Enloe Dam
Provisional Removal Plan

SUBMITTED TO
Trout Unlimited

April 21, 2016

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1. Executive Summary

This document provides an outline and description of the tasks needed to initiate and complete the successful removal of Enloe Dam, which will enhance fish access and restore this section of the Similkameen River. Enloe Dam was constructed on the Similkameen River in the early 1920's near Oroville, Washington. The dam is a 54-foot high, 315-foot-long, concrete gravity arch structure with a broad central overflow spillway that is 276 feet long. This document outlines the technical investigations recommended to identify, assess, and plan for the physical and biological impacts associated with designing and permitting dam removal. This plan identifies next steps to manage impounded sediment, design demolition of the dam infrastructure, permit removal activity and anticipate monitoring needs. When finalized, this plan could potentially serve as a guide for major work elements required for the removal of Enloe Dam.

2. Introduction

Enloe Dam was constructed on the Similkameen River in the early 1920s, 3.7 miles upstream of the 12th Avenue Bridge in Oroville, Washington. The dam is a 54-foot high, 315-foot long concrete gravity arch structure with a broad central overflow spillway that is 276 feet long (OKPUD, 2008). The dam facility began providing power generation in 1923. In the 1950's, Bonneville Power Administration's high-voltage lines entered the Okanogan Valley and began delivering less expensive power to Enloe Dam customers. Soon after, the Enloe facility became unprofitable. Power generation ceased in 1958 and the facility has not been operational since.

The Similkameen River watershed is approximately 3,620 square miles, draining the east side of the Pacific Crest in the United States and Canada. The Similkameen River crosses the border near Nighthawk, Washington, and forms a confluence with the Okanogan River near Oroville, Washington.

Similkameen Falls is located 370 feet below the dam. The falls are approximately 20 feet high during low flow and cover a longitudinal (down river) distance of 33 feet. Historical documentation indicates anadromous fish access over the falls was possible before Enloe Dam was constructed (Hooker, 2015). The Enloe Dam has no fish passage infrastructure and blocks all upstream fish migration.

The Okanogan Public Utility District (PUD) No. 1 currently has the legal right to divert 1,000 cubic feet per second of Similkameen River flow at Enloe Dam for the purpose of generating non-consumptive hydropower. In August, 2008, the district filed a proposal with the Federal Energy Regulatory Commission (FERC) to build a new hydropower generation facility on the east bank of the existing Enloe Dam site. Since 2008, the projected costs of building and operating a new hydropower facility at Enloe Dam have escalated. Based on new cost projections, the economic viability of the dam is now in question.

The Okanogan PUD is evaluating dam removal as a management option. To do so, the PUD has stated it must have the following three conditions met;

1. A lead agency must be identified to assume responsibility and liability for dam removal and have financial resources equal to or greater than that of the PUD.
2. The dam removal work group must secure funds necessary to remove the dam and all associated activities.
3. The dam removal work group must have a provisional dam removal plan in place.

To meet these conditions, proponents for dam removal, comprised of Non-Government Organizations (NGOs), Federal, State and Tribal government groups, formed a Dam Removal Work Group (DRWG). The DRWG has been meeting with Okanogan PUD Board of Commissioners and PUD staff to move forward the idea of dam removal and meet all three of the PUD removal conditions. Dam removal is a collaborative process and each is unique. Several member organizations and agencies of the DRWG have experience managing these projects and working with private entities to ensure that all stakeholders are satisfied with the proposed outcomes.

To meet condition three, Trout Unlimited - Washington Water Project contracted with Inter-Fluve Inc. to develop a Provisional Dam Removal Plan. This document is the Enloe Provisional Removal Plan. It briefly reviews potential fish access and water quality benefits of dam removal, water rights associated with the dam, and key dam removal tasks. When finalized, this plan will serve as a guide to communicate and plan all major work elements required for dam removal. Any future Enloe Dam removal project will bring together local, state, federal resource agencies and stakeholders to create a dam removal design that meets regulatory needs, addresses concerns and can be permitted and funded.

