

A CHILOQUIN ROMANCE - RESTORING THE SPRAGUE RIVER

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ABSTRACT

Chiloquin Diversion Dam is a concrete gravity structure constructed by the U.S. Indian Service (USIS) in 1914, and is located on the Sprague River in south central Oregon. Despite the existence of three fish ladders, the dam effectively blocks 95 percent of the potential spawning range of the Federal endangered Shortnose sucker and Lost River sucker within the Sprague River watershed. Federal legislation passed in 2002 required a study of the feasibility of providing adequate upstream and downstream passage for sucker fish at Chiloquin Dam, including an alternate method of water delivery to the Modoc Point Irrigation District (MPID), which currently owns and operates the dam.

Removal of Chiloquin Dam, including the construction of a small pumping plant on the Williamson River to maintain water deliveries to the MPID Main Canal, was selected as the consensus alternative through a collaborative process between the Bureau of Reclamation (Reclamation), Bureau of Indian Affairs (BIA), MPID, Oregon Department of Fish and Wildlife (ODFW), Klamath Indian Tribes, and others. Final designs and specifications were prepared by Reclamation, and a construction contract for removal of Chiloquin Dam was awarded in February 2007, for completion by December 2008. This paper documents the existing conditions, decision-making process, designs, and construction for this fish passage project.

PROJECT BACKGROUND

Chiloquin Diversion Dam was originally constructed by the U.S. Indian Service (now Bureau of Indian Affairs) in 1914 on the Sprague River in south central Oregon, about 0.9 miles upstream from the confluence with the Williamson River. The dam is owned and operated by MPID for water deliveries to 5,500 acres of irrigable land. The dam is a concrete gravity structure with an embankment section on the left abutment, and has a total length of 220 feet and a maximum height of 21 feet. Existing features include a mass concrete overflow weir, a canal headworks structure, two sluiceways, one active fish ladder (constructed in 1966), and two abandoned fish ladders. The canal headworks structure is located on the left abutment and provides irrigation releases up to 60 ft³/s to the Main Canal. Although the active fish ladder on the right abutment has been observed to pass some native redband trout and suckers, the dam effectively blocks passage to about 95 percent (or about 80 river miles) of the potential spawning range of the Lost River and Shortnose sucker fish found in Upper Klamath Lake. Riparian and aquatic habitat conditions and water quality within the upper Sprague River watershed are highly degraded and will also require restoration actions in the future.

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The Chiloquin Dam Fish Passage Feasibility Study was authorized by Congress in May 2002 under the Farm Security and Rural Investment Act, to be completed within one year. The feasibility of providing adequate upstream and downstream passage for endangered sucker fish at Chiloquin Dam was to be studied by Reclamation for the Secretary of the Interior, in collaboration with the BIA, MPID, ODFW, and Klamath Indian Tribes. The study was to evaluate various fish passage alternatives, including dam removal, and determine the preferred action which maintains MPID water deliveries. Reclamation was directed by the Secretary to conduct the study since the sucker fish are primarily dependent upon water bodies within Reclamation's Klamath Project. An appraisal-level study was performed by Reclamation due to time constraints.

EXISTING CONDITIONS

Geologic Conditions

Surface geologic mapping was performed along both abutments of the dam and downstream for a distance of about 300 feet. Based on surface bedrock exposures, most of the dam appears to be founded on a hard volcanic breccia. This volcanic breccia is exposed along the right abutment of the dam and for 120 feet along the downstream toe of the dam. Although bedrock is not exposed along the left abutment of the dam, the first few hundred feet of the canal appears to be excavated into softer volcanic tuff, siltstone, and sandstone. The left abutment of the dam may also be founded on these softer rocks.

The reservoir bottom within 900 feet of the dam is covered by fine-grained sediment consisting of sand and silt, with some organics and woody debris. Reservoir sediment depths at the upstream face of the dam range from about 3 to 10 feet, and average about 6 feet. Sediment depths are lowest immediately upstream of the right and left sluice gates (which are stuck partly open) and the three canal headworks gates. The sediment depth is greatest at the top of a sediment cone that has formed midway between the center fish ladder and the left sluice gate.

