CONSTRUCTION SEDIMENT MANAGEMENT PROGRAM

ENLOE HYDROELECTRIC PROJECT
(FERC PROJECT NO. 12569)

MAY 2012

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

LIST OF ACRONYMS

BLM	Bureau of Land Management
BMPs	Best Management Practices
CCT	Colville Confederated Tribes
CESCL	Certified Erosion and Sediment Control Lead
CEII	Critical Energy Information Infrastructure
CSMP	Construction Sediment Management Plan
CWA	Clean Water Act
District	Public Utility District No. 1 of Okanogan County
Ecology	Washington Department of Ecology
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
ESCP	Erosion and Sediment Control Plan
FLA	Final License Application
MW	megawatt
NMFS	National Marine Fisheries Service
Project	Enloe Hydroelectric Project
RM	River mile
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WSDOT	Washington State Department of Transportation

1.0 INTRODUCTION

The Public Utility District No. 1 of Okanogan County (District) proposes to restore hydropower generation at Enloe Dam on the Similkameen River, approximately 3.5 miles northwest of Oroville, Washington.

The existing 3.2 MW small hydro powerhouse was decommissioned in 1958 as it was no longer cost-competitive with power purchased from new larger power plants. Since then, changes affecting the electric utility industry which have increased the cost of power from new sources and promoted development of renewable power have motivated the District to seek approval to restore hydropower generation at Enloe Dam.

Certification under Section 401 of the Clean Water Act (CWA) and a Federal Energy Regulatory Commission (FERC) license to re-establish power generation was last granted in 1992, however the license was subsequently rescinded due to irresolvable fish passage issues at the dam. The current FERC license application (FERC Project No. 12569) submitted August 22, 2008, proposes to restore power generation at Enloe Dam by building new hydropower infrastructure on the east bank of the river, opposite from the decommissioned facilities on the west bank. The project includes measures to protect fish species upstream and downstream of Enloe Dam.

This Construction Sediment Management Program (CSMP) has been developed pursuant to requests by Washington Department of Ecology (Ecology) and Washington Department of Fish and Wildlife (WDFW) for more detailed information regarding construction plans and supplemental information regarding sediment management measures to protect water quality in the Similkameen River during project implementation. The information is needed to support their current evaluation of the project prior to certification under Section 401 of the CWA that it will comply with state water quality standards.

The CSMP has been developed in consultation with Ecology, WDFW, U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Washington Department of Natural Resources (WDNR), Bureau of Land Management (BLM), and the Colville Confederated Tribes (CCT). Planning information in the CSMP is based on feasibility-level project information available prior to issuance of a FERC license authorizing development of the Project and will likely need to be updated prior to construction at such time when detailed engineering designs and construction plans are completed.

2.0 USE OF PRELIMINARY INFORMATION

Permitting and licensing processes are carried out early in the project development process to identify environmental issues and constraints, facilitate early adoption of necessary environmental protection and mitigation measures. These processes help in fully defining the scope of the project, and to minimize waste of valuable engineering, environmental and institutional/regulatory resources in pursuing implementation of infeasible or institutionally unacceptable projects. As a consequence, the project information available during the permitting process is feasibility-level preliminary information that is potentially subject to change and refinement in the post-FERC license phase as the project advances through detailed engineering design, detailed construction planning, implementation and decades of operation.

Front line responsibility for actual implementation of construction of the project and for developing the best means of construction to address applicable goals or constraints such as public safety, worker safety, compliance with permit terms and conditions, environmental protection, weather, site conditions, river conditions, construction budget and construction schedule is the responsibility of the Project Constructor to be engaged by the District. With regard to important environmental issues such as water quality, the Constructor's role is especially crucial because the Constructor is in real-time control of performance of construction and is the first line of defense in protecting water quality. To ensure compliance with permits and licenses the District will incorporate copies of permitting documents into bid documents for the project and require compliance as a contractual obligation.

In the context of the Enloe Project, the District submits that the best approach is to focus permit terms and conditions on performance standards or outcomes rather than using this preliminary information in a way that results in overly prescriptive terms and conditions that may not ultimately be the best solution considering all issues, risks and constraints. To best accommodate necessary changes during the project implementation process, the District suggests that the permit terms include an efficient and timely process for change management.

3.0 PROPOSED PROJECT DEVELOPMENT

The District proposes to restore hydropower generation at Enloe Dam on the Similkameen River. The existing decommissioned powerhouse is located on the west bank of the Similkameen River downstream of Enloe Dam. The Final License Application (FLA) filed with FERC on August 22, 2008 proposes building new hydropower generation facilities on the east bank, opposite from the decommissioned facilities on the west bank.

The new proposal offers renewable energy development, environmental, and constructability advantages. The proposed 9.0 MW facility has a footprint that is about half the size of the existing facilities while providing nearly three times the generating capacity of the existing decommissioned plant and about twice the average annual energy output.

The proposed project arrangement also reduces the length of river affected by diversion of a portion of streamflow through the power plant. Relocating the tailrace further upstream and closer to Similkameen Falls provides for better circulation of water to the pool at the base of the Falls, which provides a cool water refugia for fish using the Similkameen River. Construction access is also improved since the east bank of the river is readily accessible from existing roads and there is sufficient room to build necessary access road spurs for construction and maintenance of the facilities.

3.1 FERC LICENSE APPLICATION

Complete information regarding the proposed project including environmental studies is presented in the FLA cited above. Relevant exhibits of the FLA are as follows:

1. Project Description – Exhibit A
2. Project Operation – Exhibit B
3. Construction Schedule – Exhibit C
4. Environmental Report – Exhibit E
5. Engineering Drawings – Exhibit F

Pursuant to FERC licensing regulations, this information was developed in consultation with resource agencies including Ecology and WDFW and has been previously submitted for agency review and comment. These exhibits are also available for viewing or download (Subject to the distribution requirements of FERC's Critical Energy Information Infrastructure (CEII) protocol) at the following website: http://www.okanoganpud.org/enloe/FLA/enloeFLAmain.htm.

Locations of most existing features and proposed major facilities described in this CSMP are shown on Figure 1. Further details regarding proposed project facilities are shown on preliminary engineering drawings found in Exhibit F of the FLA (District 2008).

3.2 INSTREAM FLOW RELEASE FACILITIES

During review of the FERC License application and consultation with agencies including Ecology and WDFW regarding 401 certification, the issue of instream flow releases to protect potential fish habitat in the 370-foot-long bypass reach between Enloe Dam and Similkameen Falls was revisited. As a result minimum instream flow releases of 10 cfs year round increasing to 30 cfs from mid-July through mid-September are presently proposed. The proposed design concept is to add a conventional orifice controlled instream flow outlet to one of two existing penstock intakes in the right abutment of the dam. Natural flows exceeding the powerhouse capacity would flow unimpeded over the top of the dam.

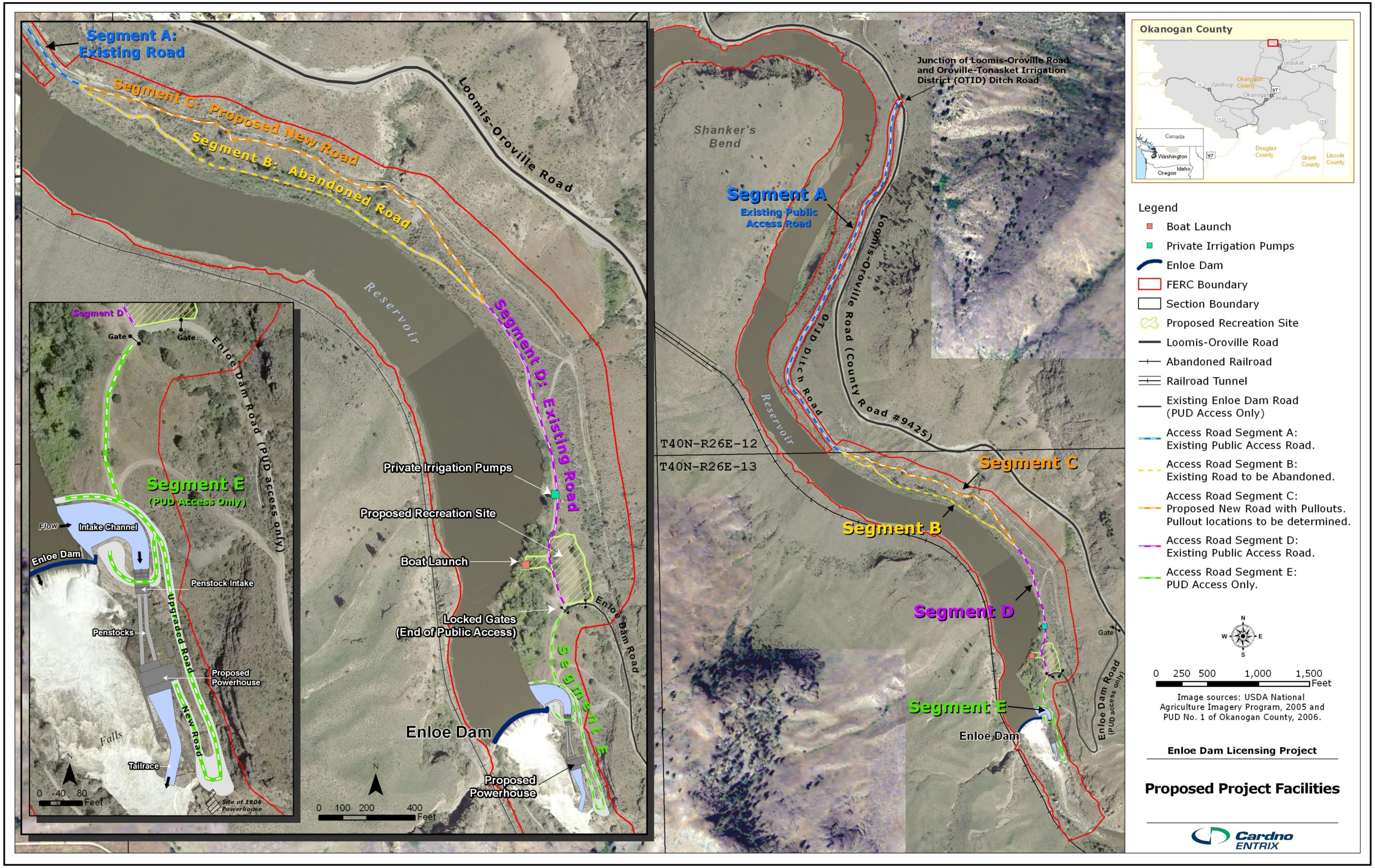


Figure 1. Proposed Project Facilities

4.0 EXISTING SITE AND FACILITY CONDITIONS

The Project is located at Enloe Dam, which is on the Similkameen River 8.8 river miles upstream from its confluence with the Okanogan River near Oroville in north central Washington. The Similkameen River originates on the eastern slopes of the Cascade Mountains near the USA-Canada border. From its headwaters, it runs north to Princeton in British Columbia, then turns to the southeast passing through Hedley and Keremeos, BC before crossing into the USA between Chopaka, BC and Nighthawk, WA.

From Princeton to Palmer Lake (located about 4 miles upstream of Nighthawk) the Similkameen River flows down a broad, low-gradient (approximate slope 1.5 feet/1000 feet) U-shaped valley reflecting geologically recent glaciation. Downstream of Palmer Lake, the river makes an abrupt turn to the northeast into a narrow, steep-sided valley that descends at a gradient of about 2.4 feet/1000 feet to Shanker's Bend at the upstream end of Enloe Impoundment. The impoundment is a 1.6 mile long narrow sinuous reach impounded in the river channel and its steep banks by construction of Enloe Dam, in 1923, just upstream of Similkameen Falls.

Downstream of Enloe Impoundment the river flows over the Falls and down a steep narrow canyon for another 2.5 miles where the valley starts to widen and the river gradient decreases as the river enters the broader Okanogan River Valley near Oroville, WA.

4.1 SOILS

Most of the soils present within or adjacent to the FERC boundary are classified as Nighthawk loam or Nighthawk extremely stony loam. Soils present in the areas of proposed construction consist of Nighthawk extremely stony loam.

Nighthawk extremely stony loam soils are generally formed in glacial till. These soils are deep and well-drained. Nighthawk extremely stony loam soils with 8 to 25 percent slopes (134) are characterized by medium runoff and present a moderate erosion hazard. When slopes reach 25 to 65 percent (135), these soils are characterized by rapid to very rapid runoff and present a high to very high erosion hazard (NRCS 2007).

Some of the soils present adjacent to the Similkameen River present high to very high erosion potential. Nighthawk extremely stony loam soils are present upstream of Shanker's Bend, adjacent to portions of Shanker's Bend, and on either side of the river adjacent to the dam, and proposed intake location. Landslide or mass wasting hazards are most likely to occur in these areas.

A complete description of site soils and their characteristics are presented in the FLA, Exhibit E.6 (District 2008).

4.2 GEOLOGY

Along the narrow valley section of the Similkameen River downstream of Palmer Lake and upstream of the Enloe impoundment, the uplands are composed primarily of Triassic-Permian metasedimentary and metavolcanic rocks of the Kobau Formation, interspersed with Jurassic metavolcanic, intrusive, and sedimentary rocks, Eocene conglomerate and Eocene intrusive dacite. Much of the valley and sideslopes are mantled in Quaternary glacial drift (Stoffel 1990).

In the immediate vicinity of the impoundment, highly deformed Triassic/Permian metamorphic rocks of the Kobau and Spectacle Formations are unconformably overlain by Jurassic/Cretaceous metaconglomerate and metavolcanic rocks of the Ellemeham Formation. These in turn are unconformably overlain by Eocene sandstone and conglomerate, and the latter are again unconformably overlain by Quaternary glacial drift, colluvium, and alluvial deposits (Villalobos 1982).

Within the impoundment itself, from Shanker's Bend downstream to approximately 1600 feet above the dam, the Similkameen River lies at the boundary of the Kobau and Ellemeham Formations; between 1600 feet above and 1000 feet below the dam the river flows over Eocene sandstone and conglomerate. Enloe Dam is located above Similkameen Falls on resistant granitic-clast conglomerate. Downstream of the dam and Falls the river again flows over Triassic/Permian metamorphic rocks of the Kobau and Spectacle Formations (Villalobos 1982).

4.3 TOPOGRAPHY

Topography in the Project Vicinity has been significantly affected by glaciation and is moderately steep and rugged. In the lower part of the river canyon, steep slopes adjacent to the river are interspersed with relatively flat benches of alluvial or glacial origin. The upper portions of the river canyon are steep and rocky. The mountains of the Okanogan Highlands lie to the east and the North Cascades to the west. Elevations range from 1,000 feet at the mouth of the Similkameen River at Oroville, to over 3,600 feet at the summit of surrounding mountains.

In the area of the proposed construction adjacent to the eastern side of the existing dam and spillway, the topography is steep and rugged with exposed bedrock. Trees and other vegetation are sparse.

4.4 CLIMATE

The climate in the lower Similkameen River watershed is typical of eastern Washington, with cool, moist winters and hot dry summers. The Cascade Mountains act as a barrier to the movement of maritime and continental air masses, creating the generally dry conditions observed in the Project Vicinity. Average annual precipitation is approximately 11 inches. River flows peak in late spring to early summer when warm temperatures melt the extensive winter snowpacks at the higher elevations in the watershed. Low flows occur in mid-winter when cold temperatures minimize runoff.

4.5 VEGETATION

The deep gorge cut by the river traverses steep, sparsely vegetated rocky hills. Shrub-steppe vegetation communities dominate the lower elevations of the Similkameen River Canyon. The most prevalent species include sagebrush and bitterbrush, with an understory of cheatgrass, bluebunch wheatgrass, and associated herbaceous species. Moist draws and seasonally flooded areas support deciduous trees and shrubs including black cottonwood, willow, water birch, mountain alder, Douglas hawthorn, and red-osier dogwood. The steepest slopes and draws above the river are sparsely vegetated with scattered ponderosa pine and deciduous shrubs, such as smooth sumac and serviceberry.

4.6 SURFACE AND GROUNDWATER DRAINAGE

Surface water drainage consists mainly of runoff that originates in high elevations from snowmelt in spring and early summer and rain events. Surface drainages consisting of intermittent streams and gullies are present on both sides of the river in and adjacent to the project area.

Groundwater in this watershed is primarily supplied in valley bottom areas where there are glacial and alluvial deposits. The Similkameen River once flowed southward through the valley now occupied by Palmer Lake and Sinlahekin Creek. During the last glaciation the river was rerouted through several temporary channels until it finally settled into its current channel as the glacier retreated. Glacial and alluvial deposits in the original channel and the temporary channels are several hundred feet thick with moderate to high yield aquifers (ENTRIX 2006). The alluvial and glacial deposits are comprised largely of fine sand, silt and clay, with some thin lenses of coarse sand and gravel. Permeability and yields in this unit can be quite high (PNRBC 1977). In contrast, where there is a lack of glacial or alluvial deposits, scarce groundwater is available in a second unit, which consists chiefly of metamorphic, granitic, and consolidated sedimentary rock with low permeability and porosity. This unit is important to the regime of surface streams draining it however, and provides small supplies to many wells and springs in the region (PNRBC 1977).

During low flow periods, there is very little flow added to the river between the USGS flow station at Nighthawk (RM 15.8) and the Ecology flow station at RM 5.0, indicating that groundwater discharge is not a significant contributor to flow in the reach of the Similkameen River which includes the project site.

4.7 ADJACENT WATERWAYS

Upstream of the dam and within the FERC boundary, several ephemeral streams that drain into the Similkameen River are located within the project area. During periods of snowmelt and heavy rain, these ephemeral streams flow into the Similkameen River.

Just downstream of the dam, ephemeral Ellemeham Draw drains into the Similkameen River from the west within the proposed project boundary. There are no known flow records for this small creek.

4.8 EXISTING FACILITY CONDITIONS

Presently, remains of the original Enloe Hydroelectric Project powerhouse are located against a steep face on the west bank. The powerhouse has deteriorated and has been vandalized.

Two unpaved roads shown in Figure 1 provide access to the dam site: Enloe Dam Road and the old Oroville-Tonasket Irrigation District (OTID) Ditch Road.

- Enloe Dam Road is a county road, designated by Okanogan County as an unmaintained primitive road. Due to its steep grade, deep ruts and loose gravel surfacing the road is only suitable for careful use by vehicles with four-wheel drive.

- Currently, the OTID Ditch Road provides access for Oroville Golf Club personnel to reach an irrigation pump upstream of Enloe Dam, as well as informal access for recreationists, ranchers, agencies, tribes, and the District.

On a terrace northeast of the east dam abutment stand trees planted in rows where houses occupied by operators of the hydroelectric facility once stood. Stone walls and concrete foundations are all that remain of the razed structures. Further downstream, below the dam, is an intake channel excavated in rock that once diverted water to an original powerhouse predating the Enloe Hydroelectric Project powerhouse on the west bank of the river. Concrete foundation remains mark the location of the earlier building. Further downstream directly across the river from the existing powerhouse is a steel tower that once anchored a wooden footbridge by which operators reached their workplace from the houses upstream.