2.1 REVIEW OF BIOLOGICAL & PHYSICAL IMPACTS OF DAMS

The effects of dams on the ecology and morphology of rivers are well documented (Baxter 1977, Ward and Stanford 1979, 1987; Armitage 1984; Petts 1984). Dams can cause dramatic changes in the riverine environment, not only in the impoundment area, but also in the river channel above and below the impoundment (Ward and Stanford 1983, Ligon et al. 1995). The most pronounced changes occur within the impoundment, and downstream where natural transport of sediments and nutrients flow, and temperatures are altered. In general, habitat within the impoundment shifts from a free-flowing stream, which favors riverine plants and animals, to a lake for which those species are not adapted. Rivers function as a continuum in which the riverine and surrounding riparian communities exchange water, nutrients, sediment and food (Cummins 1979). The complex physical, chemical and biological relationships along a river system are disrupted or severed by dams.

Overall reduction in habitat diversity within the impoundment results in the loss of species diversity and a greater abundance of those organisms tolerant of altered conditions (Allen 1995). Stream invertebrates and fishes are replaced by more tolerant or adaptable species typically associated with reservoir or lake environments (Cole 1983, Li et al., 1987, Ross 1991, Kanehl et al., 1997).

2.1.1 Fish Access

A benefit of removing Enloe Dam is the potential for upstream access to previously blocked spawning and rearing habitat. A literature review of historical documents was completed on behalf of the DRWG by American Whitewater. Historical information found in the review supports the assumptions that fish access existed over Similkameen Falls before the dam and that access could occur upstream well into Canada if the dam was removed (Hooker 2015). Further analysis of existing studies regarding fish access and potential habitat area upstream of Enloe was completed by Bowers, Hydropower Reform Coalition and DRWG in 2015 (Bowers 2015). This information provides compelling evidence of historic passage of anadromous fish, and supports the goal of dam removal to improve fish access. The upper Similkameen River and its tributaries offer a large area of spawning and rearing habitat in the United States and Canada.

The Lower Similkameen Indian Band and Colville Tribe do not support engineered (enhanced) fish passage above Similkameen Falls but do support volitional or natural access. Following dam removal, volitional access simply means allowing natural channel condition and discharge dictate what fish (species and size) and when migrate over Similkameen Falls into habitat previous blocked by Enloe Dam (Bowers et al 2015).

The same physical attributes that lead to changes in fish and macroinvertebrate communities also affect mussels. Freshwater mussels favor the stable substrate beds of rivers. Mussel larvae, or glochidia, develop in the gills of certain fish species particular to each mussel group. Dams can be barriers to the passage of certain fish upon which mussels depend for glochidia development. Increases in fine sediment load associated with reservoirs can also lead to the decline of mussel populations (Cordone and Kelley 1961, Hughes and Parmalee 1999). Recently, WDFW conducted placer mining survival experiments on western ridged mussels (Gonidea angulata) and western pearlshell mussels (Margaritifera falcata) in the Similkameen between Kabba Texas and Miners Flats just upstream of the Enloe Dam.

2.1.2 Water Temperature

Dams can elevate water temperatures by increasing residence time and increasing the exposure time of water to solar heating (Horne 2001, Poole and Berman 2001, Walks et al 2000). Temperature increases depend on the surface area and depth of the impoundment, and its water retention time.

Higher water temperatures may directly impact biota by exceeding temperature tolerance limits or indirectly by decreasing concentrations of dissolved oxygen, a problem that intensifies during low flows. Elevated water temperatures in the impoundment and downstream may contribute to changes in fish communities by eliminating or reducing the abundance of coldwater species such as salmonids and sculpins (Walks et al. 2000, Ward and Stanford 1989). It has been estimated that Enloe

Dam increases downstream water temperatures 1.8° to 2.7° (F). Based on these estimates, removal will improve water quality by creating a 1.8° to 2.7° degree downstream reduction in water temperature (Bowers 2015).

2.1.3 Sediment Transport

Dams reduce flow velocities and the mechanical ability of water to transport nutrients and products of erosion. Both fine organic and inorganic suspended sediment and larger bed load are deposited in the impoundment behind the dam instead of transporting downstream as part of the normal geomorphic process. Algae, aquatic plants, insects and fish depend on gravel, cobble and boulder substrates for attachment sites, hiding places and stable nest material. Fine sediment deposition upstream of dams changes streambed substrate particle size and composition, covers gravel and cobbles, and fills interstitial spaces between substrate particles (Waters 1995). The covering of the stream bottom by a thick layer of sediment reduces habitat diversity or heterogeneity and represents a loss of functional living space for benthic, or bottom-dwelling organisms.