The total storage capacity of the reservoir behind Chiloquin Dam has been estimated at 60 acre-feet. The average annual volume of river flow at the site is 426,000 acre-feet (based on a mean annual flow rate of 588 ft³/s). The ratio of reservoir capacity to mean annual flow is therefore 0.00014, which corresponds to an expected reservoir trap efficiency of near zero. The total estimated sediment volume is 45,000 yd³.

Concrete Dam

The dam consists of a straight concrete gravity overflow weir approximately 10 feet high and 130 feet long (not including the widths of the appurtenant structures). The dam crest is at approximately elevation 4186.5². A surveyed cross-section of the dam indicates a vertical upstream face and a 1:1 sloping downstream face, which closely matches the

² All elevations are based on the 1988 North American Vertical Datum (NAVD).

original design drawings. The concrete is hard and appears to be in satisfactory condition. An underwater examination indicated the vertical construction joints are open a maximum of ¼- to ½-inch at the upstream face but do not appear to be taking any water. The concrete structure seems to be firmly founded on a competent bedrock, with no evidence of undercutting of the structure along the downstream toe. The depth of flow appears to be uniform across the full length of the overflow crest and downstream face, with no indications of differential displacements or deformations. See Photo 1 below.



Photo 1. Chiloquin Dam on Sprague River, in Oregon.

A suspension footbridge was originally provided above the dam crest for access across the dam, consisting of three wooden support towers and steel cables with timber planks. Only the center and left towers currently remain upright, with only a few of the steel cables and timber planks remaining.

Based on a simple two-dimensional stability analysis of the concrete dam, assuming a cross-sectional area of 77 ft² above the downstream toe and a unit weight of 145 lb/ft³, the existing structure is stable against sliding and overturning for normal loading conditions, even with full uplift pressure beneath the assumed cross-section. The structure is also judged to be stable for earthquake loads up to the 2,500-year return period (having a peak ground acceleration of 0.33g), although some apparent cohesion (less than 5 lb/in²) would be required to resist sliding, and some cracking would be expected. Bearing capacity of the bedrock foundation should not be a concern under any loading conditions. Dam retention alternatives would not require stability modifications.

Appurtenant Structures

The appurtenant structures for Chiloquin Dam include a canal headworks structure on the left abutment, a sluiceway and abandoned concrete fish ladder adjacent to the canal headworks, a heavily deteriorated concrete fish ladder near the center of the dam, a functioning concrete fish ladder at the right abutment of the dam, and a non-functional sluiceway adjacent to the right abutment fish ladder. A plan view of the existing dam and appurtenant structures is shown in Figure 1.

The canal headworks structure contains three 4- by 4-foot slide gates at invert elevation 4182.5, and is estimated to have a maximum release capacity of 180 ft³/s; even though the downstream canal capacity is limited to approximately 60 ft³/s. All submerged metalwork (gates and gate frames) is rusted but is in generally satisfactory condition considering the structure is over 90 years old. Each slide gate is manually operated by a pedestal lift with a handwheel. A 47-foot-long sloping concrete headwall and a 140-foot-long concrete core wall within an earth embankment are provided to the left of the canal headworks structure to prevent overtopping of the left abutment during an extreme flood.

The left sluiceway is adjacent to the canal headworks structure and permits low-level releases to the downstream river channel through a 4- by 4-foot slide gate at invert elevation 4176.5, with a maximum estimated release capacity of 250 ft³/s. The left abutment fish ladder consists of a series of three pools with 2-foot drops and is located immediately to the right of the left sluiceway. A timber flashboard has been installed on the overflow crest of the fish ladder to prevent flow, effectively suspending its operation. The left sluiceway structure and left abutment fish ladder are each over 40 feet long.

The center fish ladder is located at about the midpoint of the dam and below the center support tower for the old footbridge. The reinforced concrete structure is approximately 45 feet long, but is severely deteriorated and little remains of the lower portion of the walls and floor. A 3- by 1-foot timber flashboard currently blocks flow to the fish ladder.