Proposed activities including construction of the new powerhouse and related infrastructure, access road improvements, and recreation area improvements are described in Section 5.0.

4.9 SIMILKAMEEN RIVER SEDIMENTS

The Similkameen River watershed was historically mined resulting in a legacy of elevated metals concentrations in some river sediments. These elevated metals concentrations are a potential concern for water quality during disturbance of the existing sediment deposits both within Enloe Impoundment and the Similkameen River upstream and downstream of Enloe Dam.

Although sediments are mobilized and redistributed in the Similkameen River during the snowmelt season and during major storm events, minor changes to sediment transport and distribution could occur during construction of the project, with the potential for short-term has impacts to water quality. Accordingly, sediment transport and sediment quality in the impoundment and river were characterized in the FLA. Measures to avoid potential water quality impacts are described in later sections of this CSMP.

4.9.1 Mining History

Mining was once a dominant land use in the region. However, commercial mining activity in the Similkameen Valley in Washington has been very limited during the past 25 to 35 years. Several small individual mining claims exist on U.S. Bureau of Land Management (BLM) lands in the Project vicinity.

One of the largest mines in the area was the Kaaba-Texas Mine, located several miles upstream of the Project area, near the community of Nighthawk. The mine operated from the late 1890's until 1951, and discharged tailings directly into the Similkameen River until 1946. In 1999, the Environmental Protection Agency (EPA) removed and disposed of approximately 81,000 cubic yards of contaminated mine tailings from the mine site. There are also deposits of mine tailings bordering the Similkameen River and its tributaries upstream in Canada resulting from a long history of mining in the reach between Princeton and the Canada/US border.

Recreational gold prospecting (small-scale placer mining; conducted primarily with motorized suction dredges) is popular within the river corridor, as discussed in the FLA, Exhibit E.7. Sediment is suction dredged from the river bottom, screened for gold and then discharged back into the river. The quantitative impact of recreational mining on water quality parameters in the Similkameen River is not known.

Contamination from historical mining operations in the Similkameen River watershed has resulted in arsenic concentrations exceeding water quality criteria in samples from Chopaka Bridge, British Columbia (RM 36.1) and Oroville, Washington (RM 5.0). Ecology has completed a Total Maximum Daily Load (TMDL) evaluation (Johnson 2002) and prepared a draft implementation plan (Peterschmidt 2005) to address the arsenic contamination. Because arsenic levels naturally exceed water quality criteria, the loading capacity for the river was set equal to the natural background concentration of arsenic (i.e., 0.4 to 0.6 µg/L total recoverable arsenic). The greatest amount of arsenic loading identified by the TMDL evaluation was re-suspension of sediments in the vicinity of Palmer Creek (RM 20), approximately 10 miles upstream from the Project. An analysis of shallow sediment core samples for trace metals, performed for the Colville Confederated Tribes (CCT), confirmed arsenic contamination in the Similkameen River and Palmer Creek upstream from Nighthawk, Washington (Hurst 2003). Copper also exceeded a CCT Sediment Quality Standard in several samples and cadmium exceeded the standard in one sample.

4.9.2 Sediment Quality Standards

A study was conducted to determine the sediment quality related to potential contamination from legacy mine activity upstream from the Project (FLA, Appendix E.2.6). The results of this study are provided as Appendix A.

Chapter 173-204-340 of the Washington Administrative Code (WAC) states that freshwater sediment quality standards are reserved (Ecology 2006). Further, this section states that Ecology shall determine on a case-by-case basis the criteria, methods and procedures necessary to meet the intent of the Sediment Management Standards (SMS). The overall purpose of the SMS is to reduce and ultimately eliminate adverse effects on biological resources and significant health threats to humans from surface sediment contamination. While there are no established Washington State regulatory criteria for chemical contaminants in freshwater sediments, there are several sediment quality values that have been used to indicate potential toxic effects in aquatic life.

Chapter 4-16 of the current CCT Tribal Code contains sediment cleanup levels both for the protection of human health and for the protection of sediment-dwelling organisms (CCT 2008). The CCT adopted cleanup screening levels for eight metals, including arsenic, cadmium and copper.

In research published by Ecology, (Michelsen 2003) examined the levels of protection and the reliability of apparent effects thresholds and other sediment quality values in predicting toxic effects. Based on this analysis, sediment quality standards and cleanup screening levels for freshwater sediment were recommended. The CCT criteria and Ecology's non-regulatory sediment quality values are presented for comparisons with the sample results in Appendix A.

4.9.3 Existing Sediment Inputs

A Bank Stability and Erosion Assessment (FLA, Appendix E.6.2) was performed by the District. This assessment identifies major and minor erosional and depositional features upstream and downstream of the Enloe Dam that may affect sediment transport processes and fish habitat in the Similkameen River and impoundment above Enloe Dam. In addition, the effect of future construction and operational activities associated with Enloe Dam on channel and bank stability, sediment transport mechanisms, and impoundment characteristics were also evaluated.

4.9.4 Sediment Regime in Enloe Impoundment

A sediment transport model was established to analyze the sediment regime within the impoundment above Enloe Dam at current conditions with the proposed new facilities (FLA, Appendix E.2.3).

The results of a sediment transport model (Appendix B) suggest that the Enloe impoundment forebay undergoes an annual cycle of erosion and deposition, and that the additional erosion that will occur due to project operations at relatively low flows is minimal compared to the amount of erosion that occurs every year during the peak flows. The sediment observed in the forebay during low-flow bathymetric surveys is likely to be a transient feature that does not contain legacy sediments from early in the impoundment's history. Although there are uncertainties associated with the construction of the 2-D hydraulic model and the sediment mobility analysis, the general pattern is robust: sediment builds up in the forebay during relatively low-flow portions of the year and is largely flushed out during annual peak flows. This pattern is expected to continue during proposed project operations.

5.0 PROPOSED CONSTRUCTION ACTIVITIES

This chapter provides additional information regarding proposed project construction activities. A summary of construction activities including detailed preliminary information requested by Ecology and WDFW regarding construction processes potential durations, area and volumes of material and a construction schedule are provided in this Section.

Supplemental information requested by Ecology and WDFW regarding site specific sediment management measures is found in Chapter 7.

5.1 ACCESS ROAD

The District proposes to work with the County to vacate Enloe Dam Road to public use and provide access by rehabilitating the OTID Ditch Road. The Enloe Dam Road will be maintained for use only by the District to provide maintenance access. It will be gated at the Loomis-Oroville Road intersection.

No public vehicle access will be provided beyond the proposed parking and recreation area shown on Figure 1; access beyond this point will be limited to authorized vehicles for security reasons. The OTID Ditch Road will be improved to a single lane gravel road with several turnouts within line of sight for use by larger construction traffic and recreation vehicles. The location of the OTID Ditch Road is presented on Figure 1 and is divided into Segments A through E.

Segment A refers to the portion of the OTID Ditch Road from its intersection with the Loomis-Oroville Road to a point just past the FERC boundary. Segment B refers to the existing roadway, which is normally flooded during periods of high water and thus will be abandoned to a point downstream of the inundated riparian area. Segment C will be reconstructed over the abandoned irrigation canal as the primary Project access road. Segment C crosses several small gullies in short lengths of elevated concrete flume. These gullies will be crossed by embankments constructed with excavated rockfill from the project. Segment C will travel along the ditch for 1530 feet before descending 475 feet to an existing spur road to rejoin Segment B (to be abandoned) at a point beyond the inundated riparian area. Segment D will continue from that point 1375 feet to terminate public access at a proposed recreation site near the dam, as illustrated in Figure 1.

The headworks and the east abutment of the dam will be accessible to the District from a 400 foot long section of road (Segment E) that will run east then south along the east side of the intake channel then turn west to cross the penstock intake structure to end at a turnaround area near the east abutment of the dam.

District vehicle access to the penstocks, powerhouse and tailrace downstream of the dam will be developed by realigning and widening an existing road that runs south along the east bank of the river downstream of the dam to a point about 500 feet downstream (also Segment E). At this location the road will turn back upstream and a 230 foot long section of new road will run along the east side of the tailrace channel to the new powerhouse.

Information regarding the construction process is summarized on Table 1. Construction of the access road will not involve any excavation of river-deposited sediments that require special handling because of the potential for trace metal contamination.

5.2 STAGING AND STORAGE AREAS

Construction of the proposed project will require temporary staging and storage of construction materials and equipment. Figure 2 depicts the locations of proposed staging and storage areas. Construction materials such as aggregate, wood, reinforcing steel, structural steel, formwork, falsework, roofing material, prefabricated sections of penstock, pipework, and pre-fabricated electrical/mechanical equipment will be temporarily stored within these areas. Additionally, construction equipment will be stored and maintained within these locations and temporary office buildings will be installed for use during construction. These buildings will be removed upon completion of the work. Portable sanitary facilities will be used with offsite disposal of effluent by tanker truck.

The Information regarding the construction process for construction staging areas is summarized on Table 1 and further discussed in Chapter 7. The layout of construction staging areas will be determined in the future by the selected constructor as part of its construction planning.

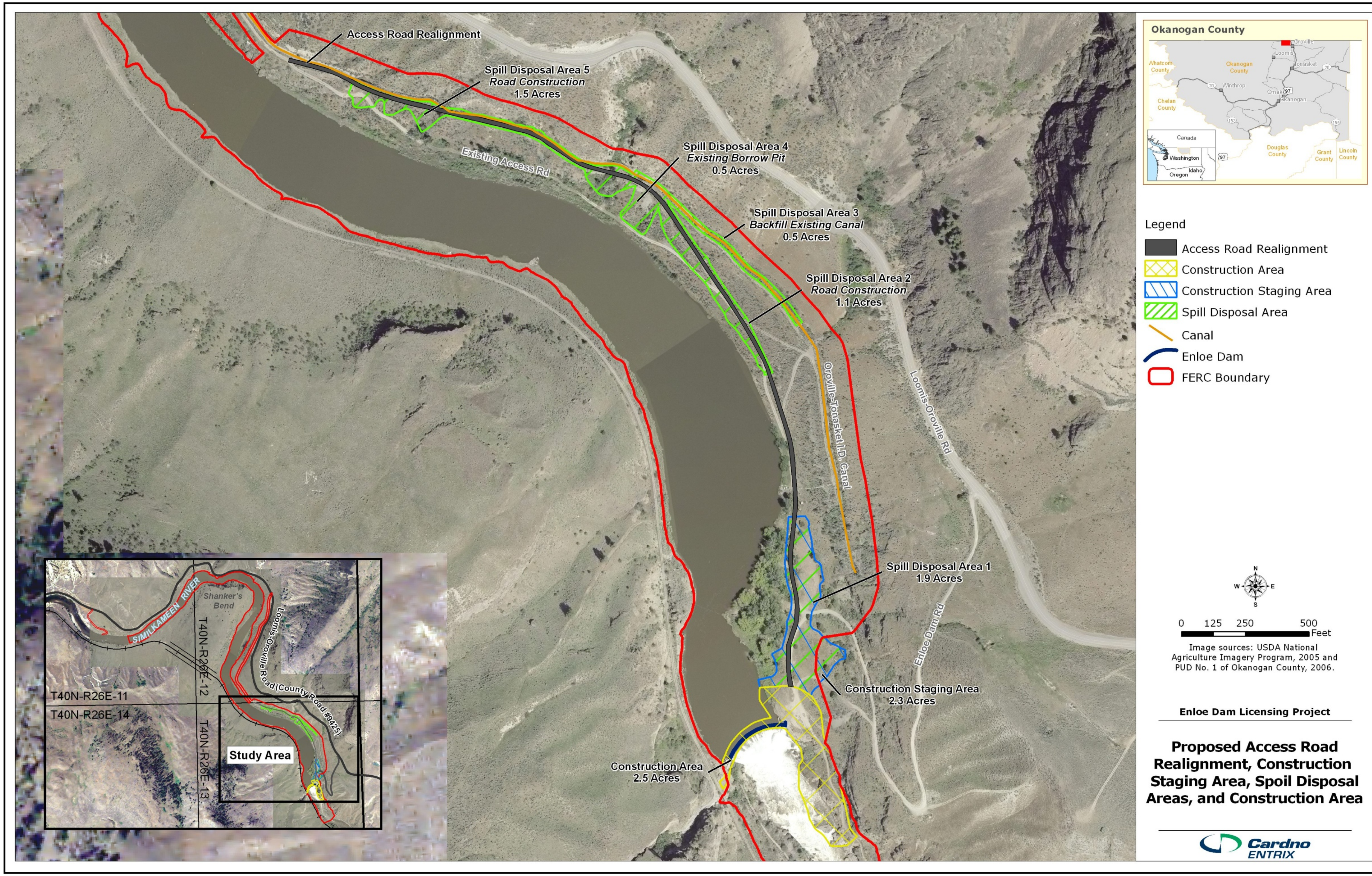


Figure 2. Proposed Spoil Disposal and Construction Staging Areas

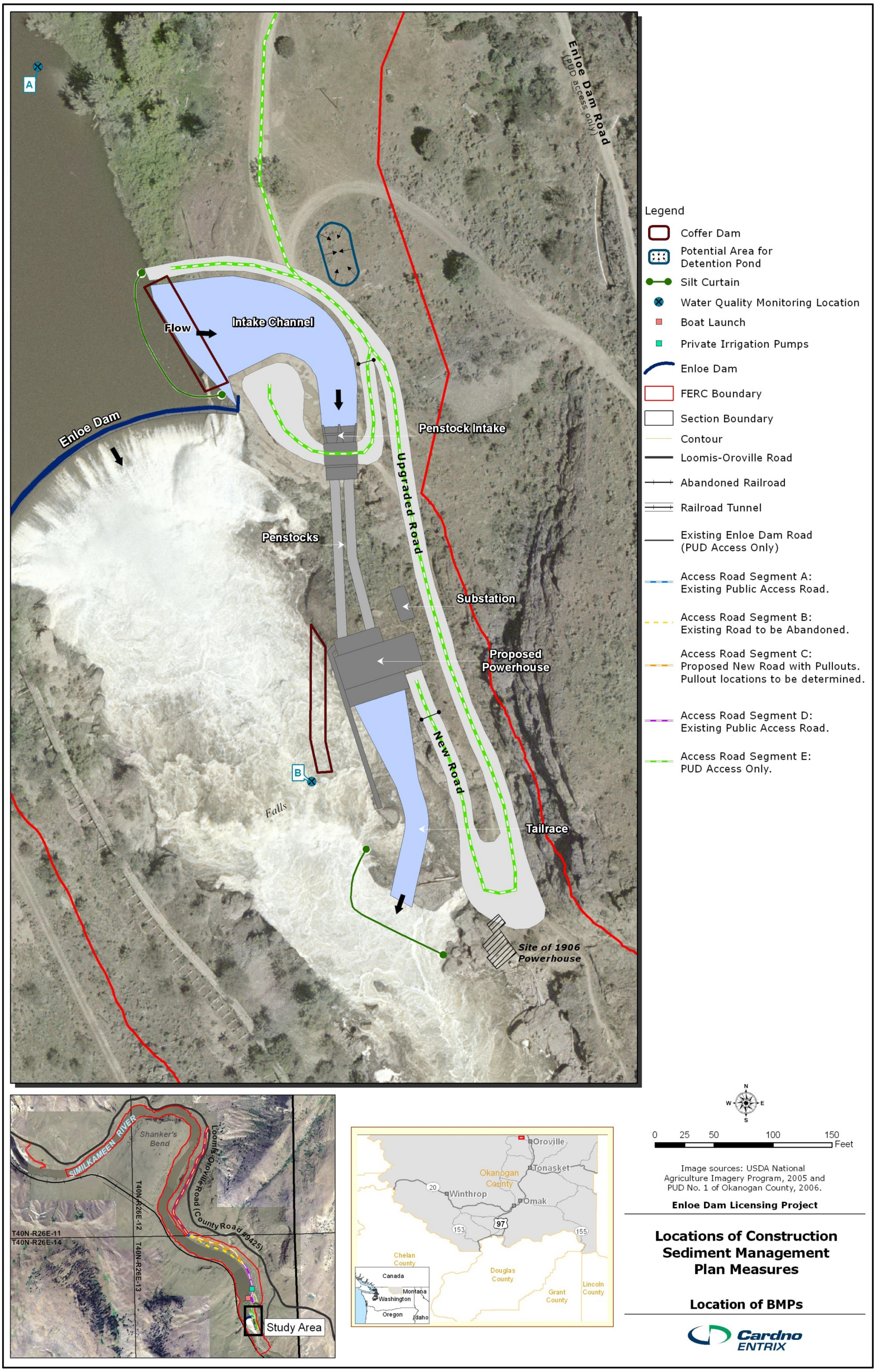


Figure 3. Proposed BMP Locations

5.3 INTAKE CHANNEL

An intake channel will divert a portion of the streamflow from the Similkameen River to the penstock intake structure that serves the proposed new power plant. The canal is designed to be wide and shallow at the upstream end to minimize disturbance to existing sediment in the impoundment, and deep at the penstock intake structure to provide adequate submergence. The location of the intake channel is presented on Figure 3.

The intake channel will carry inflow from the river intake structure to the penstock intake structure. The canal will be an approximately 190 foot long unlined trapezoidal cross section canal excavated in shallow overburden soil and rock. The canal will taper from about 100 feet top width and 8 feet deep at the riverbank to about 40 feet top width and 26 feet deep at the penstock intake structure.

Depending on rock bedding and jointing, benching and rock bolting may be required during the excavation, to ensure long term stability of the side slopes. Some grouting may also be required to control seepage losses through joints in bedrock that forms the east abutment of the dam.

Construction work will include clearing and grubbing of existing sparse vegetation, stripping of overburden soil, either ripping or controlled blasting of bedrock. Construction equipment will include scrapers, excavators, backhoes, dump trucks, rock drills, compressors and cranes.

Construction in this area will involve excavation of some river-deposited sediments that require special handling because of the potential for trace metal contamination. Further detailed information regarding construction plans and sediment management measures is provided in Chapter 7.

5.4 PENSTOCK INTAKE

As shown on Figure 1, and Exhibit F of the license application, the penstock intake will be constructed at the downstream end of the dewatered intake canal, and cut into bedrock that forms the east abutment of the dam. The proposed structure is a 35 foot long by 30 foot wide by 36 foot high reinforced concrete conveyance founded on bedrock and surmounted by a 30 feet long by 12 feet wide by 15 feet high gatehouse building. Construction of the penstock intake will not involve any excavation of river-deposited sediments that require special handling because of the potential for trace metal contamination.

Construction of this structure will involve, foundation preparation including cleanup and grouting (if needed), erection of wooden or steel formwork, installation of reinforcing steel, placement of concrete by pumps or crane and skip, stripping of formwork, erection of the gatehouse followed by installation of gates, trashracks and other electrical or mechanical equipment.

Typical construction equipment will include rock drills, compressors, excavators, grout pumps, electric generators, trucks, loaders, mobile cranes, concrete pumps, welding equipment and painting equipment.