Dams accumulate large amounts of fine sediment upstream of the structure, filling in habitats and simplifying channel cross-section (Ligon et al 1995). Because benthic macroinvertebrate abundance is correlated with substrate complexity and populations are more abundant in gravel and cobble matrices, deposition of fine sediment can be detrimental to invertebrates (Minshall 1984, Waters 1995).

Dams also affect sediment composition downstream of dams. With sediment deposited upstream of a dam, river flows become sediment-starved (Kondolf, 1997). As such, the energy that normally carries sediment downstream in an undammed river becomes available to move sediment after the water flows over the dam. This increase in available energy results in a coarsening of sediments downstream of dams.

2.1.4 Nutrient Transport

Lotic, or river ecosystems obtain their energy from both in-stream primary production (photosynthesis), and externally produced non-living organic matter, such as leaves, twigs and other debris (allochthonous sources). Both energy sources are important and dams trap and disrupt the downstream transport of nutrients derived from them. (Stanley and Doyle 2002, Ward and Stanford 1979). During periods of excessive flow, impoundments can be flushed resulting in sediment and excessive nutrient loading downstream (Gray and Ward 1982). Dams can also accumulate toxins such as PCBs and heavy metals that can be taken up by bottom-dwelling organisms (Gray and Ward 1982, Schuman 1995, Dauta et al. 1999).

2.2 ENLOE DAM WATER RIGHTS

The Okanogan PUD No. 1 has two non-consumptive water rights for the purpose of power generation. The first is a Class 1 water right of 250 cubic feet per second (subject of change of application No. CS4-CV1P243(A)). The second is a Class 3 water right of 750 cubic feet per second (subject of change of application No. CS4-CV1P243 (B)). Changes to the point of diversion for both water rights have been submitted to facilitate new hydropower facility construction on the East bank of the river. In 2010, an additional water right, application No. S4-35342, was submitted for an additional 600 cfs for hydropower use. Washington Department of Ecology approved the application August 6, 2013 but it is currently being appealed by several groups. A court date is set for April, 2016.

Surface water use is considered non-consumptive if there is no diversion from a water source or diminishment of the water source. Water diverted must also be returned immediately to the source at the point of diversion and have the same quantity and water quality as that previously diverted. Enloe Dam is a run-of-the-river hydroelectric dam where water is not diverted away from the natural confines of the river channel and is considered a non-consumptive water use.
Dam removal will invalidate existing non-consumptive water rights at the dam site. The feasibility of selling and transferring existing PUD non-consumptive water rights for use in another location is under review. The transfer and/or sale of the existing non-consumptive water rights to another entity will be determined at a later date and fall within the legal framework of existing water law and review by Washington State Water Resources Program and other interested parties.

3. Dam Removal Plan Tasks

3.1 PHASE I – PRELIMINARY ASSESSMENT

Dividing the project into phases helps ensure that no excessive studies are conducted and that future actions are driven by design data, as well as stakeholder needs.
Summary:

- 3.1.1 Existing Conditions Review
- 3.1.2 Reservoir Topography and Bathymetry
- 3.1.3 Sediment Analysis
  - Depth of Refusal/Sediment Volume
  - Supplemental Sediment Sampling
  - Risk Assessment

3.1.1 Existing Conditions Review

The Phase I assessment will include analysis of existing biological and physical processes. Evaluation of existing environmental assessments, such as the Total Maximum Daily Load (TMDL) and data collected through the Federal Energy Regulatory Commission (FERC) process, would be included in this effort. This review will include:

3.1.1.1 Hydraulic Data

Either hydraulic modeling and/or sediment transport modeling will require cross-sections up to the 100-year flow elevation or possibly higher if other flows are to be modeled. There may be accurate LiDAR data that can be used to construct a basemap, we recommend select topographic cross-sections above the water line to verify LiDAR data. Topographic cross sections can be married with bathymetry to create a base map of both above and below water topography.

3.1.1.2 Geotechnical Conditions

A due diligence analysis of surrounding hillslope soils, bedrock and future bank stability behind the dam should be completed. If reservoir sediment is not removed during dam removal, an understanding of reservoir sediment type and an estimate of the behavior of future banks that develop during pool drawdown should be made. Existing bedrock location and stability should be noted to identify hazards or risks that may accompany dam removal or may influence removal method.