The right abutment fish ladder was originally constructed in 1966 as a pool-and-weir type ladder with ten wooden stoplog weirs and a 2-foot-high concrete weir below the stoplogs. The weirs were subsequently modified by ODFW into a pool-and-orifice type ladder in an effort to improve fish passage. Each pool is currently 10 feet long with a drop to the next pool of about 1 foot. The ladder floor and right sidewall are unlined, and the structure extends about 75 feet downstream from the dam. The ladder is described as having poorly configured baffles and the overall slope (1:10) is considered too steep for effective passage of sucker fish. Water velocities through the submerged orifices are about 3.6 ft/s. There is no auxiliary attraction water system for the ladder, and the entrance is located in shallow water near the right bank and below the right sluiceway.

The right sluiceway is located to the left of the right abutment fish ladder and below the original location of the right abutment footbridge support tower. A 6- by 4-foot slide gate and pedestal lift were provided to regulate low-level releases at invert elevation 4182.5. The structure is about 22-feet long and displays significant deterioration of the concrete sidewalls, where reinforcing bars and rail steel are exposed. The right sluiceway is currently described as non-functional.

A submerged rockfill and timber crib platform is located within the reservoir about 70 feet upstream of the dam and about 50 feet from the right bank. This structure is approximately 15- by 15-feet square and 6 feet high. The platform consists of a perimeter crib constructed of 24-inch-diameter cut logs, stacked 2 or 3 logs high with the interior filled with angular volcanic cobbles and boulders. The ends of each log are

squared off and the logs are bolted together where their ends overlap. This structure may have been used as a derrick crane foundation to facilitate the removal of floating logs from the river for the local timber industry.

Water Conveyance Features

MPID maintains 35 miles of canals, laterals, and drains to supply irrigation water to project lands. The maximum diversion from the Sprague River is about 60 ft³/s, although the canal headworks has a maximum estimated release capacity of 180 ft³/s and MPID claims a diversion right of 130.5 ft³/s. The first 600 feet of the canal follows the river channel closely, and the river bank has eroded significantly over the years to the point where a portion of the canal is already at the river's edge and is potentially subject to a breach during a large flood. This location is currently protected by an old section of concrete wall (originally the site of a gated wasteway pipe) and by stacked concrete blocks, but may be subject to undermining and collapse during large flood flows, resulting in loss of a long stretch of the canal near the river bend below the dam. The canal flow passes through a buried CMP culvert just upstream of this location for a road crossing. Dam retention alternatives would require additional floodproofing or armoring in this reach of the Sprague River to prevent a future breach of the Main Canal.

A fish screen structure containing five 42-inch drum screens is provided within the Main Canal approximately 1,000 feet downstream of the canal headworks. A small pipe is provided as a fish return to the Sprague River at this location. There are no wasteway structures along this reach of the canal.

A small pumping plant was originally constructed in 1960 downstream of the dam on the Williamson River, near the Highway 97 bridge, to supplement canal flows. The pumping plant contains two 40 ft³/s, low-RPM pumps within a concrete structure and behind a trashracked intake, but is unscreened and has not been operated or maintained since original construction. Three water users within MPID boundaries are located upstream of this site and cannot be served by pumping from this location. The pumping plant specifications suggest a Main Canal capacity of 69 ft³/s upstream of the plant (with a 12-foot bottom width and a 2.7-foot flow depth) and a Main Canal capacity of 122 ft³/s downstream of the plant (with a 14-foot bottom width and a 3.2-foot flow depth).

ALTERNATIVES CONSIDERED

Federal and State environmental laws require the preparation of compliance documents defining the proposed action and a range of alternatives, including no action. These documents consider the potential impacts of each alternative, including benefits and costs, and receive extensive review by Federal and State agencies, and by project stakeholders (public and private). Benefit/cost analyses are generally difficult to perform for dam removal projects, as project benefits may be difficult to quantify. Fish passage projects can compare the costs of dam removal to the costs of constructing, operating, and maintaining fish screens and ladders for the life of the project. Dam removal may

require the purchase of water rights or the provision of replacement water for lost diversion capacity. Final decisions may be made through the legislative and environmental compliance process, culminating with the issuance of Federal, State, and local permits and the award of a demolition contract. Funding may be provided by an Act of Congress, or from a number of Federal, State, and private sources.

