Design for Overtopped Embankments” (USBR, Colorado State University, 1998) and the “Evaluating Scour at Bridges” (FHWA, 2012), which deals specifically with preventing channel flows from laterally eroding side slopes.
5. The downstream plug face will be lined with riprap that is sized to be mobile, but will also slow the rate of progressive erosion (Minimum D50 = 18 inch).
6. Once the outflows transition into the channel downstream of the plug where the channel gradient is reduced to 0.7%, the side boundary riprap will reduce in size due to the reduction in local velocities (Minimum D50 = 18 inch), which is still sufficiently sized to prevent lateral erosion and widening of the breach channel.

The above details are shown in drawings C4250 and C4255.

Once the breach channel is excavated and prepared, the remaining plug will be notched progressively from a safe access point on the right abutment according to the following sequence:

1. The first notch cut will be 1 ft below water surface at the time of breach and no greater than 10 ft wide beginning from the rock on the right abutment.
2. The behavior will be observed and if outflows begin to increase the plug crest will be evacuated to the extended cofferdam crest. If progressive erosion is not initiated, the notch will be further excavated to 3 ft below the existing water surface at the time.
3. This process will be repeated until progressive erosion is initiated. At no point will cuts be excavated deeper than 3 ft or wider than 20 ft.

5.4.4 FINAL RIVER CHANNEL

Establishment of the final river channel will involve final riverbed excavation and shaping as shown on the design Drawing C4210. The final channel has an average slope of 0.7% from where it intersects the reservoir bottom at the upstream end of the excavation to where the excavation daylights naturally near the current powerhouse tailrace.

Where the embankment excavation is to bedrock the final channel side slopes will be left untreated. Where the channel excavation is bound by fill slopes it will be protected from erosion with riprap for up to and including the 1% probable annual flood event plus 3 ft of freeboard.

All excavated side slopes that are not in bedrock or other channel side slopes that put the founding material for disposal sites at risk, will be further assessed once the reservoir has been drawn down and the native material can be assessed for erodibility. These areas are currently indicated as requiring erosion protection.

5.4.5 WATER CONVEYANCE SYSTEM REMOVAL

The power intake will be used to assist with reservoir drawdown using the existing turbines or bypass valve. Removal of the power intake structure will happen concurrently with the embankment removal when the appropriate embankment elevation has been reached. The penstock and intake structure removal requirements are shown on Drawings C4300 and C4301. Additional detail is available in the Historic Drawings, Specifically, G8858 Sheet 1 & 2, G8861 and AA87094 through AA87096.

Features associated with the powerhouse penstock, including the steel pipe, support members, foundations, anchor blocks, and couplings will be removed. Concrete thrust blocks will be removed and spoiled in the disposal sites. The final thrust block nearest to the powerhouse will be left in place and buried,and the area will undergo final stabilization consistent with Technical Specification 31 25 00..

5.4.6 POWERHOUSE SITE AND ANCILLARY COMPONENTS

Powerhouse mechanical and electrical equipment will be removed and disposed as set out in Section 5.5 and the Project technical specifications 02 41 00 and 02 41 99. Embedded oil lines and septic systems will be flushed, and surface mounted and exposed lines will be removed. Removal of the powerhouse, and ancillary equipment may occur at any point during the drawdown year after the water conveyance system has been isolated and drained.

The powerhouse structure will be demolished after its mechanical and electrical equipment have been removed. The PacifiCorp equipment register is provided in Appendix M. Powerhouse concrete will be removed as shown on Drawing C4405. The back wall of the powerhouse nearest to the road may be left in place as the powerhouse site is used to spoil concrete rubble and embankment dam fill material and the area will undergo final stabilization consistent with Technical Specification 31 25 00..

5.4.7 FISH COLLECTION FACILITIES

All remaining existing fish collection facilities, including collection ponds, the fish ladder, water supply lines, holding tanks and the spawning building that were not removed during pre-drawdown construction will be removed to establish the final river channel. A concrete slab from the fish ladder crossing will be repurposed and used to cover the gate shaft opening as shown on Drawing C4170.