5.5 PENSTOCKS

Two above-ground steel penstocks, 8.5 feet in diameter and approximately 150 feet long, will slope steeply from the intake to the powerhouse and will carry water to the turbines. The penstocks will be supported on concrete saddles and by concrete anchor blocks at the penstock bends which will be constructed on an excavated bench. Spoil from foundation excavation will be removed by excavator and transported by truck to designated spoil disposal areas adjacent to the main project access road. Construction of the penstocks will not involve any excavation of river-deposited sediments that require special handling.

Construction activities will include excavation of foundations for saddle supports and anchor blocks, reinforced concrete construction, erection of prefabricated sections of penstock, either welding of penstock sections or connection by compression couplings followed by touch-up painting.

Typical construction equipment will include compressors, drills, excavators, loaders trucks, mobile cranes, welding and painting equipment.

5.6 POWERHOUSE

The proposed powerhouse location is sited in an alcove on the east bank of the Similkameen River about 230 feet downstream of the east abutment of Enloe Dam and 140 feet upstream of Similkameen Falls.

A concrete training wall constructed at the west end of the powerhouse will separate the powerhouse and tailrace channel from the stilling basin area downstream of Enloe Dam.

The reinforced concrete powerhouse structure will be about 70 feet long and 30 feet wide and will house two vertical axis Kaplan turbine/generator units, controls, switchgear and a repair bay.

The reinforced concrete substructure will be founded in an open rock excavation in bedrock that outcrops in the banks of the river and the broad terrace upstream of the falls. To accommodate a large fluctuation in tailrace water level, the powerhouse walls will be of reinforced concrete to El. 995 feet. Above this elevation, the walls will be structural steel with insulated metal cladding. The repair bay and laydown area will be located at the east end of the powerhouse, with a floor elevation of approximately El. 995 feet. Construction of the powerhouse will not involve any excavation of river-deposited sediments that require special handling.

Construction of the powerhouse will involve, foundation preparation including cleanup, rock bolting and grouting (if needed), erection of wooden or steel formwork, installation of reinforcing steel, placement of concrete by pumps or crane/skip, stripping of formwork, erection of the powerhouse superstructure followed by installation of mechanical and electrical equipment.

Typical construction equipment will include compressors, drills, pumps, excavators, haul trucks, grout pumps, electric generators, trucks, mobile cranes, forklifts, concrete pumps, vibrocompaction equipment, concrete finishing equipment, gas and arc welding equipment and painting equipment.

5.7 TAILRACE

The tailrace channel will convey water a distance of about 180 feet from the powerhouse to the Similkameen River, downstream of the Similkameen Falls. It will be an unlined steep-sided trapezoidal channel excavated in rock by controlled blasting techniques. The channel top-width will taper from about 55 feet at the powerhouse to about 25 feet at a distance of about 75 feet downstream of the powerhouse. Downstream of this point, to the river, the channel top-width will be 25 feet. The invert of the channel will be about 30 to 40 feet below the existing rock terrace on the east side of Similkameen Falls. The location of the tailrace is shown on Figure 1.

Construction work will include rock excavation either by excavator-mounted hoe-ram equipment or controlled blasting of bedrock into fragments followed by removal by excavator. Construction of the tailrace will not involve any excavation of river-deposited sediments that require special handling because of the potential for trace metal contamination. Typical construction equipment will include rock drills, compressor, excavators, backhoes, dump trucks, rock drills, and mobile cranes.

5.8 CREST GATES

The proposed project includes restoring the functionality of the flashboards on the crest of the existing spillway by retrofitting crest gates. These gates will be 5 feet high, and will increase the water level upstream of the dam and the hydraulic head available for power generation. Due to the curvature of the crest, the steel flap gates will be installed in short straight sections with flexible connections. The gates will be raised by air bladders installed between the gate and the spillway crest. Two small piers will be added to the spillway crest to divide the crest into three gated sections and provide air intakes for the spillway overflow. Construction of crest gates will not involve removal of river-deposited sediments that require special handling because of the potential for trace metal contamination. Further detailed information regarding construction plans is provided in Chapter 7.

5.9 INSTREAM FLOW RELEASE FACILITIES

During review of the FERC License application and consultation with agencies includingEcology and WDFW regarding 401 certification, the issue of instream flow releases to protect potential fish habitat in the 370-foot-long bypass reach between Enloe Dam and Similkameen Falls was revisited. As a result minimum instream flow releases of 10 cfs year round increasing to 30 cfs from mid-July through mid-September are presently proposed.

The proposed design concept is to add a conventional orifice controlled instream flow outlet to one of two existing penstock intakes in the right (i.e. west)abutment of the dam. The outlet works is designed to provide a minimum hydraulic capacity of 30 cfs over a range of water surface elevation from El. 1043.3 feet (1 foot below the existing spillway crest) up to El. 1048.3 (the normal reservoir water surface elevation with the crest gates raised).

Water would be drawn from the reservoir via the existing penstock intake in the west abutment of the dam. The centerline of the intake is at El. 1032 (i.e., about 16 feet below the proposed normal water surface elevation of the reservoir). A trashrack with 1-inch clear spacing between bars would be provided in the existing bulkhead gate slots to exclude trash and adult fish.

A steel bulkhead would be installed in the outlet of the existing steel penstock that emerges from the downstream face of the dam. A new approx 70 foot long 18 inch diameter steel pipeline would carry flow from its connection with the bulkhead to a proposed new ring jet discharge valve to be sited about 75 feet downstream of the axis of the dam on a rock promontory on the west bank of the river overlooking the spillway plunge pool. A guard valve would be provided at the upstream end and a magnetic flowmeter would be installed on the pipe to measure flow.

The outlet of the ring jet valve will be at Elevation 1004.5 feet. which is about 17 feet above the normal water level in the spillway plunge pool. The valve will be angled upward at about 30 degrees so that the flow trajectory would be as long as possible to facilitate spreading and aeration of the discharge jet. The instream flow outlet works is further described in Appendix D

5.10 RECREATION AREA IMPROVEMENTS

Recreation area improvements include the access road improvements as described above, improvements to the existing boat ramp, and completion of an improved park-like area near the dam that includes a parking area and vault toilet. A vehicle and trailer parking area will be located a few yards away from the improved boat ramp. Construction in the boat ramp area may involve excavation of some river-deposited sediments that require special handling because of the potential for trace metal contamination. These improvements are described in detail in the Recreation Management Plan (RMP).

5.11 CONSTRUCTION SCHEDULE

A preliminary construction schedule as shown in Figure 3 has been developed to show the sequencing of principal project activities through the implementation of the project following issuance of the FERC license.

The four-year preliminary construction schedule, which was originally prepared based on information available in 2008, is based on a traditional design-bid-build approach to design engineering and construction, however, depending on factors such as risk management, time constraints or project financing needs, the District may choose to construct the Project under a design-build approach.

The sequencing of construction activities, especially those affected by river and weather conditions, is seasonally constrained. The schedule assumes issuance of the FERC License before spring of the first year so that engineering design can immediately proceed and seasonally constrained construction in the area downstream of the dam can commence after recession of the annual flood in the second year. Due to these seasonal constraints, significant delay in the early part of the schedule due to issues such as timely receipt of regulatory approvals may cause the schedule to slip a full year.

The preliminary construction schedule shows the planned sequencing of engineering design and construction activities. Engineering design will take about 10 months and will include supplementary investigations to assist in final engineering design. Preparation of bid documents, solicitation of bids from equipment vendors and construction contractors, and negotiation of contracts are estimated to take an additional six months.

Procurement, manufacture, and delivery of the two-unit water-to-wire turbine/generator package is expected to take 12 months, with shorter periods required for smaller packages such as gates, hoists, penstock cans, transformers, switchgear etc. These will be sequenced to suit construction plans.

Construction of power facilities is planned to take about 18 months. Road access improvements, installation of a temporary cofferdam, and construction of the training wall will be carried out prior to an assumed three month shutdown during the second winter. Most of the site excavation and concrete construction will be conducted during the following construction season, with installation of electrical and mechanical equipment occurring in Fall and through the third Winter. When the plant is substantially complete it will be tested and commissioned and will be scheduled to commence operations in spring of the fourth year.

Installation of the crest gates will be carried out during fall of the fourth year when river flows are low at which time the new power plant will be used to draw down the impoundment to an elevation just below the crest of the spillway. During this time, a temporary siphon will be installed on the spillway crest to maintain downstream flow in the event of an unplanned plant outage.

Table 1 Summary of Main Construction Activities

Proposed Construction Activity	Description of Construction Activity	Approx Surface Area (AC)	Approx Excavated Material Volume (Bank CY[7])	Approx Fill Material Volume (Bank CY)	Expected Construction Material Types	Process type	Approx. Process duration (Weeks)	Typical Construction Equipment	Temporary Construction Works
Access Road Construction	The existing access road on the east side of the falls will be improved and extended to gain construction access to the powerhouse and tailrace channel. The OTID Ditch Road will be improved to a single lane gravel road with several turnouts within line of sight for use by larger construction traffic and recreation vehicles.	4.15	5000	34400	Overburden comprised of gravelly loam soil Excavated conglomerate/sandstone rock. Sand/silt from impoundment.	Clearing and Grubbing, Excavation Fill placement and compaction. Grading Retaining walls Stormwater drainage As-needed rock sorting and crushing	20	Excavators Loaders Scrapers Off-road dump trucks. Bulldozers Graders Compactors, Rock sorting/crushing equipment Water trucks	Temporary rock sorting and crushing operations may be required.
Staging and Storage Area Construction.	Construction of temporary staging and storage areas needed to store construction materials and equipment	1.96	N/A	6800	Overburden comprised of gravelly loam soil Excavated conglomerate/sandstone rock.	Clearing and Grubbing, Excavation Fill placement and compaction. Grading As-needed rock sorting and crushing	4	Excavators Loaders Scrapers Off-road dump trucks. Bulldozers Graders Compactors, Rock sorting/crushing equipment Water trucks	
Intake Channel Construction	190 foot long unlined trapezoidal cross section canal excavated in rock. The canal will taper from about 100 feet wide and 8 feet deep at the riverbank to about 40 feet top-width and 26 feet deep at the penstock intake structure.	0.43	1900	N/A	Overburden gravelly loam soil Excavated conglomerate/sandstone rock River bottom sediment	Clearing and Grubbing, Excavation of shallow overburden soil Ripping of soft rock Controlled blasting of conglomerate/sandstone rock. Some grouting may also be required.	12	Scrapers Dump trucks Excavators Rock drills Compressors Cranes	Benching and rock bolting may be required during the excavation. A temporary coffer dam may be necessary to isolate the work area from flow.
Penstock Intake Construction	35 foot long by 30 foot wide concrete intake structure founded on bedrock	0.07	1800	N/A	Overburden comprised of gravelly loam soil Excavated conglomerate/sandstone rock. Reinforced concrete	Clearing and Grubbing, Excavation of shallow overburden soil Ripping of soft rock Controlled blasting of conglomerate/sandstone rock. Some grouting may also be required. Construction of reinforced concrete structure. Installation of electrical and mechanical equipment	16	Scrapers Dump trucks Excavators Loaders Rock drills Compressors Cranes Concrete trucks	
Penstock	8.5 feet in diameter and approximately 150	0.10	800	200	Overburden	Clearing and Grubbing,	12	Excavators,	

Table 1 Summary of Main Construction Activities

Proposed Construction Activity	Description of Construction Activity	Approx Surface Area (AC)	Approx Excavated Material Volume (Bank CY[7])	Approx Fill Material Volume (Bank CY)	Expected Construction Material Types	Process type	Approx. Process duration (Weeks)	Typical Construction Equipment	Temporary Construction Works
Construction	feet long				comprised of gravelly loam soil Excavated conglomerate/sandstone bedrock. Reinforced concrete Steel penstock.	Excavation of shallow overburden soil Ripping of weathered rock Controlled blasting of conglomerate/sandstone bed rock. Construction of concrete foundations Installation of welded steel penstock		Loaders Haul trucks Cranes Concrete trucks Compressors Welders Painting equipment	
Powerhouse Construction	70 feet long and 30 feet wide powerhouse structure	0.11	6800	N/A	Excavated conglomerate/sandstone bedrock. Reinforced concrete. Mechanical and electrical equipment	Clearing and Grubbing, Excavation of shallow overburden soil Ripping of soft rock Controlled blasting of conglomerate/sandstone rock. Construction of reinforced concrete building Installation of electrical and mechanical equipment	48	Excavators, Loaders Haul trucks Crane Concrete trucks Compressors Concrete Vibrators Welders Generators Pumps Painting equipment	A permanent concrete training wall will be constructed to isolate the site from the spillway discharge.
Tailrace Construction	Excavated channel in rock that will be about 180 feet long. The channel width will taper from a top width of about 55 feet at the powerhouse to about 25 feet at a distance of about 75 feet downstream of the powerhouse. Downstream of this point, to the river, the channel width will be 25 feet. The invert of the channel will be about 30 to 40 feet below the existing rock terrace on the east side of Similkameen Falls.	0.14	6000	N/A	Excavated conglomerate/sandstone rock.	Controlled blasting of conglomerate/sandstone rock. Excavation and disposal of spoil. Some rock support consisting of rockbolts and shotcrete may be needed.	32 Note: This is total duration Conceptual plan is to carry out the work in two stages	Excavators Excavators with impact tools Loaders Dump trucks Rock drills Compressors Cranes	A bedrock plug will be left in place to isolate the excavation from the river. Prior to removal of the cofferdam during low flow a net will be installed to exclude anadromous fish and a turbidity curtain will be installed to contain suspended sediment during wet excavation of the rock plug.
Crest Gate Construction	Construct two reinforced concrete piers on existing crest of Enloe dam and install 5 feet high crest gates. No ground disturbance.	0.13	N/A	N/A	Two Reinforced Concrete Piers	Concrete Placement and Forming. Installation of sole plates on the dam crest Installation of gates and equipment	8	Barge, Concrete Mixer Jackhammer Formwork. Crane Compressor Welder	During construction the contractor may install a temporary elevated walkway across the concrete spillway for personnel access.

Table 1 Summary of Main Construction Activities

Proposed Construction Activity	Description of Construction Activity	Approx Surface Area (AC)	Approx Excavated Material Volume (Bank CY[7])	Approx Fill Material Volume (Bank CY)	Expected Construction Material Types	Process type	Approx. Process duration (Weeks)	Typical Construction Equipment	Temporary Construction Works
Instream Flow Release Facilities		.07	0	0	Steel pipeline., steel valves, concrete foundations, access stairs	Clearing and grubbing, construction of foundations, concretework, installation of pipeline, valves and controls.	4	Crane, compressor, jackhammer, welder, generator, concrete truck	Construction access from railroad right of way.
Recreation Area Improvement Construction	Improvements to the existing boat ramp, and completion of an improved park-like area near the dam that includes a parking area and vault toilet. A vehicle and trailer parking area will be located a few yards away from the improved boat ramp	TBD	TBD	TBD	Vegetation Material, Soil, Concrete, Asphalt	Clearing and Grubbing, Excavation, Fill placement and compaction, Concrete placement, Asphalt placement, Revegetation Installation.	TBD	Excavators, Graders, Dozers, Asphalt Paving Equipment, Concrete Mixer and Formwork. Haul Trucks	A temporary coffer dam may be necessary to isolate the boat ramp work area from flow.

Notes:

1. This preliminary information developed to support the application for a permit under Section 401 of the Clean Water Acct. is based on conceptual level engineering design drawings developed for the FERC License application for The Enloe Hydroelectric Project FERC Project No. 12569.
2. The information is for permitting processes and not for construction purposes.
3. Preliminary Information will be subject to change during the process of detailed engineering design of the project and development of detailed construction plans by the contractor.
4. Staging and duration of activities will depend on uncertain factors such as weather and river conditions during the construction period.
5. Areas of excavations and construction site do not include buffer zones
6. Volumes of cut and fill are approximate. Total cut and fill measured in bank cubic yards do not match due to differences in material swell during excavation and shrinkage during placing and compaction
7. "Bank CY" are units of volume of soil or rock insitu, in cubic yards.

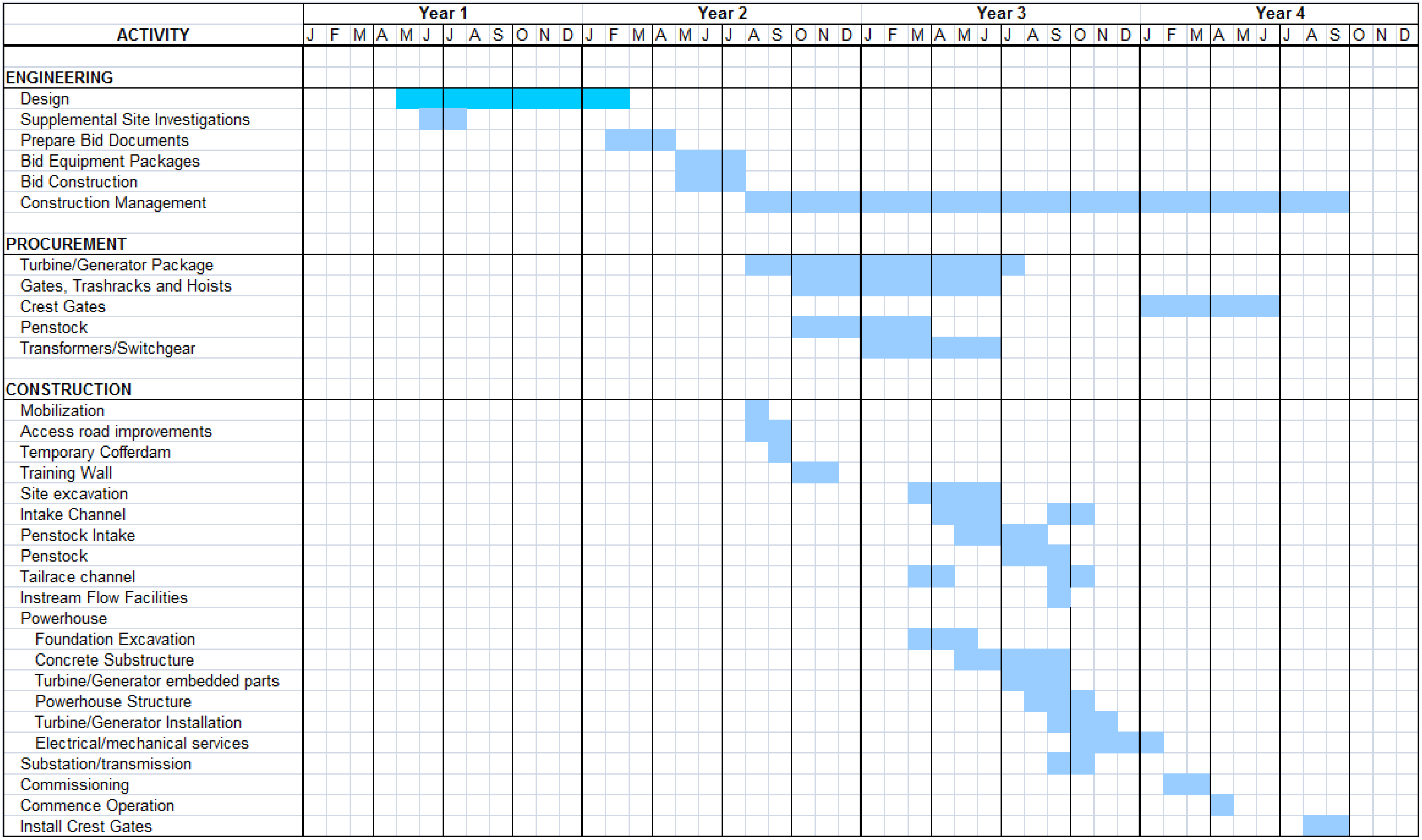


Figure 4. Enloe Project - Preliminary Construction Schedule

6.0 GENERAL SEDIMENT MANAGEMENT MEASURES

The intent of this Construction Sediment Management Program (CSMP) is to provide Best Management Practices (BMPs) to minimize sediment disturbance and maximize sediment containment during construction of project facilities on the east bank of the Similkameen River upstream and downstream of Enloe Dam including work within the impoundment and the downstream river channel. This CSMP supplements preliminary information in the project Erosion and Sediment Control Plan (ESCP, District 2008)

Construction work has the potential to change water quality due to potential changes in existing erosion and sediment transport processes or potential discharge of additional construction-generated sediment into adjacent waters.