Removal of Chiloquin Dam would prevent the gravity diversion of streamflow into the existing MPID Main Canal on the left abutment of the dam, and would therefore require the construction of a downstream pumping plant (or alternative methods) to supply irrigation water to the canal. For this alternative to be viable, the MPID point of diversion would have to be legally transferred from the Sprague River to a new pump diversion site downstream on the Williamson River. The complete removal of Chiloquin Dam, and the backfilling or regrading of the upper portion of the Main Canal, would leave nothing at the present site to operate or maintain. The operation and maintenance of an alternative water delivery system for the Main Canal would require increased operating costs resulting from the change from a gravity diversion system to a pumped water system (requiring electric power) for the dam removal alternative. Natural erosion of the impounded sediments is not expected to produce significant downstream impacts. All dam removal activities would be performed during low flow within the July through November time period, and all structures would be removed. Partial structure removal options were not considered for decommissioning due to the proximity to inhabited areas and the associated concern for public safety and the potential for legal liability.

Two structural alternatives were considered which would replace the existing concrete gravity overflow section with a gated or adjustable crest, to permit lowering the reservoir level during critical periods of fish migration. The radial gate alternative assumed three 50- by 8-foot steel radial gates with overhead hoists, while the crest gate alternative assumed a single 150- by 8-foot steel Obermeyer crest gate supported by a series of inflatable air bladders. The proposed spillway crest elevation and 150-foot crest length is comparable to the natural channel elevation and width and would not represent a flow constriction for fish passage. The existing reservoir level would be restored by gate closure to permit the gravity diversion of up to 60 ft³/s to the Main Canal from May 1 through September 30 of each year. Since spawning usually occurs between March 1 and June 1, the existing right abutment fish ladder at the dam would be retained and a pumping station would be provided on the Williamson River for periodic use during the period when both fish migration and irrigation diversion releases may be required (May 1 to June 1). Alternatively, a temporary mobile unit could be provided for pumping water from the Sprague River into the Main Canal to meet irrigation needs during the spawning period. Minimum fish screening criteria for these limited pumping requirements would be determined. Construction of either alternative would require the complete removal of the existing concrete overflow section, right sluiceway, center fish ladder, and left abutment fish ladder and sluiceway. The proposed spillway would have a total discharge capacity of about 24,000 ft³/s for a maximum head of 14 feet on the crest (to prevent overtopping the canal headworks structure). The 100-year flood is estimated to have a peak inflow of 12,800 ft³/s. Large, woody debris would be expected to safely pass over

the crest gate during normal reservoir operations, but may have to be contained behind a log boom for the radial gate structure to prevent potential damage to the radial gate arms.

The alternative of constructing a new, smaller diversion dam at an upstream site, with an upstream extension of the existing canal to maintain a gravity diversion, was eliminated from further study. Preliminary evaluations suggested an upstream diversion site would have to be about 3,000 feet upstream from the current point of diversion. This would require the construction and maintenance of an additional 3,000 feet of canal, which would include the excavation of a large rock outcrop located midway along the new canal alignment. In addition, the Klamath Indian Tribes raised concerns about the cultural significance of the upstream area along the left bank of the river, and the entire reservoir area and potential upstream diversion site are located within the Winema National Forest. Also included in the alternatives analysis were the construction of a new fish ladder on the right abutment having a flatter slope and improved entrance conditions, and the construction of a rock ramp in the downstream channel having a gradual slope to the existing dam crest suitable for fish passage.