5.4.8 GATE SHAFT AND DIVERSION TUNNEL DECOMMISSIONING

Following drawdown, the control gate will be in the open position while the embankment is being removed. The portion of the gate shaft extending above bedrock will be removed in a sequence that facilitates the final closure of the diversion tunnel following dam breach. At the conclusion of the dam removal and after breach, the gate will be permanently closed, and any remaining lifting equipment will be decommissioned. The tunnel and gate shaft will then be closed by end dumping Random Fill (E10) and/or Concrete Rubble (CR2) into the gate shaft. A concrete slab from the fish ladder crossing will be placed over the gate shaft to prevent settlement of cover material. The final grade surface in the area will provide 6 ft of cover over the shaft, including a minimum of 3 ft of General Fill (E9a) and 3 ft cover material consistent with the C4600 drawing series.. This is shown on Drawings C4170.

The inlet and outlet of the diversion tunnel will be buried and permanently blocked following the final embankment breach. Concrete Rubble (CR1) and Erosion Protection (E7a) will be used to block the inlet and outlet. A protective layer of larger erosion protection material (E7b) will protect the tunnel closure fill materials and will be extended above the tunnel crown. The use of coarse material in the closure fill will facilitate drainage of any water accumulating in the tunnel after the Project is complete. The tunnel intake and outlet closures are shown on Drawing C4175 and C4176, respectively.

5.4.9 REMOVAL OF ELECTRICAL COMPONENTS

Following de-energization of transmission lines in accordance with Technical Specification 02 41 99 – Electrical Distribution System Removal, removal of distribution poles to village houses, production poles in the area (*6G31 Iron Gate Dam)*, and 6.6 miles of 69 kV between Copco No. 2 and Iron Gate (*Iron Gate-Copco 2)*. Poles between Copco No. 2 and Iron Gate are shared structures with 69 kV above and distribution underbuild (*5G19 Town).* All above ground equipment within the substation will be demolished and removed. The PacifiCorp equipment register is provided in Appendix M.

5.5 MATERIAL DISPOSAL

Details of the disposal requirements are included in the Project Technical Specifications and Table A7.6 of Appendix A7. A basic overview is provided below.

5.5.1 BULK EARTHFILL AND CONCRETE RUBBLE DISPOSAL

Embankment fill will be spoiled into three main locations: The Iron Gate spillway, the upland disposal site on the left bank, and the powerhouse site. Concrete rubble from the demolition of the powerhouse will also be used to infill the powerhouse excavation. The disposal sites are shown on Drawings C4215 to C4219 and C4230 to C4231.

The Iron Gate spillway will be used as the initial disposal site for dam fill, followed by the upland Disposal Site. Additional information on embankment demolition and spoil to these disposal sites is provided in Section 5.4.2. The powerhouse site will also be used as a spoil area for embankment materials, as needed, and for concrete rubble. This area will then be capped with spoil material from zone 1, zone 2, and riprap from dam excavation, contoured to drain and the area will undergo final stabilization consistent with Technical Specification 31 25 00. The maximum extent of powerhouse spoil is shown in the C4400 drawing series. The use of the powerhouse site as a spoil area reduces the amount of fill that needs to be spoiled in the other disposal sites described above.

Access to the upland disposal site will be via a new construction access road passing through the reservoir inundation area, the design criteria of which is described in Appendix F6. Much of the proposed alignment is currently under water in the Iron Gate reservoir. Additionally, no subsurface investigation data were available at the time of the preliminary design. As a result, the slope stability analysis and road design are preliminary and subject to change. Site conditions will be reviewed by the engineer following reservoir drawdown and the design will be updated prior to road construction.