Potential sources of construction related sediment from construction of the Enloe Project include: increased erosion of native soil due to removal of ground cover, disturbance of soil or changes in drainage patterns; excavation and disposal of overburden; generation of dust during rock excavation, transportation, crushing or placing operations; excavation of existing sediment from the impoundment at the mouth of the intake channel, overburden and excavated rock spoil disposal operations, construction of temporary construction staging areas and construction of temporary and permanent access roads.

The installation of the 5 foot crest gates will increase the impoundment water surface elevation during low flow, thus extending the time the impoundment elevation is high compared to current conditions. This prolonged increase in the impoundment water surface during operation may contribute to bank erosion. During operations bank erosion along the margin of the impoundment will be monitored. An evaluation of the potential disturbance to the existing sediment budget and transport as a result of these facilities is included in this CSMP in Appendix B.

6.1 SEDIMENT CONTAINMENT

Silt Curtain/Gunderboom – A silt curtain/gunderboom (a type of silt curtain that is designed to extend to the sediment bed) will be utilized to reduce resuspended sediment concentrations due to construction outside of the curtained area throughout the water column. The silt curtain/gunderboom needs to be anchored in place to ensure proper placement is maintained in water not exceeding 1 knot (~1.7 feet per second). Any repairs and device installation and removal shall be according to the manufacturer's recommendation.

Cofferdam – A cofferdam is a temporary structure built into a waterway to enclose a construction area and reduce sediment pollution from construction work in and under water. Cofferdams can be made of steel, rock, sand bags, wood or aqua barriers. When used in watercourses or streams, cofferdams must be used in accordance with permit requirements. Fish will be excluded from the cofferdam prior to dewatering following the guideline outlined in Appendix E of the Washington Department of

Transportation (WSDOT) Regional Road Maintenance Endangered Species Act Program Guidelines

6.2 DEWATERING

Water within the installed cofferdams will need to be removed prior to construction of the intake canal, powerhouse, and tailrace. During this phase of the construction project, silt curtains/gunderbooms will be used to minimize the spread of construction-related turbidity. De-watering water will be discharged into a controlled conveyance system prior to discharge to a siltation pond/settling tank. The capacity of the conveyance system and the type and size of sediment removal facility will be determined by the contractor. This highly turbid de-watering water from in-water construction areas will be handled separately from upland stormwater due to potential contamination from river-deposited sediments suspended in the water. Monitoring and maintenance of facilities handling potentially contaminated dewatering water will be ongoing, and the failure of any of these devices will be rectified immediately. Secondary containment will prevent a release of this water to the river or other receiving waters.

Siltation Pond/Settling Tank – A siltation pond/settling tank is a temporary containment structure or area for silt-laden water to be initially directed for treatment. After sufficient settling, confirmed by turbidity monitoring, the water may be discharged to the river or infiltrated at the site. This allows soil particles (i.e., suspended sediment that may contain elevated levels of trace metals) to settle prior to the water being discharged.

By pumping them to separate sedimentation facilities, drainage from potentially contaminated excavated river sediment will be segregated from uncontaminated stormwater drainage, seepage from excavated soils that may be saturated with groundwater, or seepage into excavations. The sludge from sedimentation of drainage from contaminated river sediments will be disposed at an off-site disposal site approved for such material. Sludge from sedimentation of uncontaminated stormwater drainage will be disposed of on-site by burial at spoil disposal areas.

Sizing of the siltation pond/settling tanks will be sufficient to accommodate all dewatering water during construction. Prior to discharge from the siltation pond/settling tank, turbidity measurements will be conducted as described in the next section “Water Quality Monitoring”. Residual sediments from siltation ponds and settling tanks will be combined with dredged sediments and tested to determine whether the material is suitable for beneficial re-use as fill on the site or requires offsite disposal at an approved landfill.

6.3 WATER QUALITY MONITORING

All sediment containment and dewatering BMPs placed on-site will be inspected, maintained, and repaired by the Certified Erosion and Sediment Control Lead (CESCL) and Constructor as needed to assure continued performance of the intended functions. Whenever inspection and/or monitoring reveals that BMPs are inadequate to fulfill their intended purpose, the BMP will be modified or replaced in a timely manner. Additionally, the CSMP will be updated to document these modifications.

Inspections will be carried out as follows: routine inspections must be performed by the CECSL at least weekly and within 24 hours after a rain event greater than 0.5 inches in a 24 hour period. All weekly written reports will include active construction activities. All inspections will be documented using the “Routine Inspection Form” provided in the SWPPP. The Routine Inspection Form, including water quality monitoring results, will be sent to Ecology electronically each week.

Detailed information on water quality monitoring procedures during construction is provided in the Construction Monitoring Quality Assurance Project Plan. For in-water construction activities, water quality monitoring will be conducted within the Similkameen River including the impoundment above Enloe Dam during construction. During construction of the intake channel, tailrace, powerhouse foundation, or any other instream activity, real-time turbidity monitoring will be performed at selected locations upriver (background) and at the downstream point of compliance (see example locations on Figure 2). Any time turbidity exceeds water quality standards, construction will be suspended until compliance with turbidity standards is achieved, and adjustments will be made in the construction methods and/or BMPs to reduce water quality impacts from sediment disturbance before construction is resumed. During upland construction, turbidity monitoring will be conducted daily at the selected locations within the Similkameen River and impoundment above Enloe Dam monitored during in-water construction, as described in the Erosion and Sediment Control Plan. For upland discharges, the point of compliance monitoring location will be designated by the CESCL based on where construction activities are occurring and/or at a location where storm water is observed to be discharging into the Similkameen River. The same criteria for turbidity described for in-water construction will apply to upland construction and the same protocols outlined above will be followed in the event of any exceedence.

Water quality monitoring will also be conducted prior to discharge from a siltation pond or settling tank. Turbidity of the treated water will be measured and not exceed 5 NTU over background turbidity of the Similkameen River upstream from the construction area, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU. In the case of water produced from dewatering or other handling of potentially contaminated river sediments, a turbidity standard of 5 NTU will be met prior to infiltration or discharge back to the river.

6.4 MAINTENANCE OF BMPS

Temporary and permanent sediment management BMPs shall be maintained and repaired as needed to assure continued performance of their intended function.

The CESCL will inspect sediment management BMPs weekly after installation or continually during any instream construction activity or near shore construction activity within 5 feet of the Similkameen River or impoundment above Enloe Dam. Maintenance activities will be completed within 24 hours of the inspection. An inspection and maintenance report will be prepared following each inspection. Specific maintenance requirements for each BMP will be performed according to the maintenance guidelines in the Washington State Department of Ecology's Stormwater Management Manual, Eastern Washington, Volume II.

Temporary sediment management BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer deemed necessary by the CESCL. Trapped sediment shall be removed or stabilized on site. Disturbed soil resulting from removal of BMPs or vegetation shall be permanently stabilized.

The Constructor and the CESCL will monitor performance of silt curtains/gunderbooms when active construction is occurring to ensure that silt curtains/gunderbooms are properly located and functioning. If any turbid discharges are observed outside of the silt curtain/gunderboom, corrective actions will be prescribed. Where deficiencies exist, additional BMPs shall be installed as directed by the CESCL.

7.0 SITE SPECIFIC SEDIMENT MANAGEMENT MEASURES

This chapter of the CSMP presents additional details regarding preliminary construction plans and supplemental information regarding site specific sediment management measures to assist in understanding the construction process and evaluating potential water quality impacts of the construction process.

7.1 HEADWORKS

The project headworks is a collective term for the intake channel, penstock intake structure and two penstocks that will deliver water from Enloe Impoundment to the proposed new hydroelectric powerhouse. Excavation for the intake channel and penstock intake structure would be carried out so as to leave a plug of native material at the bank of the river to provide a temporary cofferdam to exclude the river from the excavation.

Shallow overburden soil will be removed with excavators and loaded on to haul trucks for removal to proposed spoil disposal areas that are alongside the access road to the northeast of the dam. Depending on the hardness, degree of weathering and foliation of the underlying metasedimentary conglomerate rock and the contractor’s construction methods; ripping, excavator-mounted hoe-ram rock excavation, or controlled blasting will be used to fragment rock prior to excavation from the intake channel.

During this phase of construction, excavated spoil will be comprised of either overburden soil or fragmented excavated rock. The close proximity to the existing dam will affect the use of explosives and will require careful controlled blasting to achieve the required excavation profile while avoiding damage to the existing structure. Controlled blasting involves drilling of closely spaced blast holes and either preshearing or cushion blasting using time delays to control the blast dynamics. This is necessary to limit shock waves and peak particle velocities and to reduce excavation overbreak. Heavy blast mats are also used to contain the blast and control flyrock.

Exposed cut slopes in excavated rock will be in the range of 1H/5V to 1H/10V depending on rock quality and orientation of the slope to the bedding plane of the conglomerate rock and sandstone layers. Excavation for the intake structure will be as near-vertical as practical to minimize overbreak and additional concrete. Temporary or permanent benching will be used on high slopes where needed for additional stability of worker safety. Where necessary, rockbolts, steel mesh and shotcrete will also be used to improve slope stability.

Cut slopes in overburden will in the range of 1H/1V to 1.5H/1V depending on material type and compaction. Fill slopes will be 1.5H/1V. Where steeper slopes are required, slopes will be reinforced with lateral anchors and either wire mesh or concrete facing.

During excavation work, water trucks will be used, if needed, to control fugitive dust in excavation areas and on haul roads. Seepage or surface water drainage entering the excavation area will be collected and pumped to a temporary settling basin for removal of suspended sediment prior to disposal. The location of the settling basin (shown on Figure 2) will be just north of the excavation, with the exact size and location to be determined by the Constructor. Discharge will be monitored for turbidity and sedimentation sludge will be disposed of by burial in the proposed spoil disposal area to the north of the project (also shown on Figure 2). As an option to directly discharging drainage effluent to the river providing a point source of discharge, drainage effluent could be pumped for on-site land disposal so that it can filter through native soil before returning to the river. Discharge could also be usable for dust control subject to applicable water quality limits for this use. As explained in Section 6.2, a separate settling basin or tank will be used to contain and treat water that drains from potentially contaminated excavated river sediments.

In the project Spill Response Plan, protection measures are proposed to avoid contamination of soil and water by fuel and oil from construction work. Specific measures to avoid contamination of stormwater drainage and seepage from excavations are also proposed. Fueling and regular lubrication of construction equipment will primarily be carried out at designated fueling areas in proposed construction staging areas that are located away from the river. Where it is impractical to move construction equipment to a staging area for refueling, lubrication or maintenance - mobile fueling and maintenance by trained staff will be permitted. Fueling, lubrication and equipment maintenance will be subject to normal construction fueling best management practices which typically include use of automatic-shutoff filling equipment; containment via use of impermeable barriers, drip-pans and absorbent pads; provision of spill kits and proper off-site disposal of oil-contaminated waste. As a back-up measure, an oil skimmer will be provided at the settling basin to remove any oil that may find its way from construction equipment into drainage from the excavation. Any oil collected by the skimmer will be disposed off-site as waste oil. Discharge from the settling basin will be via a baffled submerged outlet to maintain separation between any surface oil and drainage effluent.

The concrete penstock intake structure will be constructed at the south end of the intake channel behind the temporary cofferdam therefore there will be no direct contact between uncured concrete and the river during construction of this structure.

When the intake structure is complete, the intake gates are installed, and the south end of the channel is complete, the in-situ plug that forms the temporary cofferdam at the mouth of the channel will be removed and the entrance to the channel will be excavated. Details of construction methods will be determined by the constructor, however the concept is to remove the plug and deepen the entrance to the channel when the river level and flow is low during Fall or winter, by creating a temporary berm in the impoundment at the mouth of the channel to provide a platform for drilling and blasting of underlying rock prior to excavation of the mouth of the channel. During this time, the intake channel would be flooded so that water level is the same as the impoundment, and a floating silt curtain (also known as turbidity curtain or “Gunderboom”) will be installed to act as a turbidity barrier between the excavation and the river. To reduce water velocity near the floating boom, temporary flashboards will be installed on the east end on the spillway crest to divert the overflow to the center and west end of the spillway.

The insitu-plug, berm, excavated rock and any deposited sediment on the left bank of the impoundment at the channel mouth will be then excavated under wet conditions behind the silt curtain, will be temporarily stockpiled on the north side of the channel to drain to the sedimentation basin and then loaded on to haul trucks for disposal in designated spoil disposal areas adjacent to the main access road. If impoundment sediment is contaminated with heavy metals and unacceptable for on-site land disposal, it will be stockpiled separately for off-site disposal at a landfill site that is approved for disposal of contaminated soil. Any other existing sediment removed from the old penstock intake area or boat launch construction area will be managed in the same way. In the unlikely event that construction excavations become flooded with sediment-laden inflow during a high flow period, the excavation will be dewatered and any residual sediment will be removed, dewatered and tested for contamination prior to disposal.

The depth of accumulated sediment on the impoundment bottom at the mouth of the intake channel is not known. For planning purposes, the following rough estimate of the order of magnitude of accumulated sediment volume was made. Excavation of the entrance of the intake channel on the left bank of the river requires an excavation in the impoundment that is approximately 120 feet long and about 40 feet wide. The impoundment bottom slopes from about Elevation (El.) 1045 at the impoundment bank to El.1038 at the bottom of the channel. Excavation of an average depth of one foot of sediment over the entire area would yield an estimated volume of 180 cubic yards of sediment. An average depth of three feet would yield about 500 cubic yards of sediment. In relative terms, this range of quantity is about 0.4% to 1.2 of the estimated total quantity of construction spoil.

BMPs such as silt fence and coir logs will be utilized to limit the mobilization and transport of upland sediments into the Similkameen River and impoundment above Enloe Dam during construction of the headworks as described in the Erosion and Sediment Control Plan.

With planned sediment management measures it is not anticipated that there will be significant adverse impacts to the existing sediment regime of the impoundment or to water quality in either Enloe Impoundment or the Similkameen River due to construction of the headworks. Any changes to the project that may change the sediment regime and affect water quality would require updating of this CSMP.

7.2 POWERHOUSE AND TAILRACE

The powerhouse and tailrace will be constructed in a bedrock terrace on the east bank of the river downstream of Enloe Dam. This area has been heavily scoured during annual floods so there is no significant accumulation of river sediment and therefore no potential water quality issue related to disturbance of accumulated sediment that might be contaminated with heavy metals from upstream mining operations.

Prior to excavation of the tailrace channel a permanent concrete training wall will be constructed between the spillway plunge pool outlet and the proposed tailrace area on the left bank of the river downstream of Enloe Dam to direct spillway discharge away from the powerhouse and tailrace area.

The proposed concrete training wall will be constructed early in the construction period during the annual low flow period in Fall and early Winter. A small temporary cofferdam will be used to isolate the foundation of the training wall from low flow between the spillway plunge pool and the Falls.

Dental rock excavation will be carried out using hydraulic hoe-ram excavators to provide a sound footing for the training wall and to key it into its rock foundation. If necessary, some controlled blasting may also be used to prepare the foundation. Since placing of concrete for the wall will be carried out in the dry, there is expected to be no issue regarding contact of uncured concrete with the river. Seepage into the excavation that is unsuitable for direct discharge by pumping to the river due to elevated turbidity will be pumped to a temporary settling tank for sedimentation prior to discharge. Monitoring and testing of turbidity of drainage discharge shall be as previously described in Section 6.2.

Rock excavation for the north end of the tailrace channel and the powerhouse structure will be carried out behind the training wall with an in-situ bedrock plug left in place at the outlet of the proposed tailrace channel. The bedrock plug will be a short section of bedrock terrace at the outlet of the channel left in place to serve as a cofferdam. Rock will be removed either by controlled blasting or hoe-ram impact tools followed by excavation by a hydraulic track-mounted excavator. Excavated rock will be loaded into haul trucks for disposal in designated spoil disposal areas located north of Enloe Dam.

Similar to the headworks excavation, exposed cut slopes in excavated rock will typically be in the range of 1H/5V to 1H/10V depending on rock quality and orientation of the slope to the bedding plane of the conglomerate rock and sandstone layers. Excavation for the powerhouse structure will be as near-vertical as practical to minimize overbreak and additional concrete. Temporary or permanent benching will be used on high slopes where needed for additional stability or worker safety. Where necessary, rockbolts, steel mesh and shotcrete will also be used to improve slope stability.

Seepage or stormwater drainage entering the excavation that is unsuitable fror direct discharge by pumping directly to the river due to elevated turbidity will be collected and pumped into either into a nearby portable sedimentation tank or to the sedimentation basin located upstream of the dam for sedimentation prior to discharge.

When the powerhouse and tailrace is complete and ready to be watered up, the rock plug at the entrance to the tailrace channel will be removed by controlled blasting and excavation. Removal of the upper part of the plug will be carried out in dry conditions above water level. Excavation of the last 8-10 feet of the plug that will be below water level would be carried out underwater. This work will be carried out under low flow conditions so that a barrier net can be placed across the river near the old powerhouse to prevent fish from swimming upstream into the plunge pool below the Falls and the tailrace outlet area during this phase of construction. Fish trapped in the plunge pool below the falls will be caught and released downstream of the barrier net.

A temporary floating silt curtain will be installed at the tailrace outlet to minimize entrainment of dust from rock excavation into the river during removal of the plug. The tailrace channel will be flooded by pumping in river water to equalize the water level with that of the river before excavation and removal of the plug. The plug will be removed by controlled blasting supplemented by dental rock excavation with hydraulic excavators. Excavated rock will be removed by excavators and allowed to drain before being loaded onto haul trucks for disposal in designated spoil disposal areas. Upon completion of the tailrace channel, excavation of the plug, and removal of as much excavated material in the wet, as practical, the silt curtain will be gradually removed to allow water in the river and the tailrace channel to merge while avoiding a sudden increase in turbidity in the river.