3.1.1.3 Geomorphology

Some geomorphic assessment work has already been completed, primarily related to sources of sediment upstream of the impoundment (PUD 2012). This information is valuable, and during this early phase of the work, hydrologists and fluvial geomorphologists will use existing information and additional sediment data gathered (see below) to determine whether additional geomorphic assessment data and sediment transport modeling will be needed.

3.1.1.4 Fisheries and Stream Ecology

It will be important to review existing data and possibly collect updated fisheries information upstream, within and downstream of the dam impoundment. Knowledge of migration times, spawning, rearing and holding areas for summer Chinook, Upper Columbia River (UCR) steelhead, mussels and other key species (e.g. Bull Trout) will be helpful in determining the impact of any sediment release, and also develop pre-removal monitoring of target species for upstream fish access post dam removal. If post-removal monitoring includes index of biotic integrity (IBI) or other macroinvertebrate based indices of similarity, then pre-removal macroinvertebrate data is recommended. This includes mussels, which, if present, can be relocated during the removal process. This analysis also includes assessing the impacts any potential restoration decisions will have on current habitat and any ESA-listed species. For example, the project will need to follow permitting process as it relates to ESA species. Dam removal may not affect the other terrestrial species, but this will need to be documented and concurrence obtained. The dam removal will support the tributary habitat goals outlined in the Federal Columbia River Power System Biological Opinion, and will support efforts to strengthen and reestablish ESA listed salmonids and other species.

3.1.2 Reservoir Topography and Bathymetry

Final design will require accurate topographic surveying of the dam and all historical infrastructure present. The right side of the valley wall near the dam should be surveyed in detail to digitally capture road locations and allow for redesign of access and staging areas as necessary. All survey data needs to include adequate survey controls that will be safe and usable during construction. The existing bathymetry data suggests that the impoundment could be surveyed at least partially by watercraft, possibly wading in very shallow areas. Bathymetry can be collected in a variety of ways, including total station survey, GPS based survey, or sonar. Typical bathymetric surveys for impoundments use real-time, sonar, elevation data and water levels as a reference at the time of survey. Usually, bathymetric data is combined with topographic data, either surveyed or LiDAR, to create a basemap for the site.

3.1.3 Sediment Analysis

Sediment management is the most important factor associated with the Enloe Dam removal and will have significant influence on the cost and environmental impacts. Responsible dam removal sediment management includes accurately assessing the volume, character (size and chemical composition) and mobility of the impounded sediment.
Reservoir sediment investigations should consider how sediment data ties into feasibility and final removal design. Dam infrastructure may alter or influence sediment management during removal and its potential influence should be understood. All of this information is then considered through a risk assessment lens (e.g., what's the worst that could happen). The outcome of this analysis determines whether the sediment management plan can be developed or whether additional study and analysis is needed.

3.1.3.1 Sediment Depth of Refusal/Sediment Volume

Probing the sediments to the pre-dam channel and floodplain bottom is important to obtain an accurate estimate of sediment volume. The methods used for sediment probing vary from simple rods up to barge mounted vibratory coring units depending on the grain size and density of the sediments. Fine silt and organic sediment can be probed using probe rods. Sand and coarser material may require alternative methods including vibrocoring, traditional wet coring, geoprobe, or seismic refraction surveying. However, difficulties can be encountered with seismic refraction in reservoirs with organic material trapped in sediments, resulting in false depth readings. Coring can be done in conjunction with sediment quality or contamination testing sampling to reduce costs.

Depending on the depositional history of the site, it may be necessary to collect stratified samples or develop an aerial facies map of sediment sizes/types. If the impounded sediment is fractioned by longitudinal distance or depth, higher concentrations of contaminants may be found in different sections of the impoundment, and the entire volume may not need to be special handled. Different sediment sizes and thus hotspots have the potential to be both horizontal and vertical. Isolating them can greatly decrease project costs, as finer fractions typically harbor higher contaminant concentrations. Grain size relates to both mobility and retention of contaminants, and should be analyzed (lab sieve) with each sample. In addition, any depth of refusal probing or coring should at least record stratification and general sediment sizes (e.g. silt, sand, gravel, clay).