In July 2003, the dam removal alternative was selected by the study collaborators as the best solution for fish passage, requiring MPID to move its point of diversion about one mile downstream to a new pumping plant site on the Williamson River. Detailed feasibility studies and environmental compliance activities were performed in 2004 to develop the proposed action for final approval. The U.S. Fish and Wildlife Service issued a Biological Opinion in support of the dam removal proposal in February 2005, and the BIA completed an Environmental Assessment in September 2005 which addressed the potential impacts of the various alternatives. MPID agreed to the removal of Chiloquin Dam by signing a Cooperative Agreement with BIA in October 2006. A Request for Proposals was issued by Reclamation on October 30, 2006. Existing features to be removed are shown on Figure 1.

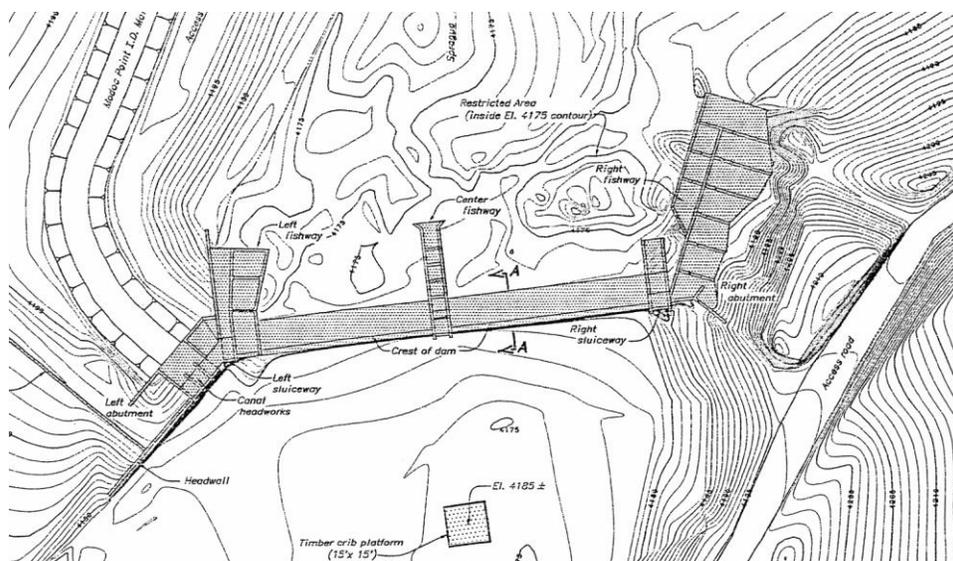


Figure 1. – Existing features to be removed from Chiloquin Dam site.

ENGINEERING CONSIDERATIONS

An engineering plan was required to assess the technical feasibility and associated costs of the dam removal alternative. Site access, streamflow diversion, structure demolition, waste disposal, and site restoration were considered.

Site Access

Chiloquin Dam is located in Klamath County, approximately 30 miles north of Klamath Falls, Oregon, and is accessible via Highways 97 and 422 to Chiloquin, then southeast through town to Chiloquin High School. The last 1,500 feet from the high school to the right abutment of the dam is by narrow, unpaved road on Klamath County School District property. Right of Entry agreements were obtained for access to the Main Canal and the left abutment of the dam across private lands, including the use of a privately-owned steel truss bridge with a posted 25 ton load limit, which crosses the Sprague River approximately 2,000 feet downstream of the dam. Land upstream of the dam on both abutments is owned by the Federal government, while the dam and appurtenant structures are owned by MPID.

Streamflow Diversion

Dam removal activities will occur during the low-flow period for the Sprague River (July through November) and following the spawning period (March 1 to June 1). An alternative system for water deliveries of up to 60 ft³/s to the Main Canal should be in place and operational prior to dam removal. A streamflow gage (Number 11501000) on the Sprague River near Chiloquin, Oregon, indicates streamflow generally ranges between 100 and 400 ft³/s during the July through November period, with a mean annual flow of 588 ft³/s. The reservoir will be drawn down below the dam crest elevation by maximum releases through the canal headworks and left sluiceway, with a combined discharge capacity of 430 ft³/s at elevation 4186.5, assuming that the Main Canal is breached in the vicinity of the existing concrete blocks to return the flow to the river channel below the dam site, and the existing CMP culvert is removed from the canal to increase the discharge capacity. Some of the estimated 122 existing concrete blocks (each weighing over 3,000 pounds) located along the Main Canal could be repositioned within the river channel to help divert the streamflow downstream of the demolition site, or additional concrete blocks or Jersey barriers could be used. Sandbags could be placed on the dam crest to provide further protection against overtopping.