Any fragmented conglomerate and sandstone bedrock that escapes the wet excavation process will initially settle on the floor of the tailrace channel outlet area. This material will be entrained by the river during its annual flood and carried downstream along with other colluvium that periodically enters the river from the steep bedrock slopes that form the lower Similkameen River Canyon. Ultimately this fragmented rock migrates downstream through the Similkameen River Canyon and becomes part of the gravel substrate of the lower Similkameen River or Okanogan River.

7.3 CREST GATES

Installation of crest gates on Enloe Dam will be carried out after completion of the new power generation facilities to provide safe access to the spillway crest while maintaining streamflow and water quality.

The water level on Enloe Impoundment will be temporarily lowered during low flow season below the crest of the spillway by diverting water through the power facilities. Then a portable construction barge with a small crane will be launched on the impoundment and secured against the crest of the dam for installation work for the crest gates. For safety, the barge will be secured with breast lines belayed to upstream anchorages on each bank of the river. In the event there is an unplanned power plant outage requiring spill over the spillway crest, the barge will be winched upstream away from the spillway.

Installation of the crest gates involves construction of two reinforced concrete piers on the crest of the spillway and then installation of the pneumatic control piping and the sole plates which secure the gates to the crest of the spillway. Construction of these piers will also be carried out under dry conditions with the impoundment temporarily drawn down to just below spillway crest level. During construction an elevated temporary walkway will be installed across the concrete spillway on the downstream side of the spillway crest for personnel access and temporary piping for delivery of pumped concrete. The piers will be anchored into the existing dam crest and formed with either wood or steel forms.

Upon completion of the piers, curing of the concrete and installation of the spillway crest gates, the gates will be dry tested. The temporary walkway will then be removed, and the portable barge will be demobilized. The impoundment will gradually be filled to impound water against the gates. At this time, only the front faces of the piers will be immersed in the large body of water that forms the impoundment, so the potential pH impacts of cured concrete to such a large freely moving body of water will be insignificant. Then the gates will be wet tested by redirecting flow from the bypass reach to the spillway and individually testing each spillway gate by regulating flow through the turbines as flow over the spillway crest gates is changed by gradually lowering and raising each crest gate.

During operation, when the gates are lowered and the piers are partially immersed in the spillway discharge, the large volume of water passing the piers will again render any potential pH impact of cured concrete to such a large flowing volume of water to be insignificant.

BMPs will be utilized to limit the mobilization and transport of upland sediments into the Similkameen River and impoundment above Enloe Dam during installation of the crest gates as described in the Erosion and Sediment Control Plan. It is not anticipated there will be any disturbance to sediments within the Similkameen River including the impoundment above Enloe Dam during crest gate installation.

7.4 PLACEMENT OF CONCRETE

As described in the preceding sections, the proposed plan is to construct concrete structures including the penstock intake, penstock supports, powerhouse training wall, powerhouse and piers for the spillway crest gates under dry conditions. No underwater placement of concrete is planned for these structures. No direct contact between the river and concrete that has been cured for less than 7 days is planned.

The normal reinforced concrete construction process is as follows:

1. Preparation of the mating surface of excavations or existing structures to remove loose material and ensure a clean surface for good bonding.

2. Erection of wood or steel formwork supported by falsework that can support the weight of the formwork and wet concrete.

3. Placement of reinforcing steel cages.

4. Mixing of concrete from ingredients including selected aggregate, flyash, cement and water either at a portable or off-site concrete batch plant.

5. Transportation of the concrete to the work site by concrete truck.

6. On-site slump testing of concrete workability and collection of samples for strength tests off-site at a materials testing laboratory.
7. Placement of concrete by gravity chute, concrete pump or crane and skip.
8. Vibrocompaction of concrete to reduce voids.
9. Screeding of concrete surfaces to achieve required surface profile and texture.
10. Finishing of concrete surfaces with hand or mechanical floats as needed.
11. Curing of concrete surfaces by keeping it moist or by spraying on a water impermeable curing compound.
12. Stripping of formwork and false work.
13. Patching of voids with cement mortar.

Since new concrete is normally poured under dry weather conditions to avoid impacts on water-cement ratio contact between heavy precipitation and fresh concrete will be avoided.

The potential for contact between fresh concrete and either stormwater drainage or infiltration into the construction area will be minimized by diverting such inflow away from freshly poured concrete to sumps for pumping to sedimentation facilities. Once concrete construction is within elevated formwork the potential for such contact will be further reduced.

As previously described in Sections 7.1 and 7.2 stormwater drainage and seepage from sumps at intake structure and powerhouse construction sites that is unsuitable for direct discharge to the river will be pumped to isolated sedimentation facilities. If the pH of effluent becomes elevated above acceptable limits for discharge due to contact with uncured cementitious material, then neutralization using carbon dioxide sparging will be used. If sludge from sedimentation facilities that contains cementitious material becomes unsuitable for on-site disposal by burial at spoil disposal sites, it will be disposed off-site at an approved facility. No discharge of waste concrete or concrete wash-water to the river will be permitted.

7.5 INSTREAM FLOW RELEASE FACILITIES

Construction of the instream release facilities involves installation of above-ground pipeline on reinforced concrete foundations adjacent to the existing penstocks downstream of the dam. The site is well above river level, so this work will be carried out under dry conditions. No contact between concrete and the river is anticipated and typical construction site BMPs would be employed to contain any pipe support foundation excavation or construction materials.

7.6 CONSTRUCTION STAGING AND SPOIL DISPOSAL AREAS

BMPs such as silt fence and coir logs will be utilized to limit the mobilization and transport of sediments into the Similkameen River and impoundment above Enloe Dam during construction and operation of the staging and storage areas as described in the Erosion and Sediment Control Plan.

Construction staging and storage areas will be sited to maintain a minimum 50' buffer from the edge of the river channel. A color map showing proposed construction staging and spoil disposal areas is shown on Figure 2.

All wetlands and sensitive areas will be delineated and protected. Construction equipment will be clean of grease prior to arriving on site and use biodegradable hydraulic fluid. If construction materials are to be stockpiled over-winter, BMPs such as silt fence, coir logs, and plastic tarps will be used to limit mobilization and transport of sediments into the Similkameen River. It is not anticipated there will be any disturbance to sediments within the Similkameen River including the impoundment above Enloe Dam during construction of the access road. Any changes to the design that will create the potential to mobilize sediments within the river or impoundment will require updating of this CSMP.

Spoil from construction of the intake channel, powerhouse and tailrace channel at Enloe Dam will be disposed of locally at designated spoil disposal areas located adjacent to the existing access road from the North which enters from the Loomis Oroville road near Shankers Bend and heads south to the Dam following the decommissioned Oroville-Tonasket irrigation canal along the east bank of the Similkameen River Valley.

Construction spoil will be used to improve the road including relocating a portion that currently traverses the river's flood plain and is subject to flooding in most years. Relocation of this road will also increase the surface area and improve continuity of wetland habitat within the flood plain.

The spoil which will be mainly comprised of excavated overburden soil and rock will be hauled to the disposal site by either scrapers or dump trucks and then either directly offloaded in the disposal area or temporarily stockpiled within or adjacent to the disposal area for spreading by other equipment. Bulldozers, graders and compaction equipment will be used to form the spoil into a road embankment. Some sorting or crushing of rock may be necessary at the stockpile area.

Wet spoil will be temporarily stockpiled adjacent to excavation areas and allowed to drain with the drainage collected and conveyed to sedimentation facilities before land disposal. A small amount of river sediment that is to be excavated from the mouth of the intake channel will be stockpiled separately and tested for contamination by heavy metals from upstream mine drainage. Depending on the outcome of these tests the sediment will either be exported to an appropriate off-site disposal area that is suitable for contaminated soil or buried on-site in the designated spoil disposal area.

Typical fill slopes in spoil disposal areas will be 1.5H/1V which is typical of existing spoil disposal from construction of now. Cut slopes in overburden will be in the range of 1H/1V to 1.5H/1V depending on material type and compaction. BMPs such as silt fence and coir logs will be utilized to limit the mobilization and transport of upland sediments into the Similkameen River and impoundment above Enloe Dam during construction in the Erosion and Sediment Control Plan.

Best management practices for control of fugitive dust, stormwater and soil erosion are to be employed during and after construction. During construction, water trucks will be used to control fugitive dust on haul roads and in spoil disposal areas. Erosion control measures including diversion of runoff from spoil disposal areas, installation of silt fences and coir rolls will be used, as–needed to prevent erosion and loss of sediment. At completion of construction, slope surfaces will be stabilized and revegetated in accordance with requirements of the project Erosion and Sediment Control Plan.

It is not anticipated there will be any disturbance to sediments within the Similkameen River including the impoundment above Enloe Dam during construction of these facilities. Any changes to the design that will create the potential to mobilize sediments within the river or impoundment will require updating of this CSMP.

7.7 ACCESS ROADS

BMPs such as silt fence and coir logs will be utilized to limit the mobilization and transport of upland sediments into the Similkameen River and impoundment above Enloe Dam during construction of the access roads as described in the Erosion and Sediment Control Plan. It is not anticipated there will be any disturbance to sediments within the Similkameen River including the impoundment above Enloe Dam during construction of the access road. Any changes to the design that will create the potential to mobilize sediments within the river or impoundment will require updating of this CSMP.

8.0 REFERENCES

CCT. 2008. Chapter 4-8, Water Quality Standards, Current Colville Tribal Law and Order Code. Colville Confederated Tribes. Nespelum, Washington. Available online at: http://codeamend.colvilletribes.com/current.htm

Christensen, 2007. Restoration of Renewable Hydropower Generation at Enloe Dam. Geology Report. April 2007.

Ecology. 2006. Waters requiring supplemental spawning and incubation protection for salmonid species. Revised November 2006. Publication No. 06-10-038. Washington State Department of Ecology. Olympia, Washington.

ENTRIX. 2006. Okanogan River Watershed Resource Inventory Area 49, Level I Water Quality Technical Assessment. Project No. 4138301. Prepared by ENTRIX, Inc. for Okanogan County Watershed Planning Unit, Okanogan, WA. June 2006.

Hurst, D. 2003. Project synopsis: Analysis of sediment samples from the Similkameen River and Palmer Creek, U.S. Prepared by Fulcrum Environmental Consulting for the Confederated Tribes of the Colville Reservation, Environmental Trust Department. Nespelem, Washington. April 17, 2003.

Johnson, A. 2002. A total maximum daily load evaluation for arsenic in the Similkameen River. Washington State Department of Ecology Environmental Assessment Program. Publication No. 02-03-044. Olympia, Washington. November 2002.

Michelsen, T. 2003. Development of freshwater sediment quality values for use in Washington state: Phase II report: Development and recommendation of SQVs for freshwater sediments in Washington state. Publication No. 03-09-088.

Prepared for the Washington Department of Ecology, Toxics Cleanup Program, Sediment Management Unit. Prepared by Avocet Consulting, Kenmore, Washington.

Natural Resource Conservation Service (NRCS). 2007. Web Soil Survey 1.1, Soil Survey of Okanogan County Area. Available at: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Public Utility District Number 1 of Okanogan County (District) 2008. Final License Application (FLA), Enloe Hydroelectric Project No. 12569, August 2008.

Pacific Northwest River Basins Commission (PNRBC). 1977. Okanogan River Basin Level B Study of the Water and Related Land Resources. Pacific Northwest River Basins Commission, Revised December 1977.

Stoffel, K. L. 1990. Geologic Map of the Oroville 1:100,000 Quadrangle, Washington; Washington State Department of Natural Resources, Washington Division of

Geology and Earth Resources, Washington Division of Geology and Earth Resources; Open File Report 90-11.

Villalobos, H. A. 1982. Engineering Geology Reconnaissance of Five Damsites and Reservoir Study Areas, Similkameen River, Okanogan County, Washington. M.S. Thesis, San Jose University, San Jose, CA.

Washington State Department of Ecology (Ecology). 2004. Stormwater Management Manual for Eastern Washington. Publication No. 04-10-076.

Washington State Department of Transportation (WSDOT) 2008. Regional Road Maintenance Endangered Species Act Program Guidelines. Available at: http://www.wsdot.wa.gov/Maintenance/roadside/esa.htm

Appendix A

Sediment Quality

Sediment Quality

2007 SEDIMENT QUALITY MONITORING RESULTS

Bulk Sediment Chemistry

The primary objective of the 2007 sediment quality study was to document concentrations of selected trace metals in sediments accumulated behind Enloe Dam that have the potential to be re-suspended during construction and operation of the Project. Seven sediment sampling locations were selected to target areas representative of sediment above Enloe Dam that might be disturbed under different Project alternatives (Figure A1-1). For example, dredging an entrance to the new approach channel near the dam on the northeast side of the reservoir could disturb contaminated sediments during construction. Other sediment sampling locations were selected to target areas within the reservoir where sediment erosion and transport may be anticipated during future Project operations. To provide information on pre-construction baseline concentrations of the same trace metals and pesticides in sediment downstream from the project site, surface sediment samples were collected from sand bar deposits at seven locations downstream from the old powerhouse and upstream from the Oroville Bridge (Figure A1-1).

Bulk sediment chemistry analyses were conducted on the sediment samples, to provide for site-specific comparisons to sediment quality criteria and guidelines. The Dredging Elutriate Test (DRET) was used to evaluate the potential for water quality impacts from sediment disturbance. The DRET involves mixing sediment and site water, allowing the heavier particles to settle, sampling the supernatant (i.e., overlying water), and analyzing for dissolved and particle-bound contaminants. A secondary objective was to analyze sediment samples from the Project Area for physical properties to evaluate sediment transport potential under different Project alternatives.

Sediment samples were analyzed for pesticides, arsenic, cadmium and copper. Bulk sediments were also analyzed for grain size composition and total solids. Pesticides were not detected in any sample. Cadmium was detected in 3 of 15 samples, but in all cases was below CCT criterion and Ecology sediment quality values (SQVs, Table A1-1). Copper was detected in all samples, and in all cases was below SQSs. Three samples exceeded the CCT copper criterion, but were below the sediment quality standard proposed by Michelsen (2003). Arsenic exceeded the CCT criterion in 11 of the 15 samples and 4 of 15 exceeded Ecology's lower SQV, but all arsenic concentrations were below levels known to cause adverse effects. The average sediment arsenic concentration (14 mg/kg) was about one half of the average reported by Ecology in a previous study (Johnson 2002).

The preconstruction baseline samples below the dam (the most-upstream of the sampling locations below the dam) within the vicinity of the Enloe Project included one site that exceeded the CCT criteria for arsenic and copper. These trace metals are understood to have entered the Similkameen River from historic mining operations upstream in the watershed and they have been transported through the project for many decades by river flows. The Daily Implementation Plan for the Lower Similkameen River Arsenic TMDL (Peterschmidt 2005) provides additional information on the sources of arsenic in the water and sediments.

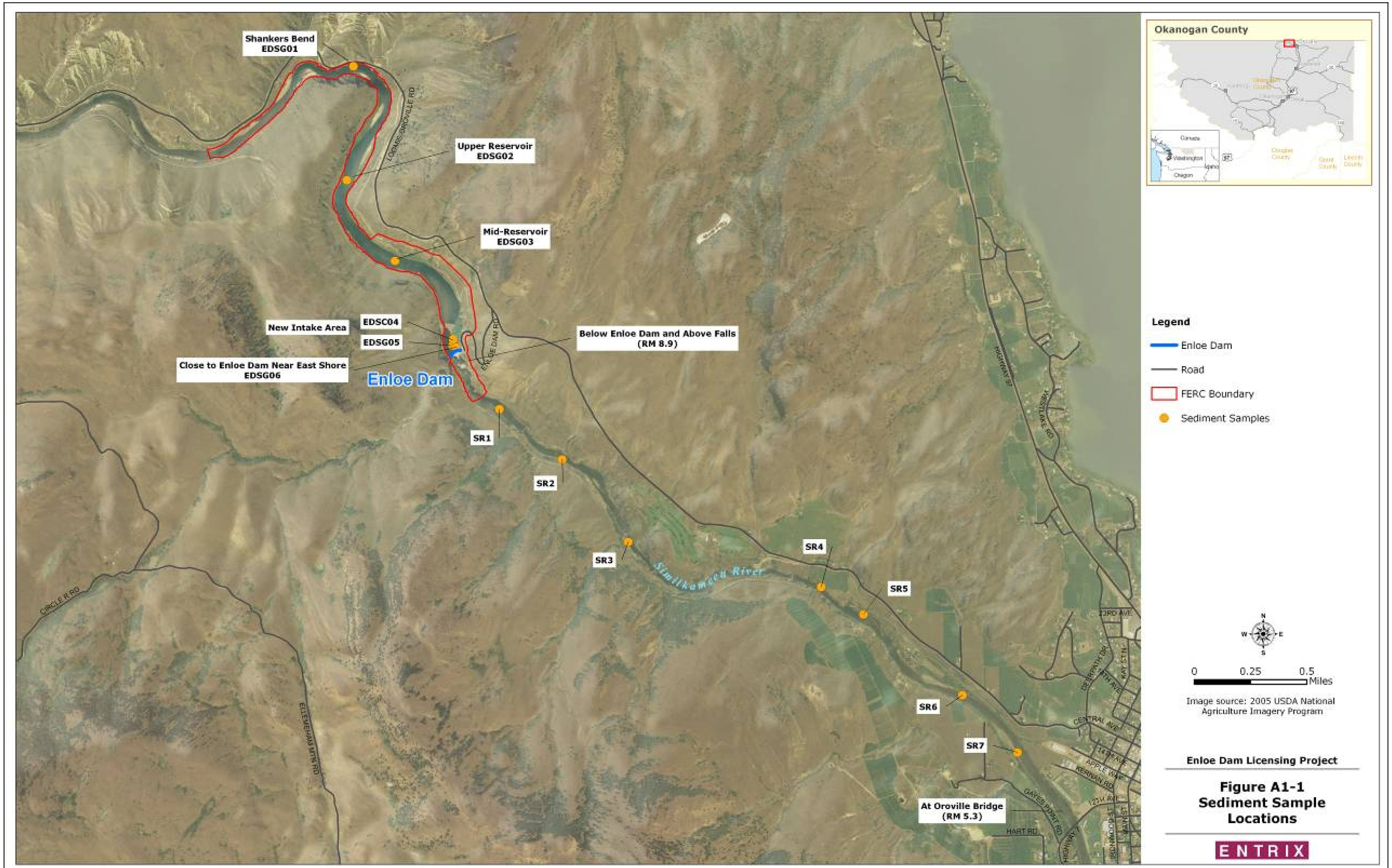

Shankers Bend
EDSG01
Upper Reservoir
EDSG02
Mid-Reservoir
EDSG03
New Intake Area
EDSC04
EDSG05
Close to Enloe Dam Near East Shore
EDSG06
Below Enloe Dam and Above Falls
(RM 8.9)
Enloe Dam
SR1
SR2
SR3
SR4
SR5
SR6
SR7
Similkameen River
At Oroville Bridge
(RM 5.3)
Okanogan County
Legend
Enloe Dam
Road
FERC Boundary
Sediment Samples
0
0.25
0.5
Miles
Image source: 2005 USDA National Agriculture Imagery Program
Enloe Dam Licensing Project
Figure A1-1
Sediment Sample Locations
ENTRIX