3.1.3.2 Supplemental Sediment Sampling

Okanogan County Public Utility District (PUD) sediment sampling collected several samples within and downstream of the impoundment, and although not an extensive sampling, this effort qualifies as an adequate first step in identifying the presence or absence of contaminants (PUD 2012). Results found in this survey were similar to data collected in developing the Similkameen River TMDL for Arsenic. Arsenic values are above the referenced State SQV (Michelsen 2003) and Tribal (CCT 2008) water quality standards, but the overall concentration of arsenic in the impoundment appears to be similar to concentrations in the river downstream. The PUD report does not detail how the samples were collected or grain size. Future sediment sampling should include a Sediment Sampling Plan that includes agency review and approval prior to actual fieldwork. Potential templates for the creation of a Plan include United States Environmental Protection Agency (USEPA) and/or United States Bureau of Reclamation (USBOR) guidelines for sampling and managing sediment in impoundments. Site specific and regionally approved impounded sediment sampling protocols based on these standards will need to be developed. Sediment sampling and analysis would be performed in accordance with EPA and Washington Department of Ecology (DOE) guidelines.

A determination will need to be made during Phase I whether additional analysis (building on what has already been collected by the Washington DOE for the TMDL) is needed for background data for EPA Priority Pollutant Metals and in-channel sediment concentrations upstream and downstream of the impoundment.

3.1.3.3 Risk Assessment

A critical piece of any project design is conducting a risk assessment. Oftentimes this is as simple as the project team asking themselves what's the worst thing that can happen, and for some projects, this involves a more in-depth analysis. The importance of a risk assessment is that it helps (1) you identify any factors that need to be designed for and (2) prevents overly designed projects based on faulty assumptions. The potential issues to consider include:

CONTAMINANT EXPOSURE

The big question with Enloe Dam is whether or not the sediment contaminant values that have or will be obtained will trigger special handling of sediment, either through on-site processing or removal to an off-site storage facility. The Washington Department of Ecology (DOE) has developed the Lower Similkameen River Arsenic Total Maximum Daily Load (Water Cleanup Plan), 2005. The plan recognizes a downward trend in arsenic levels to meet water quality targets. In terms of risk assessment, our key consideration here is to understand how sequestered sediments may affect arsenic concentrations if released by dam removal and what, if any, impacts there may be on downstream drinking water supplies, as well as fish and wildlife.

FISH AND WILDLIFE IMPACTS

Summer Chinook spawning downstream is a major concern for the CCT and other stakeholders. High return rates of summer Chinook spawners to this area makes sediment a priority concern. Specifically, this risk assessment should include a preliminary evaluation on sediment transport and the potential impacts of a sediment release on spawning and other fish and macroinvertebrate habitat.

The impact of temporary sediment impacts can be quantified, and must be balanced with the long term fisheries benefits of a free flowing river. The CCT has had some success in improving UCR steelhead populations, and is interested in reintroducing spring Chinook, now extirpated from the

Okanogan River sub-basin. Free flowing conditions will benefit steelhead, and will also benefit any spring Chinook reintroduction efforts by the CCT.

FLOODING IMPACTS

Another issue to consider, that affects sediment management and the final dam removal design, are whether the project team should be concerned with potential flooding impacts. About 1.5 miles downstream of Similkameen Falls, the channel slope decreases and the floodplain widens considerably. Based on previous experience with similar dams, discharge of impounded sediment from full drawdown would occur quickly, likely in less than one year. A simple calculation spreading the 1.79 CY volume (Nelson 1972) over a 6 mile stretch of river would result in a temporary bed increase of up to 5 feet. In reality, sand and gravel move in pulses and do not deposit uniformly across the river section. Mobilized sediment also deposits on floodplains. Based on our previous removal experience, bedload accumulations will likely be more than 5 feet in lower gradient reaches just below the dam, peaking out and then decreasing rapidly downstream. There is also undoubtedly a finer fraction of sediment that will remain in suspension longer and transport further downstream in a short time. However, this exercise illustrates that there will likely be some sediment accumulation in the bed, particularly where the channel slope decreases and flood energy is dissipated on the surrounding floodplain. This is a normal process and should be expected.

Understanding this process is important and will help define whether the dam is removed all at once or over several years to meter reservoir sediment transport down river and reduce or prevent local bed aggradation. Although channel bed elevations can increase and cause bank erosion and increased flooding, removal of the dam will not increase flood frequency or flood flows, as this is a run of the river dam with no flood storage.