Structure Demolition

The initial streamflow diversion described above will permit the removal of the right abutment fish ladder and the remaining walls of the center fish ladder in the dry. A 100-foot-long temporary cofferdam, consisting of steel H-piles driven into the reservoir sediments and river alluvium to refusal, with timber planks installed between the H-piles,

could be used to unwater the right half of the dam for removal of the right sluiceway and at least 50 linear feet of the dam to the original bedrock surface.

A controlled breach of the temporary cofferdam by selective removal of the timber planks by crane would establish the streamflow through the dam breach and draw the reservoir level down below the existing sediment level at the dam. This would allow the removal of the left abutment structures consisting of the canal headworks and wingwalls, and the left sluiceway and fish ladder. The timber support towers and footbridge remnants could also be removed. Finally, the remaining portions of the dam and center fish ladder would be removed. A second temporary cofferdam, also consisting of steel H-piles and timber planks, could be installed as needed to facilitate unwatering of the left portion of the dam for removal.

Demolition of the concrete appurtenant structures could utilize a backhoe with a hydraulic hoe-ram and/or a bucket with hydraulic thumb. Demolition of the mass concrete dam could use conventional drill and blast methods. The timber support towers could be cut or pulled down for demolition, with the large support timbers to be salvaged.

Waste Disposal

Full removal of the dam and appurtenant structures would result in approximately 700 yd³ of concrete debris, including reinforcing bars and rail steel (of unknown quantity), approximately 10,000 pounds of mechanical items, 6 tons of timber, and over 100 linear feet of chain link fencing. Total waste would amount to over 1,300 tons. The nearest public landfill is located on Old Fort Road in Klamath Falls, a distance of 28 miles from the dam. Waste items should be sorted by type of material (concrete, wood, steel). The large support timbers, steel reinforcement, and mechanical items may have some salvage value, although none was assumed for this study. The existing Main Canal could be partially backfilled with waste materials for onsite disposal. No waste disposal is assumed within the river channel or within the Winema National Forest.

Site Restoration

The dam removal plans require the removal of all structures and the backfilling or regrading of the Main Canal to pre-dam conditions. Some additional regrading of the site would be required at the canal headworks and embankment on the left abutment, as shown on Figure 2. No concrete removal would be required below the original bedrock surface, regardless of the depth or extent of any structural keyway beneath the concrete dam (which is unknown). Lower portions of the left abutment concrete core wall may be left in place if sufficiently buried. The placement of seeded topsoil will be required to help revegetate the site.