Table A1-1: Summary of Preliminary Enloe Dam Sediment Trace Metals Results (mg/kg)

PMX Sample ID	ARI Sample ID	Depth (ft)	Arsenic	Cadmium	Copper	Notes
Shallow Core Samples						
EDSG01	07-16068-LK08A	0 to 1	15.7	0.3U	22.3	
EDSG02	07-16069-LK08B	0 to 1	23.5	0.3U	33.3	
VanVeen Grab Samples						
EDSG03	07-16070-LK08C	0 to 0.5	11.2	0.2	18.4	
EDSG05	07-16071-LK08D	0 to 0.5	20.4	0.3U	27.9	
EDSG06	07-16072-LK08E	0 to 0.5	10	0.3U	17.1	
EDSG08	07-16073-LK08F	0 to 0.5	9.2	0.3U	17.2	duplicate of EDSG06
Freeze Core Samples						
EDSC04-0-4	07-16099-LK13A	0 to 5.0	8.8	0.2U	16.3	
EDSC04-4-8	07-16100-LK13B	5.0 to 6.6	29.3	0.4	47.5	
EDSC04-8-12	07-16101-LK13C	6.6 to 8.0	10.3	0.2U	16.2	
EDSC08-0-4	07-16102-LK13D	00 to 5.0	7.0	0.2U	13.6	duplicate of EDSC04-0-4
EDSC08-8-12	07-16103-LK13E	6.6 to 8.0	8.6	0.2U	16.0	duplicate of EDSC04-8-12
Surface Grab Samples Below Enloe Dam						
07-16081-LK11A	SR-1	00 to 0.1	24.8	0.3	31.8	
07-16082-LK11B	SR-2	00 to 0.1	9.3	0.3U	16.0	
07-16083-LK11C	SR-3	00 to 0.1	10.6	0.3U	15.9	
07-16084-LK11D	SR-4	00 to 0.1	9.1	0.3U	15.1	
07-16085-LK11E	SR-5	00 to 0.1	8.2	0.3U	12.8	
07-16086-LK11F	SR-6	00 to 0.1	9.5	0.3U	15.1	
07-16087-LK11G	SR-7	00 to 0.1	13.1	0.3U	17.3	
07-16088-LK11H	SR-8	00 to 0.1	10.4	0.3U	14.4	duplicate of SR-3
Freshwater Sediment Quality Values (mg/kg)						
Sediment Quality Standard [1]			20	0.6	80	
Cleanup Screening Level [1]			51	1	830	
Cleanup Screening Level [2]			9.79	0.99	31.6	
Probable Effect Concentration [3]			33	4.98	149	

[1] Michelsen 2003

[2] CCT 2003

[3] MacDonald et al. 2000

Sediment samples located near the proposed intake channel adjacent to the dam contained many of the highest measured concentrations of Arsenic, exceeding SQS (Michelsen 2003) and CCT (2003) SQVs in roughly half of the locations sampled. These sediments are most likely to mobilize during Project construction due to disturbance and operations due to increased velocity near the intake channel. These findings highlight the need to minimize sediment mobilization and maximize sediment containment during construction activities within the Similkameen River and impoundment above Enloe Dam.

Sediment Elutriate Analyses

In addition to the analysis of contaminant concentrations in the sediment, the same contaminants were analyzed using the Dredging Elutriate Test (DRET) to mimic water column concentrations that could occur if sediments were disturbed by dredging. As with the bulk sediment samples, pesticides were not detected in any elutriate samples (Table A1-2). Cadmium was detected at the detection limit in several samples, but was well below the water quality criteria in all samples. Arsenic was detected in all samples, but was also well below the water quality criteria. Copper was detected in all samples, and exceeded both chronic and acute criteria in 5 of the 8 primary samples. All elutriate samples exceeded the arsenic and copper concentrations in the ambient water sample from mid-reservoir.

Sediment disturbance and transport occurs every year during high flows in the Similkameen River as discussed later in section Sediment Transport Model. The results of the sediment sampling efforts indicate that metals, especially arsenic and copper could be released into the water column should sediments become mobilized. Accordingly, there is a need to minimize sediment disturbance during project construction to avoid exceedances of the water quality criteria.

Table A1-2: Summary of Preliminary Enloe Dam Sediment Elutriate Results (µg/L)

PMX Sample ID	ARI Sample ID	Depth (ft)	Arsenic	Cadmium	Copper	Notes
Shallow Core Samples						
EDSG01	07-16068-LK08A	0 to 1	12.5	0.2	12.1	
EDSG02	07-16069-LK08B	0 to 1	29.1	0.2	28.2	
VanVeen Grab Samples						
EDSG03	07-16070-LK08C	0 to 0.5	5.6	0.2U	4.6	
EDSG05	07-16071-LK08D	0 to 0.5	20.9	0.2	28.1	
EDSG06	07-16072-LK08E	0 to 0.5	7.5	0.2U	9.9	
EDSG08	07-16073-LK08F	0 to 0.5	6.4	0.2U	6.5	duplicate of EDSG06
Freeze Core Samples						
EDSC04-0-4	07-16099-LK13A	0 to 5.0	5.3	0.2U	4.7	
EDSC04-4-8	07-16100-LK13B	5.0 to 6.6	53.6	0.2	52.2	
EDSC04-8-12	07-16101-LK13C	6.6 to 8.0	6.3	0.2U	4.6	
EDSC08-0-4	07-16102-LK13D	00 to 5.0	5.1	0.2U	3.4	duplicate of EDSC04-0-4
EDSC08-8-12	07-16103-LK13E	6.6 to 8.0	7.7	0.2U	6.2	duplicate of EDSC04-8-12
Ambient Water Sample						
07-16054-LK07A	EDW01	3.5	3.6	0.2U	0.9	
Water Quality Criteria (µg/L)						
Acute, aquatic life			360	1.82*	9.2*	
Chronic, aquatic life			190	0.64*	6.5*	

* Criteria adjusted for 52 mg/L hardness (Ecology 2005)

Appendix B

Sediment Sources and Transport Model

Sediment Sources and Transport Model

EXISTING SEDIMENT INPUTS

A Bank Stability and Erosion Assessment (FLA, Appendix E.6.2) was performed by the District. This assessment identifies major and minor erosional and depositional features upstream and downstream of the Enloe Dam that may affect sediment transport processes and fish habitat in the Similkameen River and impoundment above Enloe Dam. In addition, the effect of future construction and operational activities associated with Enloe Dam on channel and bank stability, sediment transport mechanisms, and impoundment characteristics were also evaluated.

Air photo analysis was performed to identify potential sediment sources (upland erosional settings), obtain channel characteristics and depositional features, and assess any historic changes to upland and channel features over a 47 year period. Potential sediment sources identified included badlands (areas with steep slopes, gullies, loose soil, and frequent erosion), gullies (typically with some vegetation and streambeds), and landslides (talus and scree slopes). Depositional features identified included instream bars, banks, terraces, and benches. Historic changes to upland and channel features were assessed by comparison of air photos from 1953 and 2000.

Field reconnaissance was conducted during exceptionally low flow conditions, where much of the channel substrate and banks were exposed. Observations of channel and bank conditions, and potential sediment sources and sinks were summarized for three main reaches that included: 1) upstream of the impoundment, 2) impoundment, and 3) downstream of impoundment.

The air photo assessment indicated 40 upland sediment sources in the study area. These sources included badlands, gullies, streambeds (wet or dry), and minor landslides. The majority of these features lie in the area upstream of Shanker's Bend. All of these sources were observed in both the 1953 and 2000 set of aerial photographs, and the sizes or extent of these features have not measurably changed. Most of the upland sources, however, do not appear to have a direct connection to the Similkameen River, as the sediment eroded from these sources is deposited upgradient of the highway roadbed (to the north) or the railroad bed (to the south).

The river channel conditions and morphology upstream and downstream of the impoundment remained largely unchanged suggesting that sediment production from upland sediment sources is relatively minor. Furthermore, periodic high flows strip away any accumulated fine sediment load (gravels, sands and silt) and deposit the load in the impoundment (as attested to by the small and large sand bars along the right bank) or in the Okanogan River. Because the river is entrenched over the entire study area, there is little chance to alter the stream planform, except near the confluence of the Similkameen and Okanogan Rivers, where minor shifts in the channel planform are noted.

Just upstream of the confluence with Okanagan River, the Similkameen River meanders more; between 1953 and 2000 the river in this area has undergone minor bank erosion with several adjustments to the channel planform. The 2000 photos reveal more exposure of point bars and sidebars compared with the 1953 photos, but these changes are most likely due to the reduced flow recorded on July 29, 2000 (1360 cfs) when compared with the flow on July 2, 1953 (6770 cfs).

The field reconnaissance assessment indicated that within the channel upstream of the impoundment, zones of fine-grained sedimentation are scattered and generally small in size and volume. Tributary sources are minimal and limited to a few gullies. Coarser material (cobbles and boulders) is abundant, and the channel morphology is influenced most by its level of incision into the glacial overburden and/or bedrock.

Within the reservoir, channel width is relatively uniform and the reservoir substrate is dominated by sands. The few sediment sources within the impoundment area (colluvium from road fill, a gully draining badlands along the left bank, and the long erosional scars associated with the high water lines along the right bank) are considered relatively small in overall sediment production.

Downstream of the dam, zones of fine-grained sediment sources are rare, although the extensive landslip/badland cuts just downstream of the old railroad crossing could potentially produce high volumes of fine-grained material during exceptional rain storms and/or high flows. Further, there are in general few fine-grained sediment deposits suggesting that there are minimal fine-grained sediment sources. Tributary sources of sediment are essentially non-existent. Within the canyon, coarser material (cobbles and boulders) is abundant, and the channel is shaped primarily by bedrock. Downstream of the canyon, the river is confined by relatively high terraces (protected by rip-rap) and dikes, and the substrate is composed of predominantly cobbles and large gravels.

Proposed operation of the Enloe Hydroelectric Project will extend the period during which the reservoir inundates land to the ordinary high water mark. Although saturating the toe of slopes this could create minor bank instabilities around the impoundment, bank erosion has already occurred and a stony surface armor has developed along much of the shoreline. The proposed water-surface elevation increase is within the historical range of variability in April, May and June (which created impoundment elevation increases of 0.5, 2.7 and 3.0 feet, respectively, above the median flow condition). Any slopes that could not withstand saturation are likely to have already failed.

SEDIMENT TRANSPORT MODEL

A one-dimensional hydraulic model was used to characterize annual patterns of sediment transport through the impoundment and estimate changes that would result from proposed operations. Such a model does not have the ability to capture the changes in flow patterns that are likely to occur in the forebay with the addition of an inlet channel on the east bank just above the dam spillway. As can be seen in Figure 1 (at cross-section 24), the shallowest part of the forebay is adjacent to the proposed intake location, and there is concern that sediments in this location could be mobilized by proposed operations. To estimate the likelihood of this occurring we constructed a two-dimensional hydraulic model of the reservoir using the program River 2D.

Models were developed for five combinations of flow and forebay geometry: 2,200 cfs under existing and proposed conditions; 10,200 cfs under existing conditions; and 16,100 cfs under existing and proposed conditions. The modeled range of flows spans the range of flow magnitudes over which the 1-D impoundment hydraulic model predicted a transition from potential deposition to potential erosion.

This model incorporates the following assumptions:

1. Horizontal flow direction does not change with changes in bed topography.

2. Threshold velocities do not change with depth.

The volume and weight of potential erosion/deposition were estimated for each flow condition, assuming a characteristic grain size of approximately 0.6 mm, an erosion/transport threshold of 1 feet/second and a deposition threshold of 0.1 feet/second, and a constant bulk density of sand equal to 100 lb ft3.

The results of the River 2D model (Figure 2) are consistent with the expectation that the addition of the inlet channel would change flow velocities within the forebay. The intake channel causes the flow to veer southeast towards the intake at both 2,200 and 16,100 cfs. The model also indicates that with the addition of the proposed intake increased velocities are likely just upstream of the pinch point that defines the upstream end of the forebay. The model predicts very high velocities in the intake channel, which suggests that sedimentation there is unlikely during normal operations.

The increase in velocities towards the southeast corner of the forebay in the proposed configuration leads to an increase in potential erosion there at both modeled flow velocities for proposed conditions. This is best illustrated by the maps of equilibrium bed elevation (Figure 3 a-f). However, at the higher flow the equilibrium bed elevation is much lower than the bed elevations mapped in 2006 during low-flow conditions. (Note that 16,100 cfs is the median annual flood, the discharge that occurs on average once every two years.) Similarly, the equilibrium bed elevation for 10,200 cfs under existing conditions is considerably lower than that mapped in 2006 (10,200 cfs is the 5% exceedance daily mean discharge, and occurs almost every year).

Figure 1: Enloe Impoundment Bathymetry and Representative Cross-sections from Nelson (1972).

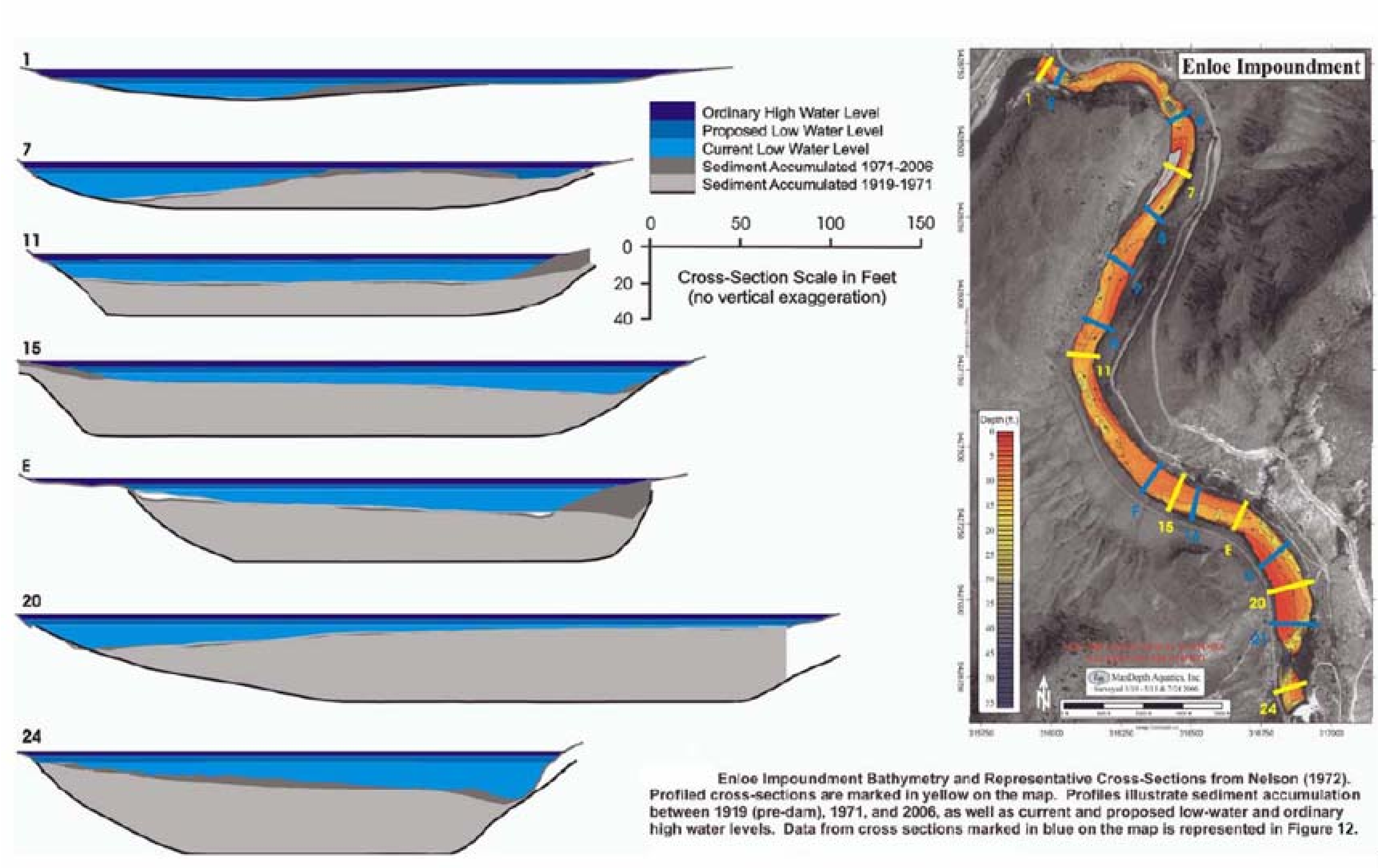


Figure 2: River 2D Flow-direction Maps (arrows indicate direction, warmer colors indicate greater magnitude)