3.2 PHASE II – FINAL DESIGN

The preliminary assessment conducted in Phase I will provide information and design data that will allow us to tailor final data collection and design to the specific needs of this project.
Summary:

- 3.2.1 Hydraulic Modeling
- 3.2.2 Sediment Management Plan
- 3.2.3 Demolition Plan

3.2.1 Hydraulic Modeling

The recent relicensing work did produce both a 1-D and a River 2D existing conditions hydraulic model using 2006 topography (PUD 2012). It can be assumed that hydrology for the project site has also been completed recently. This helpful information will be utilized in subsequent modeling efforts. Additional data will be collected where needed to expand the model reach where necessary or re-survey areas that have changed since 2006.

3.2.2 Sediment Management Plan

Development of the sediment management plan (SMP) and the potential for further study (discussed below) will be driven by the analysis conducted during Phase I and will reflect the appropriate amount of detail for the dam involved. With most dam removal projects, there are three primary sediment management options: passively releasing mobilized sediment downstream, dredging and disposing of sediment stored behind the dam, and some combination of the two approaches. Bringing these analyses together will determine acceptable removal methods.

Certain scenarios will raise the cost of the project by a magnitude or more. If the sediment can be allowed to release downstream, then anticipated costs can be reduced greatly. If there is a need to dredge material and deposit it nearby, local disposal (within 0.5 miles) would greatly reduce the cost of dredging if that is required by the approved Sediment Management Plan. There are also efforts that can include active excavation and removal of some or all of the sediment, or staged drawdown whereby sediment is allowed to transport in stages. Staged drawdown is an attractive option here, because of the channel slope, access and confined channel upstream. If staged drawdown is deemed infeasible, then active removal of fine sediment or some portion of fine sediment may be necessary.

Again, the design team will look to the data to dictate our path forward. In the event additional analysis is needed, the following studies should be considered:

3.2.2.1 Simple Sediment Mobility

Sediment evacuation in the Enloe Dam case will depend on several factors, including valley shape, slope, grain size, cohesiveness and flows. It will be important to determine, at the very least, the amount of sediment predicted to mobilize versus the annual sediment load for the river. A review of the Similkameen River TMDL documents did not reveal any sediment load information for the river. However, a Pacific Southwest Interagency Committee (PSIAC) model was incorporated by the Natural Resources Conservation Service (NRCS) as a task within the Okanogan Watershed Water Quality Management Plan (OWC 2000), to estimate sediment yield from the Similkameen River watershed. The model, applied only to the portion of the Similkameen River watershed within the United States (approximately 3.1% of total basin area), resulted in the highest sediment production in the basin at 3.54 tons per acre. Sediment mobility analysis will help to determine both the probability of sediment movement and the likelihood of sediment causing significant downstream channel or floodplain aggradation. The sediment in the impoundment is sand and gravel, most likely, with some fine fraction probably lower in the impoundment near the dam. This material will readily transport, with sand moving, even at base flows, in a confined channel with a minimum slope of 0.3%.

3.2.2.2 Short Term vs. Longer Term Impact Analysis

It is important to quantify the short term impacts of dam removal versus long term physical and biological benefits of river restoration. All dam removals have temporary impacts that can vary on the order of days to months to years. Several questions that will need to be investigated and assessed include: Will suspended sediment and bedload transport in future years mimic natural loading, or will they cause harmful impacts to the biota? If so, how long will these short term impacts last?

3.2.2.3 Sediment Transport Modeling

Following the USBOR draft guidelines for sediment management in dam removal, we believe it likely that this removal warrants detailed sediment data collection and possibly sediment transport analysis modeling. Some projects require more certainty in data collection and analysis, and more rigorous quantitative assessment of sediment impacts. Because of the size of the dam, the volume of sediment and the proximity of Oroville, we highly recommend some type of sediment fate analysis. There are several models available that can help predict sediment depths and mobility downstream. This dam removal is relatively simple apart from the downstream sediment issue, and so a physical model will not likely add much value.

3.2.3 Demolition Plan

There are no major buildings or powerhouse infrastructure associated with the Enloe Dam, which makes the demolition more straightforward. A demolition plan should include the following:

3.2.3.1 Water Management Plan

Every demolition plan should include a water management plan, including drawdown, dewatering and/or diversion as needed for various aspects of the demolition. This ties directly into sediment management, particularly for staged drawdown scenarios. For this dam, much of the work can be done without significant dewatering, but will ultimately depend on permitting requirements related to the physical, chemical and biological affects to sediment release.