5.5.2 MISCELLANEOUS DISPOSAL

Other items that will require disposal off-site as part of the Iron Gate facility removal activities include:

- Steel penstock
- Turbine and generator equipment
- Gates and valves
- Exposed and surface mounted pipes
- Exposed and surface mounted electrical conduits and cable trays
- Wiring and cabling
- Lighting and HVAC
- Miscellaneous mechanical and electrical equipment
- Transformers
- Transmission lines
- Building superstructures
- Septic systems

6.0 ROADS, BRIDGES, AND CULVERTS

6.1 GENERAL

The scope of work for roads, bridges and culverts consists of two components:

- Mitigation of drawdown effects on permanent bridge and culvert crossings
- Construction access improvements: roads, bridges, and culverts

6.1.1 MITIGATION OF DRAWDOWN EFFECTS

Reservoir drawdown could potentially affect certain bridges and culverts located on reservoir tributaries by initiating tributary channel incision and headcutting, which could undermine abutments or outlets. Impassable fish barriers could be created where an upstream migrating headcut intersects a crossing-related hard point (i.e. culvert outlet).

The Fall Creek culvert at Daggett Road will be replaced with a multi-plate arch culvert to mitigate potential post-drawdown effects.

Post-drawdown monitoring of other bridges and culverts, and design and implementation of mitigation measures will be completed as required. This will include post-drawdown assessment of the Camp Creek and Scotch Creek culverts. Designs for these culverts have been developed and are presented in the design drawings of Table 6.1 but may be varied based on conditions after drawdown.

6.1.2 TEMPORARY CONSTRUCTION ACCESS IMPROVEMENTS

Temporary construction access improvements are required where existing roads and bridges are not sufficient to handle construction equipment dimensions or loads, or to create new access to certain areas that do not currently have access.

The planned construction access improvements are summarized below:

- Temporary strengthening systems will be installed at existing bridges to meet construction load requirements:
    - Fall Creek Bridge (Copco Road)
    - Dry Creek Bridge
- Improvement of public roads and culverts, as needed, leaving them in equal or better condition after Project implementation than they are at present:
    - Copco Road – to be repaired and upgraded as required to accommodate Project traffic
- Local construction access – J.C. Boyle
    - Road realignment at scour hole
    - Temporary road reactivation at lower penstock access road
    - Intersection improvements at the OR66 – J.C. Boyle intersections
    - Left bank disposal site access road
    - Potential right bank alternate disposal site access road):
- Local construction access – Copco No. 1:
    - Road improvement of Right Bank access from Copco Road down to Copco No. 1 Powerhouse
    - New road for access to new drawdown tunnel outlet

- Local construction access – Copco No. 2:
  - New road for Right Bank access to downstream of Copco No. 2 Dam
  - Road improvement of Left Bank utility corridor leading toward Copco No. 2 Dam
- Local construction access – Iron Gate:
  - Construction access will be routed through approximately 5.8 miles of private roads, servicing the Left Bank of the Iron Gate Dam site, connecting to Ager Beswick Road. The replacement of the existing Lakeview Road bridge is targeted for completion by October 2023 (by others).
  - New temporary road for Right Bank access to Iron Gate Dam low-level tunnel outlet
  - New temporaryroad and fish ladder bridge crossing for Left Bank access to Iron Gate Dam low-level tunnel outlet through the fish sorting facility

The drawings list for the drawdown-affected bridges and culverts (C5000 drawing series), and for the construction access improvements other than local construction access (C6000 drawing series), are presented in Table 6.1. Local construction access improvements at the four hydropower facilities are addressed in the applicable report sections (2 through 5) and Design Drawings.