a) 2,200 cfs, existing conditions b) 2,200 cfs, proposed configuration

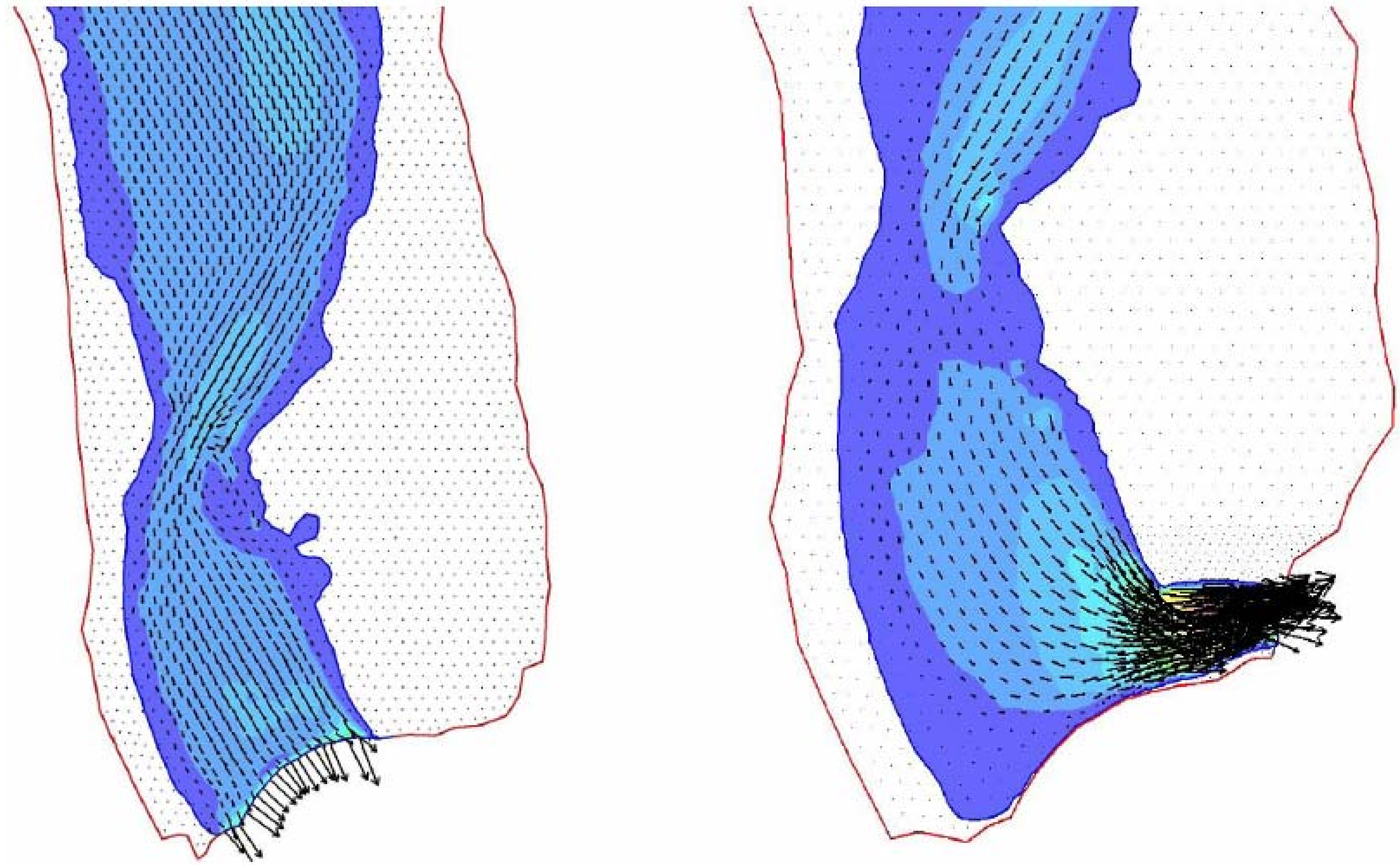
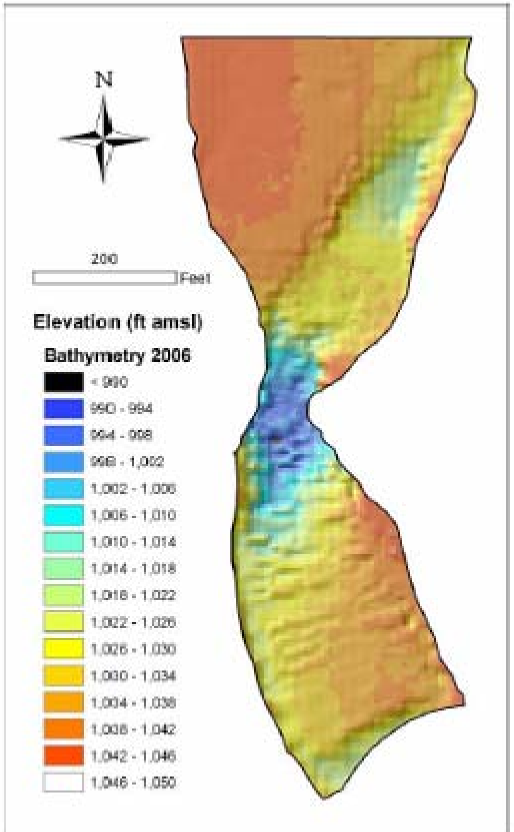
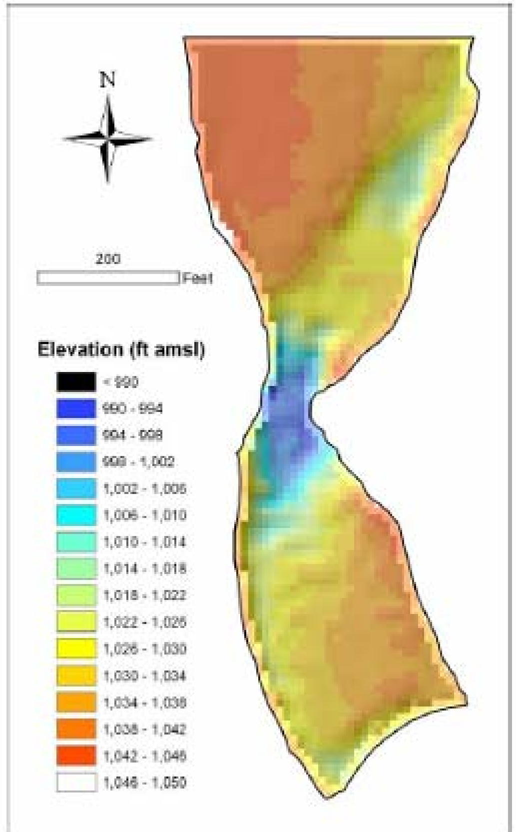


Figure 3: Equilibrium Bed Elevations

a) 2006 bathymetry (for comparison)



b) 2,200 cfs, existing conditions



c) 2,200 cfs, proposed configuration

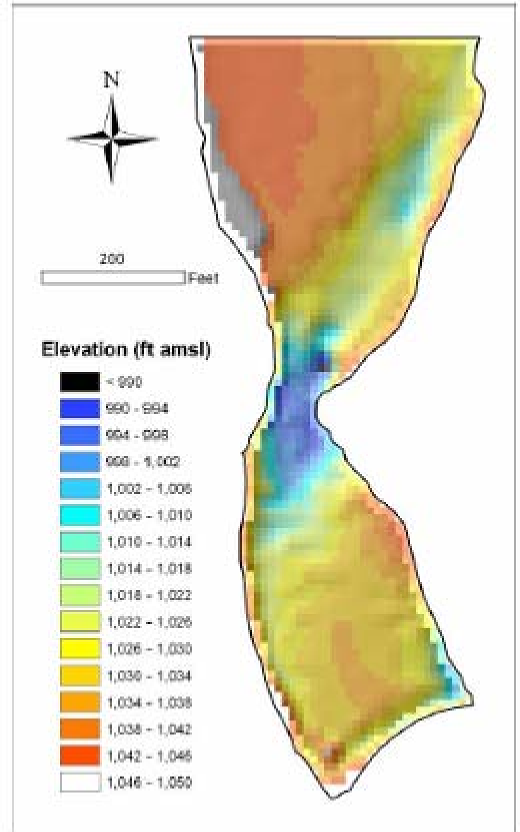
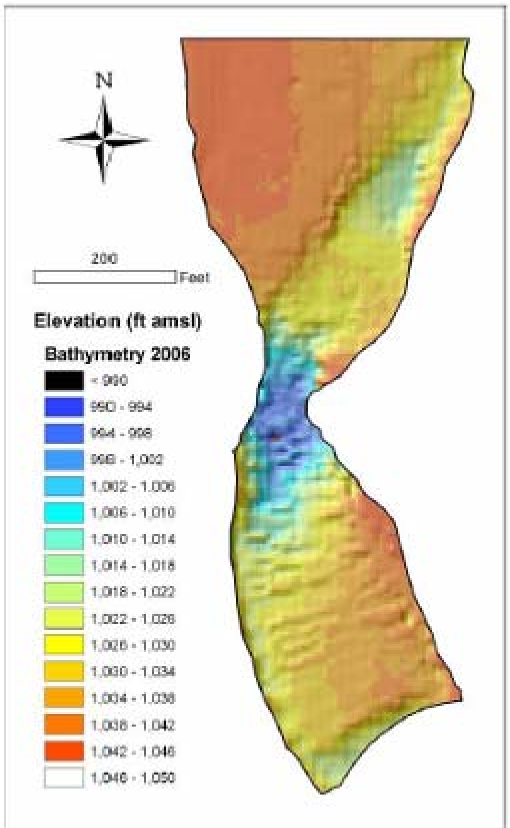
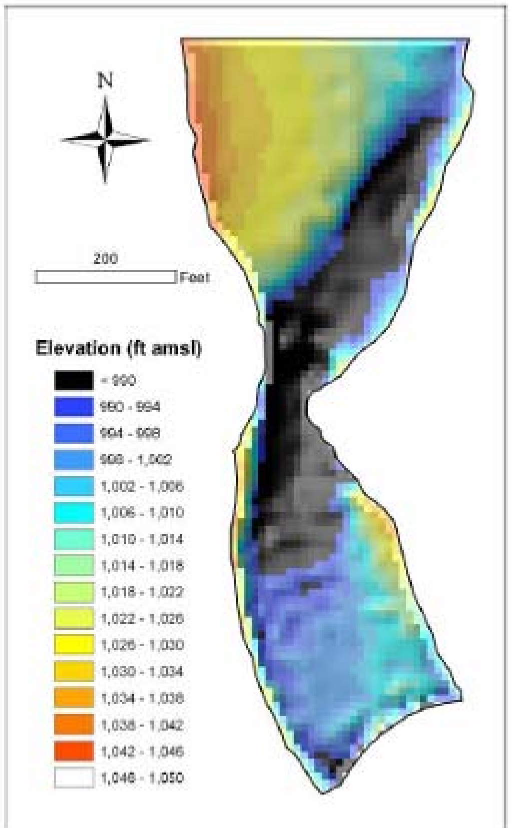


Figure 3, continued: Equilibrium Bed Elevations

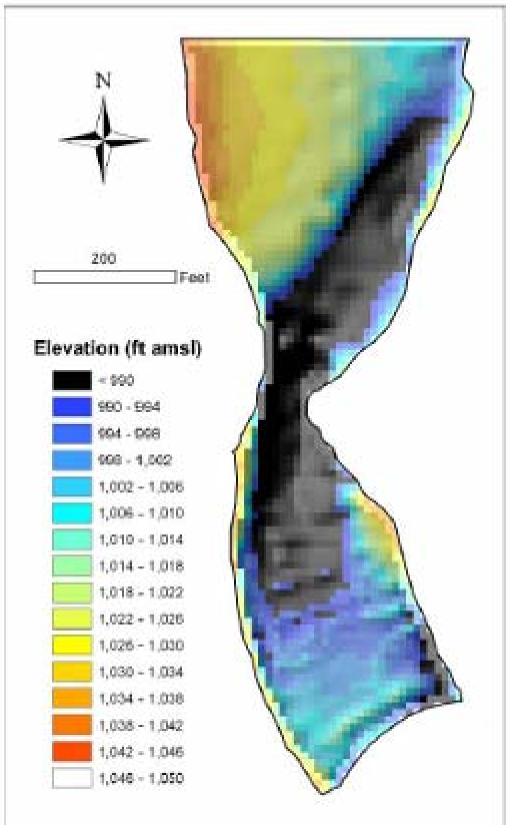
d) 2006 bathymetry (for comparison)



e) 16,100 cfs, existing conditions



f) 16,100 cfs, proposed configuration



Enloe Hydroelectric Project
401 Water Quality Certification
Construction Sediment Management Plan Implementation
Appendix C
December 2011

1. INTRODUCTION

This Appendix has been prepared in response to a request from the State of Washington Department of Ecology communicated at a meeting with Okanogan Public Utility District on September 28, 2011 for additional information about proposed construction methods and proposed construction sediment management plans for the Enloe Hydroelectric Project. This appendix is intended to be detached from the Construction Sediment Management Plan (CSMP) and/or Stormwater Pollution Prevention Plan (SWPPP) for use by Ecology and construction monitors.

2. CONSTRUCTION OF INTAKE CHANNEL AND TAILRACE CHANNEL

Construction of the intake and tailrace channels is planned so as to maximize the amount of work conducted under “dry” conditions. This will be accomplished by leaving a bedrock plug to form a physical barrier between the excavation work and the Similkameen River.

Intake Channel

The intake channel will be excavated so as to leave a plug of native material at the bank of the river to provide a temporary cofferdam to exclude the river from the excavation.

Overburden would be removed with excavators and loaded on to haul trucks for removal to proposed spoil disposal areas that are alongside the access road to the northeast of the dam. Depending on the hardness, weathering and foliation of the rock and the contractor’s construction methods; ripping, excavator-mounted hoe-ram rock excavation, or controlled blasting will be used to fragment rock prior to excavation from the intake channel. During this phase of construction, spoil will be comprised of either overburden soil of excavated rock. The close proximity to the existing dam will affect the use of explosives and will require careful controlled blasting to achieve the required excavation profile while avoiding damage to the existing structure. Controlled blasting involves drilling of closely spaced blast holes and either preshearing or cushion blasting using time delays to control the blast dynamics. This is necessary to limit shock waves and peak particle velocities and to reduce excavation overbreak.

During excavation work, water trucks will be used, if needed, to control fugitive dust in excavation areas and on haul roads. Seepage or surface water drainage entering the excavation area would be collected and pumped to a temporary settling basin for removal of suspended sediment prior to land disposal. The location of the settling basin will be just north of the excavation, with the exact location to be determined by the Contractor. Rather than directly discharge drainage effluent to the river providing a point source of discharge, our proposal is to pump drainage effluent for land disposal so that it can filter through native soil before returning to the river.

Protection measures are proposed to avoid contamination of the river by fuel and oil. Fueling and regular lubrication of construction equipment will be carried out at proposed construction staging areas that are located away from the river. An oil skimmer would also be provided at the settling basin to remove any oil that may find its way from construction equipment into drainage from the excavation. The concrete intake structure for the penstocks would be constructed at the south end of the intake channel behind the temporary cofferdam therefore there would be no direct contact between uncured concrete and the river during construction of this structure.

When the intake structure is complete, the intake gates and bulkheads are installed, and the south end of the channel is complete, the cofferdam at the mouth of the channel will be removed. Details of construction methods will be determined by the constructor, however the concept would be to remove the plug when the river level and flow is low during Fall or winter, and to create a temporary cofferdam in the reservoir at the mouth of the channel to provide a platform for drilling and blasting of the underlying rock prior to excavation of the mouth of the channel. The cofferdam, excavated rock and any deposited sediment on the left bank of the reservoir at the channel mouth would be then excavated under wet conditions, would be temporarily stockpiled on the north side of the channel to drain to the sedimentation basin and then loaded on to haul trucks for disposal in designated spoil disposal areas.

Tailrace

Prior to excavation of the tailrace channel a permanent concrete training wall will be constructed between the spillway plunge pool and the proposed tailrace area on the left bank of the river downstream of Enloe Dam to direct spillway discharge away from the proposed powerhouse and tailrace area.

The proposed concrete training wall would be constructed early in the construction period during the annual low flow period in Fall and Winter. A small temporary cofferdam would be used to isolate the foundation of the training wall from the low flow between the spillway plunge pool and the Falls. Dental rock excavation will be carried out using hydraulic hoe-ram excavators to provide a sound footing for the training wall and to key it into its rock foundation. If necessary, some controlled blasting may also be used to prepare the foundation. Since placing of concrete for the wall will be carried out in the dry, there is expected to be no issue regarding contact of uncured concrete with the river. Seepage into the excavation that is unsuitable for direct discharge by pumping to the river will be pumped to a temporary settling tank for sedimentation prior to discharge.

The north end of the tailrace channel and the excavation for the powerhouse structure will be carried out behind the training wall and with a rock plug left in place at the outlet of the proposed tailrace channel. Rock will be excavated by either excavator-mounted hoe-ram rock excavation, or controlled blasting. Excavated rock will be loaded into haul trucks for disposal in designated spoil disposal areas located north of Enloe Dam. Seepage or stormwater drainage entering the excavation will be collected and pumped into the sedimentation basin located upstream of the dam.

When the powerhouse and tailrace is complete and ready to be watered up, the rock plug at the entrance to the tailrace channel will be removed by controlled blasting and excavation in the wet. This work would be carried out under low flow conditions so that a barrier net can be placed across the river near the old powerhouse to prevent fish from swimming upstream into the plunge pool below the Falls and the tailrace outlet area during this phase of construction. Fish trapped in the plunge pool below the falls would be caught and released downstream of the barrier net. A temporary floating silt fence would be installed at the tailrace outlet to minimize release of sediment to the river during removal of the plug.. The tailrace channel would be flooded by pumping in river water to equalize the water level with that of the river before excavation and removal of the plug. The plug would be removed by controlled blasting supplemented by dental rock excavation with hydraulic excavators. Excavated rock will be removed by excavators and loaded onto haul trucks for disposal in designated spoil disposal areas. Upon completion of the tailrace channel, excavation of the plug, and removal of as much excavated material in the wet, as practical, the silt fence will be removed to allow water in the river and the tailrace channel to merge.

3. PLACEMENT OF CONCRETE IN WATER

As described in the preceding sections, the proposed plan is to construct the concrete training wall, powerhouse and intakes structure under dry conditions. No underwater placement of concrete is planned for these structures. Precipitation, surface runoff or infiltration of water into construction areas could result in contact between drainage and concrete. However, since this drainage will be pumped to isolated sedimentation facilities for sedimentation then land disposal, direct contact with the river will be avoided.

4. CONSTRUCTION, ACCESS AND SPOIL DISPOSAL AREAS

A color map showing proposed construction, road access and spoil disposal areas is attached (Figure C-1) and proposed spoil disposal activities are described below.

Spoil from construction of the intake channel, powerhouse and tailrace channel at Enloe Dam will be disposed of locally at designated spoil disposal areas located adjacent to the existing access road from the North which enters from the Loomis Oroville road near Shankers Bend and heads south to the Dam following the decommissioned Oroville-Tonasket irrigation canal along the east bank of the Similkameen River Valley.

Construction spoil will be used to improve the road including relocating a portion that currently traverses the river's flood plain and is subject to flooding in most years. Relocation of this road would also increase the surface area and improve continuity of wetland habitat within the flood plain.

The spoil which would be mainly comprised of excavated overburden soil and rock would be hauled to the disposal site by either scrapers or dump trucks and then dumped either directly in the spoil area or in a temporary stockpile prior to placement. Bulldozers, graders and compaction equipment would be used to form the spoil into a road embankment. Some sorting or crushing of rock may be necessary at the stockpile area.

Wet spoil would be temporarily stockpiled and allowed to drain with the drainage collected and conveyed to sedimentation facilities before land disposal. A small amount of river sediment excavated from the mouth of the intake channel would be tested for contamination by heavy metals from upstream mine drainage. Depending on the outcome of these tests the sediment would either be exported to a suitable off-site disposal area for hazardous materials or buried on-site in the designated spoil disposal area.

Best management practices for control of fugitive dust, stormwater and soil erosion are to be employed during and after construction. During construction water trucks would be used to control fugitive dust on haul roads and in spoil disposal areas. Erosion control measures including diversion of runoff from spoil disposal areas, installation of silt fences and wattles will be used, as–needed to prevent erosion and loss of sediment. At completion of construction, slopes will be revegetated by mulching and hydroseeding with a mixture of native ground cover seed.

5. AMOUNT OF SEDIMENT TO BE EXCAVATED FROM THE RIVER

Excavation of the entrance of the intake channel on the left bank of the river into the reservoir requires an excavation approximately 120 feet long in the reservoir and about 40 feet wide. The reservoir bottom slopes from about Elevation (El.) 1045 at the reservoir bank to El.1038 at the bottom of the channel.

The thickness of deposited sediment on the reservoir bottom at the entrance to the intake channel is not known, however to give some idea of order of magnitude, an average depth of one foot over the entire area would be equivalent to 180 cubic yards of sediment. An average depth of three feet would yield about 500 cubic yards of sediment. In relative terms this range of quantity is about 0.4% to 1.2 of the estimated total quantity of construction spoil.