Every dam demolition plan requires a detailed schedule. Fisheries impacts and hydrology tie directly into sediment management and must be merged into a plan that makes sense. If downstream discharge of sediment is planned in stages, for instance, it may make sense to do this work during spring/summer high flows or winter low flows depending on the goals.

3.2.3.2 Drawdown Plan

How much of the dam is removed and when depends on the dam's structural design and sediment management. This can vary greatly. In most dam removals, demolition occurs slowly and systematically by notching the dam and removing the structure from the top down. Drawdown can occur through various means, including siphoning, notching, pumping or rapid bottom release as was used in the recent Condit Dam removal in Washington. Unlike some aspects of construction, which can be determined by the contractor, we strongly recommend that the design team develop the drawdown plan since they have the most knowledge of the sediment management aspects.

3.2.3.3 Access and Staging

The relicensing plans called for reconstruction of the left bank access road, which may be the best alternative for removal as well, and also give areas for available staging. There is a significant staging area on river left. These would be shown on the design plans.

3.2.3.4 Infrastructure

Underground utilities must be identified prior to any grading, and the demolition plan needs to include any removal of penstocks or old foundation remnants as necessary.

3.2.3.5 Hauling and off-site Disposal

If off-site disposal is needed, the disposal site needs to be identified early in the process, and its capacity and willingness to handle incoming contaminated material must be verified contractually. Costs for disposal need to be incorporated into the per yard cost of any active sediment removal. If nearby BLM land can be used for disposal, costs can be decreased.

3.3 PHASE III – PERMITTING, ETC.

Summary:

- 3.3.1 Permitting
- 3.3.2 Monitoring Plan
- 3.3.3 Recreation Management Plan

3.3.1 Permitting

Permitting for large dam removals can be challenging; however, this project benefits from several partner groups with experience shepherding large dam removal projects through the regulatory process. In either case of passive sediment release or active sediment excavation, there will need to be coordination with stakeholders and regulatory agencies to determine the best course of action. This project involves significant impact to waters and structures regulated by local, state and federal permit processes including:

FEDERAL

- Clean Water Act (CWA) Section 404
- National Environmental Policy Act (NEPA)
- Endangered Species Act (ESA)
- Magnuson-Stevens Fishery Conservation and Management Act-Essential Fish Habitat (EFH)
- National Historic Preservation Act – Section 106
- Rivers and Harbors Act, Section 10
- Federal Energy Regulatory Commission (FERC) License Surrender
- National Pollution Discharge Elimination System (NPDES)
- Resource Conservation and Recovery Act (RCRA)
- Cultural Resources Impact Review (Section 106)

STATE

- State Environmental Policy Act (SEPA)
- Hydraulic Project Approval (HPA)
- Section 401 Water Quality Certification
- Air Quality
- Application for Change/Transfer of Water Rights

LOCAL

- Okanogan County Critical Areas Ordinance (CAO)
- Local building, utility decommissioning, burning, and land use permits

3.3.2 Monitoring Plan

It is safe to assume that for the Enloe Dam removal, some level of monitoring will be needed as a condition of permits. Monitoring can include repeated geomorphic surveying compared to pre-dam conditions, sediment, habitat, hydrology, vegetation, and aquatic biota.

3.3.2.1 Recreation Management Plan

Some effort was made to address recreation during the relicensing process. For removal, recreation management may include warning signage for the Similkameen Falls, improved road access to the site, historic signage, parking and picnicking facilities, and possibly watercraft access downstream of the Falls.

3.3.2.2 Cost estimate

Based on previous dam removal analysis, design and construction experience of the authors, a planning level cost estimate for Enloe Dam removal was completed. As noted within this plan, there are significant unknown pieces of information relative to the sediment management of impounded material that will have large impacts on the dam removal cost. Regardless, we understand the need to determine potential "order of magnitude" project costs for planning purposes. A best guess estimate of potential removal costs are as follows:

Project development, survey, sampling, design, engineering, permitting, construction oversight, and post-project monitoring: $2.5 - $3.0M Dam removal (staged drawdown, passive sediment release): $4M +/- 50% Dam removal (active sediment removal): $33M +/- 50%.

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