Table 6.1 Roads, Bridges, and Culverts Drawings List

Drawing Number	Drawing Title
C5000	Civil - Roads & Culverts - General Notes
C5001	Civil - Roads & Culverts - Abbreviations
C5002	Civil - Roads & Culverts - Legend, Symbols & Linetypes
C5003	Civil - Roads & Culverts - Typical Details - (Sheet 1 of 2)
C5004	Civil - Roads & Culverts - Typical Details - (Sheet 2 of 2)
C5200	Camp Creek Culvert - General Arrangement
C5201	Camp Creek Culvert - Plan, Profile, and Section
C5202	Camp Creek Culvert - Channel Alignment - Plan and Profile
C5203	Camp Creek Culvert - Temporary Erosion and Sediment Control Plan
C5204	Camp Creek Culvert - Final Erosion and Sediment Control Plan
C5205	Camp Creek Culvert - Traffic Management Plan
C5300	Scotch Creek Culvert - General Arrangement
C5301	Scotch Creek Culvert - Plan, Profile, and Section
C5302	Scotch Creek Culvert - Channel Alignment - Plan and Profile
C5303	Scotch Creek Culvert - Temporary Erosion and Sediment Control Plan
C5304	Scotch Creek Culvert - Final Erosion and Sedimentation Control Plan
C5305	Scotch Creek Culvert - Traffic Management Plan
C5400	Fall Creek Culvert (Daggett Road) - General Arrangement
C5401	Fall Creek Culvert (Daggett Road) - Plan, Profile, and Section
C5402	Fall Creek Culvert (Daggett Road) - Channel Alignment - Plan and Profile
C5403	Fall Creek Culvert (Daggett Road) - Temporary Traffic, Erosion and Sediment Control Plan
C5404	Fall Creek Culvert (Daggett Road) - Final Erosion and Sedimentation Control Plan
C6000	Civil - Roads & Bridges - General Notes
C6100	Fall Creek Bridge (Copco Road) - General Arrangement
C6101	Fall Creek Bridge (Copco Road) - Plan, Profile, and Section

Drawing Number	Drawing Title
C6102	Fall Creek Bridge (Copco Road) - Details
C6103	Fall Creek Bridge (Copco Road) - Temporary Erosion and Sediment Control Plan
C6104	Fall Creek Bridge (Copco Road) - Traffic Management Plan
C6400	Dry Creek Bridge - General Arrangement
C6401	Dry Creek Bridge - Plan, Profile, and Section
C6402	Dry Creek Bridge - Details
C6403	Dry Creek Bridge - Temporary Erosion and Sediment Control Plan
C6405	Dry Creek Bridge - Traffic Management Plan
C6500	Lakeview/Ager Beswick Intersection Improvement - Concept Layout
C6600	OR66 Intersection 1 Improvement - Site Plan
C6601	OR66 Intersection 1 Improvement - Restoration Plan
C6610	OR66 Intersection 2 Improvement - Site Plan
C6611	OR66 Intersection 2 Improvement - Restoration Plan
C6720	Transport - Construction Access - Potential Road Repairs - Typical Sections and Details
C6721	Transport - Construction Access - Potential Culvert Repairs - Typical Sections and Details

6.2 DESIGN OVERVIEW

Roads, bridges, and culverts improvements aim to provide safe and effective access to the various Project areas during construction and in the long-term. Appendix A7 Table A7.5 provides design criteria and Appendix F provides additional design information for the various components.

The required timing of the improvements varies depending on whether the work is to support construction activities or long-term post-Project use. The construction schedule is provided in Appendix I.

7.0 RECREATION SITES DEMOLITION

The recreation site locations were chosen based on the predicted results of Project implementation and return of the river system back to its original location. The recreation site demolition key maps and plans are presented on the C7000 drawing series, as shown on Table 7.1.

Table 7.1 Recreation Drawings List

Drawing Number	Drawing Title
Oregon Sites	
C7000	J.C. Boyle Reservoir - Recreation Site Demolition - Key Map
C7005	Pioneer Park East Recreation Facility - Demolition Plan
C7010	Pioneer Park West Recreation Facility - Demolition Plan
C7015	Topsy Campground Recreation Facility - Demolition Plan
California Sites	
C7020	Copco Lake - Recreation Site Demolition - Key Map
C7025	Mallard Cove Recreation Facility - Demolition Plan
C7030	Copco Cove Recreation Facility - Demolition Plan
C7035	Iron Gate Reservoir - Recreation Site Demolition - Key Map
C7040	Fall Creek Recreation Facility - Demolition Plan
C7045	Jenny Creek Recreation Facility - Demolition Plan
C7050	Wanaka Springs Recreation Facility - Demolition Plan
C7055	Camp Creek Recreation Facility - Demolition Plan
C7060	Juniper Point Recreation Facility - Demolition Plan
C7065	Mirror Cove Recreation Facility - Demolition Plan
C7070	Overlook Point Recreation Facility - Demolition Plan
C7075	Long Gulch Recreation Facility - Demolition Plan