6. INSTALLATION OF CREST GATES ON ENLOE DAM

Installation of crest gates on Enloe Dam will be carried out after completion of the new power generation facilities to provide safe access to the spillway crest and to maintain streamflow and water quality.

The water level on Enloe Reservoir will be temporarily lowered during low flow season below the crest of the spillway by diverting water through the power facilities. Then a portable construction barge with a small crane will be launched on the reservoir and secured against the crest of the dam for installation work for the crest gates. For safety, the barge will be secured with breast lines belayed to upstream anchorages on each bank of the river. In the event there is an unplanned power plant outage requiring spill over the spillway crest, the barge would be winched upstream away from the spillway.

Installation of the crest gates involves construction of two reinforced concrete piers on the crest of the spillway and then installation of the pneumatic control piping and the sole plates which secure the gates to the crest of the spillway. During construction an elevated temporary walkway will be installed across the concrete spillway on the downstream side of the spillway crest for personnel access and temporary piping for delivery of pumped concrete.

Upon completion of installation of the crest gates, the gates will be dry tested, the temporary walkway will be removed, the barge will then be demobilized prior to closing the crest gates and allowing the reservoir to slowly fill while still bypassing water through the power facilities so as to maintain adequate flow in the downstream reach of the Similkameen River. The gates will be wet tested one bay at a time by directing flow from the bypass reach to one of the controlled spillway bays by reducing flow through the turbines as flow is increased over the spillway crest gates by gradually lowering and raising each crest gate.

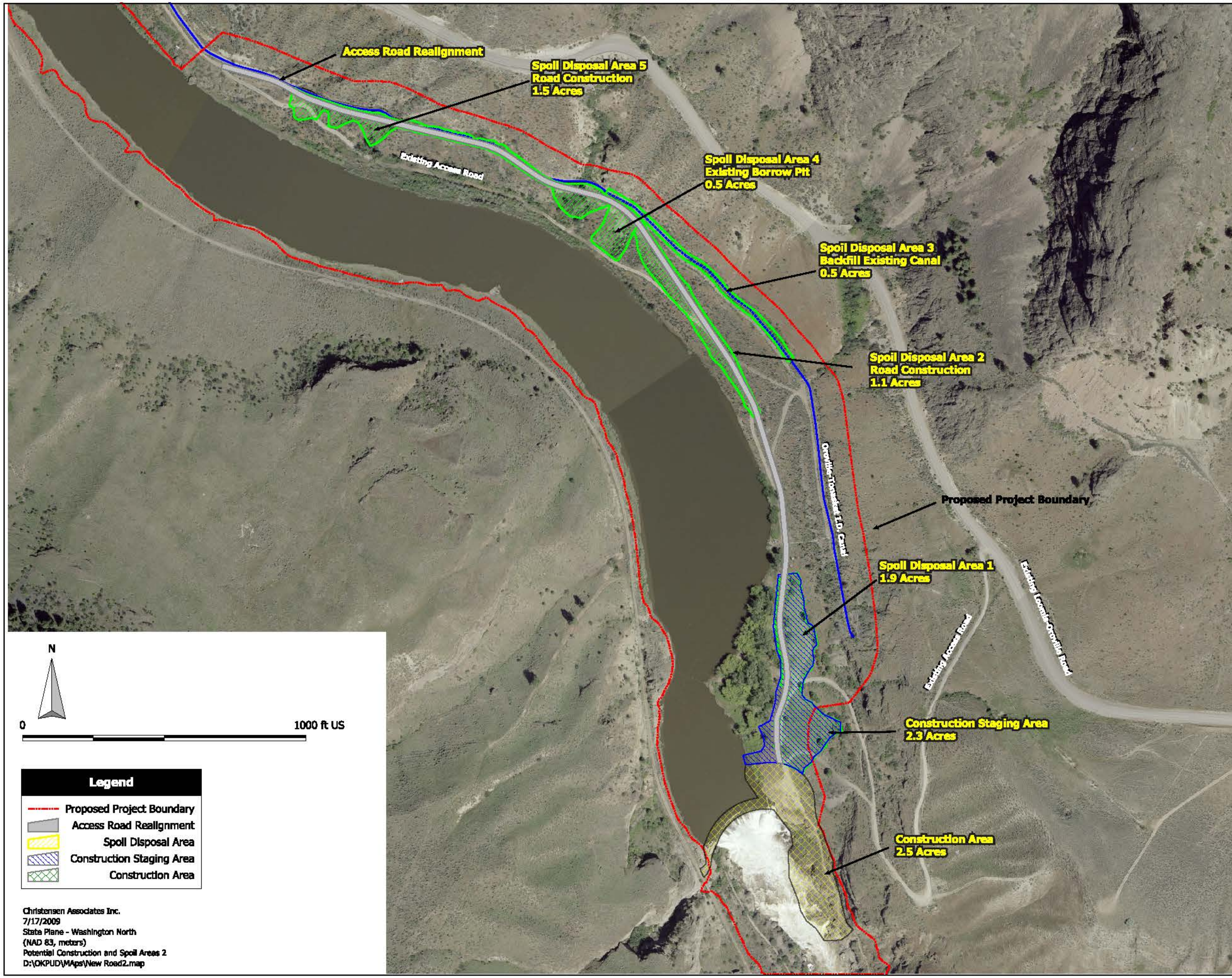


Figure C-1

Okanogan Public Utility District

Enloe Hydroelectric Project
FERC Project No. 12569-01

Map Showing Proposed
Access Road Realignment
Construction Staging Area
Spoil Disposal Areas
Construction Area

Appendix D:

Instream Flow Outlet Works

Okanogan Public Utility District
Enloe Hydroelectric Project

INSTREAM FLOW OUTLET WORKS

Purpose

The purpose of this document is to describe the conceptual design of the proposed instream flow outlet works to be implemented at Enloe Dam as part of the restoration of hydropower generation at this facility.

Background

The proposed hydroelectric power plant at Enloe Dam is to be built on the east side of the river in the left abutment of Enloe Dam.

Up to 1600 cfs of the flow of the river will be diverted through the power plant and returned to the river at a large pool immediately downstream of Similkameen Falls which is about 370 feet downstream of the dam. The reach between the reservoir and the pool is comprised of the overflow spillway on the downstream face of the dam, the spillway apron, the spillway plunge pool and a shallow channel that has been scoured across the bedrock terrace between the spillway plunge pool and Similkameen Falls.

Photographs of the reach of river between the dam and the Falls at different flows are shown on Figure 1 and Figure 2. The flow shown on Figure 1 is just below the median flow and is exceeded about 60% of the time. The higher flood flow shown on Figure 2 is exceeded about 7% of the time.

Design Criteria

The following design considerations and criteria have been developed in consultation with Washington Department of Ecology and Washington Department of Fish and Wildlife.

1. Instream Flow

The proposed instream flow in the reach between the dam and the fall is to be a minimum of 10 cfs increasing to a minimum of 30 cfs between July 15 and September 15.

2. Water Quality

Instream flow releases should be made in a manner that does not adversely affect downstream water quality as follows:

Dissolved Oxygen – Previous studies have determined that flow over the existing spillway serves to increase dissolved oxygen in outflow from the reservoir by an estimated 1 mg/l. High dissolved oxygen levels benefit anadromous fish. Similar levels of aeration of instream flow releases are therefore desirable.

Water Temperature - Existing high water temperatures during summer in the lower Similkameen River have the potential to adversely affect habitat for cold water fish. Peak instantaneous water temperatures measured at Oroville typically reach 26 ºC (79 ºF) in July with peak daily mean temperatures reaching 24 ºC (75 ºF). Instream flow releases should be made so as to avoid additional temperature rise.

Suspended Solids - Enloe Reservoir is heavily silted. Bathymetric studies show that the reservoir is shallow in the upper reach where much of the larger bedload has accumulated and deeper near the dam due to the trapping of larger sediment upstream and scouring velocities that occur in the reach between the dam and a narrows in the river some 500 feet upstream.

Outflow from the existing reservoir over the spillway, minimizes the entrainment of sediment from the reservoir in the outflow. Instream flow releases should be made to avoid blockage by sediment or any adverse effects on downstream fish habitat due to entrainment of sediment in outflow released from the instream flow outlet.

3. Fish

The instream flow outlet should be designed to avoid an increase in fish mortality for downstream passage relative to current passage over the spillway.

4. Reliability

To assure compliance with instream flow requirements it is necessary to provide reliable outlet works that have the capability to automatically regulate instream flow unattended throughout the year.

Proposed Outlet Works

The recommended design concept involves adding a conventional orifice controlled instream flow outlet to one of two existing penstock intakes in the right abutment of the dam. The proposed design of the facility is shown on Figure 3 and Figure 4.

Water would be drawn from the reservoir via the existing penstock intake in the west abutment of the dam. The centerline of the intake is at El. 1032 (i.e. about 16 feet below the proposed normal water surface elevation of the reservoir). A trashrack with one inch clear spacing between bars would be provided in the existing bulkhead gate slots to exclude trash and adult fish.

A steel bulkhead would be installed in the outlet of the existing steel penstock that emerges from the downstream face of the dam. A new approximately 70 foot long 18 inch diameter steel pipeline would carry flow from its connection with the bulkhead to a proposed new ring jet discharge valve to be sited about 75 feet downstream of the axis of the dam on a rock promontory on the west bank of the river overlooking the spillway plunge pool. A guard valve would be provided at the upstream end and a magnetic flowmeter would be installed on the pipe to measure flow.

The outlet of the ring jet valve will be at Elevation 1004.5 feet which is about 17 feet above the normal water level in the spillway plunge pool. The valve will be angled upward at about

30degrees so that the flow trajectory would be as long as possible to facilitate spreading and aeration of the discharge jet.

The outlet works is designed to provide a minimum hydraulic capacity of 30 cfs over a range of water surface elevation from El. 1043.3ft (1 foot below the existing spillway crest) up to El. 1048.3 (the normal reservoir water surface elevation with the crest gates raised).

From an environmental prospective, the primary advantage of this configuration is that the flow can be accurately controlled and measured to ensure that the required minimum releases are provided under varying streamflow, winter ice and hydraulic head conditions.

A low level outlet with a concentrated discharge would also minimize any temperature gain in water released from the reservoir as compared to a widely dispersed release of a thin film of surface water over the existing spillway.

There is some concern regarding future seasonal accumulation of sediment in front of the intake when the gates are raised and there is no spill at the dam. During times when there is no spill at the dam it is expected that the relatively low amounts of incoming bedload and suspended sediment to the reservoir will settle out in the velocity deceleration zone in the upper reaches of the reservoir. During the annual spill this sediment will be re-entrained by scouring velocities in the reservoir and be swept over the spillway. High scour velocities in the area immediately upstream of the spillway during the annual flood are expected to continue to scour out the area near the spillway and the proposed location for the instream flow outlet works.

In the proposed configuration, aeration of instream flow would occur at the ring jet valve where air would be entrained in the flow via the valve hood and would be in contact with the water as it travels approximately 40 feet horizontally and 17 feet vertically in a parabolic trajectory from the valve into the existing spillway plunge pool.

Figure 1 Enloe Dam and Similkameen Falls – October 14, 2010 – Approx Flow – 650 cfs

Figure 2 Enloe Dam and Similkameen Falls – May 31, 2006 – Approx Flow 8500 cfs

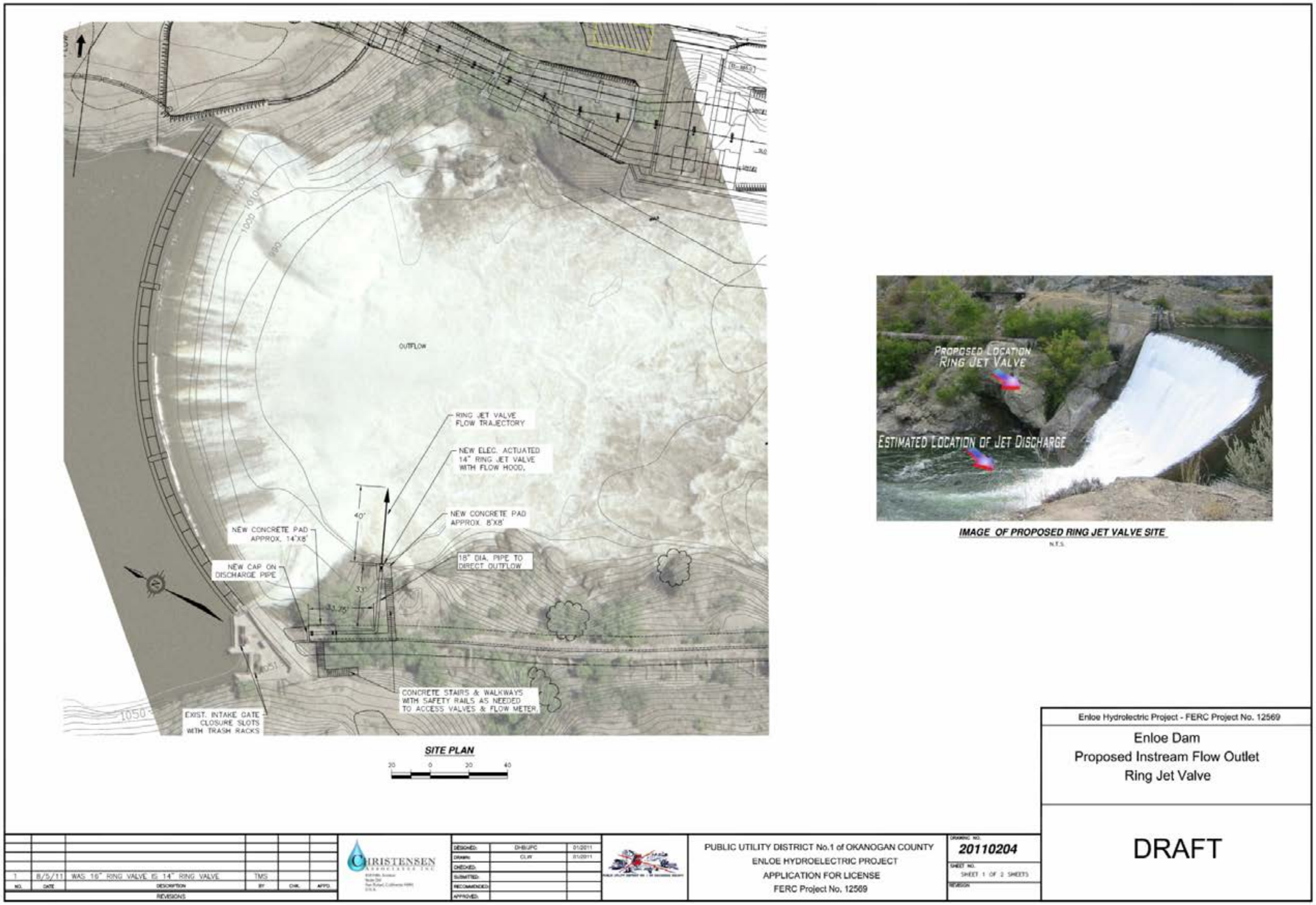


Figure 3 Proposed Instream Flow Outlet Works - Plan

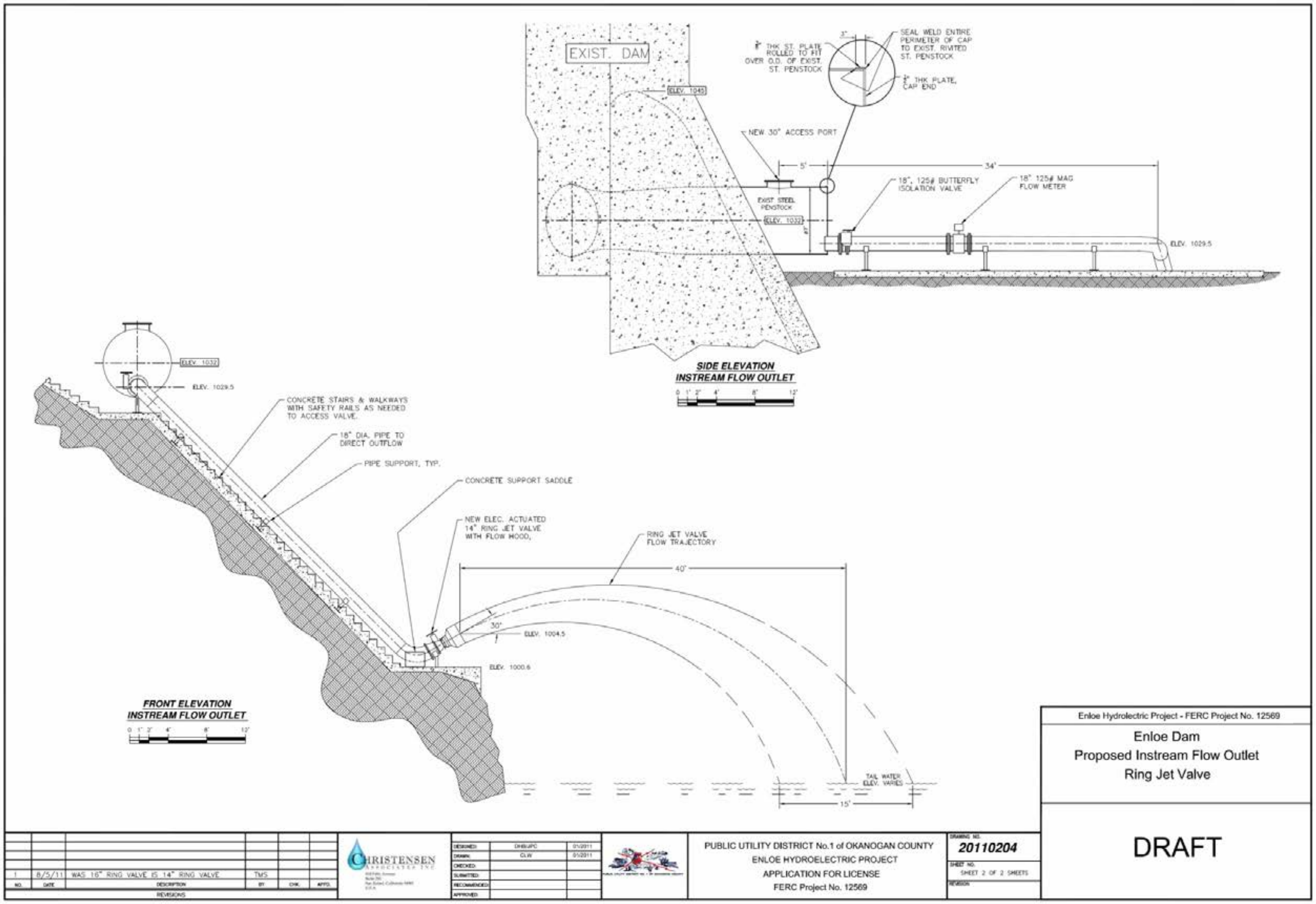


Figure 4 Proposed Instream Flow Outlet Works - Elevations