8.0 MANAGEMENT PLANS

The Lower Klamath River Project ("Proposed Action") will require the development of regulatory permit conditions incorporated into management plans. The FERC Amended License Surrender Application (ALSA) has established 16 Management Plans to be filed with FERC incorporating the terms and conditions from federal, state, and local permits and/or agreements. The consolidation of plans into the Management Plans is a necessary element to align common resource subject area protection measures into one plan, rather than the multiple plans currently identified in executed governmental approvals. The process of completing these Management Plans will further refine the Proposed Action implementation requirements in consultation with multiple state, federal and local authorities. Once the Management Plans have been finalized, they will be submitted to the FERC for approval. Table 8.1 below identifies the Management Plans as well as their corresponding governmental approval management plans and/or actions.

These Management Plans have incorporated the proposed measures from the following Governmental Approvals:

- Oregon Clean Water Act Section 401 Water Quality Certification (OR 401 WQC)
- California Clean Water Act Section 401 Water Quality Certification (CA 401 WQC)
- Siskiyou County MOU
- Klamath County MOU
- Del Norte MOU
- California Department of Fish and Wildlife MOU

The California State Water Resources Control Board Final Environmental Impact Report (CA FEIR) provides additional management plan details for incorporation. The FEIR Mitigation, Monitoring, and Reporting Plan (MMRP) provides the specific FEIR measures and their interrelationship to the CA 401 WQC conditions.

Table 8.1 Proposed Action Management Plans

FERC Surrender Application Management Plans		Management Plans Identified in CA 401/FEIR/OR 401/Klamath MOU/CDFW MOU	
		Plan Subsections	**Governing Document**
1	**Aquatic Resources Management Plan**	Spawning Habitat Availability Report and Plan	CA 401 WQC-Cond 6
		California AR-6 Adaptive Management Plan (Suckers)	
		Fish Presence Monitoring Plan	
		Tributary-Mainstem Connectivity Plan	
		Juvenile Salmonids and Pacific Lamprey Rescue and Relocation Plan	
		Oregon AR-6 Adaptive Management Plan (Suckers)	OR 401 WQC-Cond 4

FERC Surrender Application Management Plans		Management Plans Identified in CA 401/FEIR/OR 401/Klamath MOU/CDFW MOU	
		Plan Subsections	**Governing Document**
2	**Construction Management Plan**	Oregon Traffic Management Plan	Klamath County MOU
		California Traffic Management Plan	Siskiyou County MOU
		Emergency Response Plan	ALSA
		Use and Occupancy Plan for Bureau of Land Management Lands	NA
		Construction Camp Management Plan	NA
3	**Erosion and Sediment Control Plan**	Oregon Erosion and Sediment Control Plan	OR 401 WQC-Cond 8
4	**Hatcheries Management and Operations Plan**	Hatcheries Management and Operations Plan	CA 401 WQC-Cond 13
5	**Health and Safety Plan**	Klamath River Renewal Corporation Safety Policies	ALSA
		Site-Specific Health and Safety Plan	
		Public Safety Plan	
6	**Historic Properties Management Plan**	Confidential Historic Property Maps	ALSA
		Monitoring and Inadvertent Discovery Plan	
		Looting and Vandalism Prevention Plan	
7	**Interim Hydropower Operations Plan**	NA	CA 401 WQC-Cond 20
8	**Recreation Facilities Plan**	NA	CA 401 WQC-Cond 19
9	**Remaining Facilities Plan**	Remaining Facilities Plan (CA)	CA 401 WQC-Cond. 7
		Remaining Facilities and Operations Plan (OR)	OR 401 WQC- Cond 7
10	**Reservoir Area Management Plan**	NA	CA 401 WQC-Cond. 14
			OR 401 WQC-Cond. 6
11	**Reservoir Drawdown and Diversion Plan**	California Reservoir Drawdown and Diversion Plan	CA 401 WQC-Cond. 3
		California Slope Stability Monitoring Plan	CA 401 WQC-Cond. 18
		Oregon Reservoir Drawdown and Diversion Plan	OR 401 WQC Cond. 5
12	**Sediment Deposit Remediation Plan**	California Sediment Deposit Remediation Plan	CA 401 WQC-Cond. 4
		Del Norte Sediment Management Plan	Del Norte MOU
13	**Terrestrial and Wildlife Management Plan**	California Terrestrial and Wildlife Management Plan	CA 401 WQC-Cond 16
		Oregon Terrestrial and Wildlife Management Plan	OR 401 WQC-Cond 4
		Eagle Conservation Plan	CA 401 WQC-Cond 17
14	**Waste Disposal and Hazardous Management Plan**	California Hazardous Materials Management Plan	CA 401 WQC-Cond 11
		California Waste Disposal Plan	CA 401 WQC Cond. 12
		Oregon Waste Disposal and Hazardous Materials Management Plan	OR 401 WQC Cond. 9
		Oregon Spill Prevention, Control and Countermeasure Plan	OR 401 WQC-Cond 10
15		Oregon Water Quality Management Plan	OR 401 WQC-Cond 1

FERC Surrender Application Management Plans		Management Plans Identified in CA 401/FEIR/OR 401/Klamath MOU/CDFW MOU	
		Plan Subsections	**Governing Document**
	Water Quality Monitoring Management Plan	California Water Quality Monitoring Plan	CA 401 WQC-Conds 1 & 2
		Quality Assurance Project Plan	OR 401 WQC Cond. 1 CA 401 WQC Cond. 1
16	**Water Supply Monitoring and Management Plan**	California Water Supply Management Plan	CA 401 WQC-Cond 15
		California Public Drinking Water Management Plan	CA 401 WQC Cond. 15
		Oregon Groundwater Well Management Plan	OR 401 WQC-Cond.11
		Fire Management Plan	CA 401 WQC-Cond 15

NOTES:

1. THE SISKIYOU COUNTY MOU DOES NOT CONTAIN THE PREPARATION OF A SPECIFIC PLAN FOR COUNTY APPROVAL; RATHER IS OUTLINES SPECIFIC COMMITMENTS BETWEEN THE PARTIES. THESE COMMITMENTS WILL BE SUMMARIZED IN THE CONSTRUCTION PLAN PROVIDED TO FERC.
2. OR CWA 401 DOES NOT REQUIRE A GROUNDWATER WELL MANAGEMENT PLAN. IT RATHER IMPLIES THAT THE KRRC WILL DEVELOP SUCH IN ACCORDANCE TO THE 2018 DEFINITE PLAN REPORT. CONDITION 11 REQUIRES REPORTING BASED ON THE IMPLEMENTATION OF THE PLAN. THEREFORE, BY INFERENCE, THE PLAN IS REQUIRED.

9.0 LIMITATIONS

This report was prepared by Knight Piésold, with specific chapter contributions by Kiewit Power and Camas LLC, for the account of the Klamath River Renewal Corporation on behalf of Kiewit Infrastructure West Co. Report content reflects the best judgement of the authors, designers, and construction professionals involved based on the available information at the time of preparation. Any use a third party makes of this report, or any reliance on or decisions made based on it is the responsibility of such third parties. Knight Piésold, Kiewit, and other report contributors accept no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. Any reproductions of this report are uncontrolled and might not be the most recent revision.

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11.0 CERTIFICATION

This report is the product of a collaborative effort by several authors and reviewers from the Project Team (Knight Piésold, Kiewit Power, and Camas LLC).

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Report Sections 1, 2, 3, 4, 5, 6, and 7 and Appendices A, B, C, D, E, F, and G, were prepared and reviewed by the undersigned.

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Klamath River Renewal Project
100% Design Report

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CALIFORNIA – ROADS, BRIDGES, CULVERTS, RECREATION SITES REMOVAL

(Sections 6 and 7; Appendix F)

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OREGON – ROADS, RECREATION SITES REMOVAL

(Sections 6 and 7; Appendix F)

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