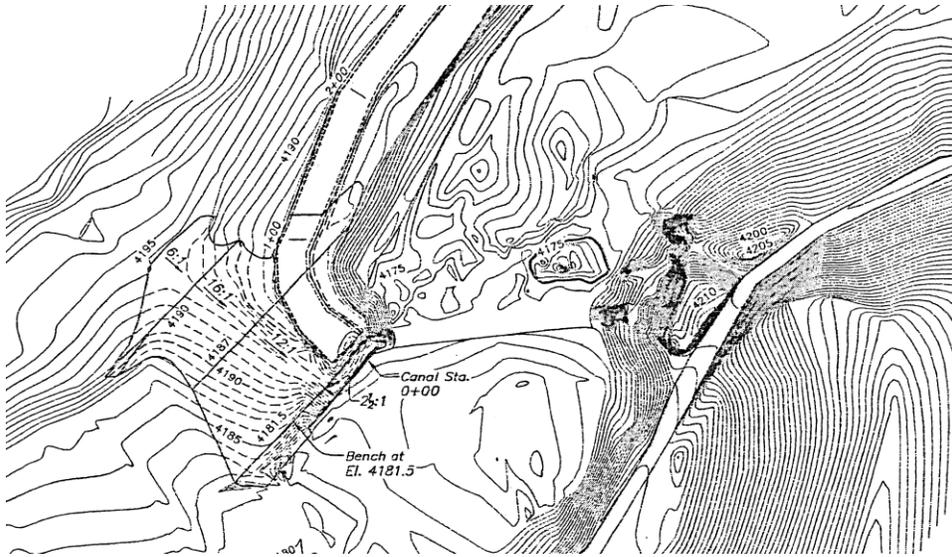


Figure 2. – Proposed restoration plan at Chiloquin Dam site.

ENVIRONMENTAL MITIGATION AND PERMITTING ISSUES

Water Quality

Dam removal would be expected to increase turbidity levels to some degree due to any construction operations within the river channel and as a result of the dam breach and associated sediment erosion. Potential adverse impacts are expected to be minor and short-lived. No significant long-term impacts to water quality (such as temperature, dissolved oxygen, or turbidity) or flood control are expected, due to the very small storage capacity of the reservoir and the large conveyance capacity of the lower Williamson River.

Approvals were received from the U.S. Army Corps of Engineers for a Section 404 (dredge and fill) permit, and from the Oregon Department of Water Resources for a Section 401 (water quality) certificate for the dam site. Suitable precautions would be taken to prevent any hazardous material spills (diesel fuel, oil, gasoline) from construction equipment working in the river channel. Such precautions would include daily inspections for hydraulic leaks, steam cleaning of the undercarriage as required, operation with minimum fuel load and with minimum movement, and maintenance of absorbent pads and booms on site. In addition, the work would be planned to minimize equipment time in the channel, but at a pace necessary to minimize turbidity impacts.

Environmental Controls

Noise would be produced by various dam removal and construction activities including the operation of heavy construction equipment, hauling equipment (dump trucks), drills and jackhammers, air compressors, and controlled blasting for concrete excavation.

Noise levels may produce short-term adverse impacts close to the damsite, but should not be noticeable beyond a distance of about one mile. Some natural attenuation of noise levels should be provided by trees and the existing terrain. No special noise abatement procedures would be necessary for daytime operations. Any night operations would be required to comply with specification requirements for light control. Floodlights must be shielded and directed downward so as not to be a nuisance to surrounding areas.

Construction activities could send minor amounts of traffic-related pollutants and some particulates into the air in the immediate areas. Local construction traffic is expected to be relatively minor for the dam removal, primarily consisting of hauling equipment for removal of waste materials. Special traffic control measures would be required during construction. Dust generated by construction traffic may require some mitigation by periodically spraying water for dust abatement.

Cultural Resources

Removal of Chiloquin Diversion Dam would mean the loss of an historic structure potentially eligible for listing on the National Register. Mitigation would be provided by the preparation of a Historic American Engineering Record (HAER) for the dam and appurtenant structures, including detailed drawings and photographs.

River Restoration

Removal of Chiloquin Dam would serve to restore the Sprague River through the existing reservoir area. However, the upstream riverine habitat above the dam has been decimated by the logging industry, resulting in the loss of shade and the existence of higher river temperatures. The U.S. Fish and Wildlife Service (FWS) Ecosystem Restoration Office (ERO) is assembling available data pertaining to habitat restoration efforts in the upper Sprague River watershed for future consideration.

SEDIMENT MANAGEMENT

Sediment management is normally a critical factor in the engineering assessment, and considers the impacts of natural erosion of sediments compared to mechanical excavation or stabilization of sediments in place. Investigations during design indicated a minor impact potential from the release of sediment stored in the reservoir behind Chiloquin Dam as a result of dam removal. The total estimated sediment volume of 45,000 yd³ would be completely eroded during the first winter flood season, passing through the Sprague and Williamson Rivers to Upper Klamath Lake. Reservoir silt would remain in suspension until reaching Upper Klamath Lake, resulting in an increase in turbidity for a short period of time (from days to weeks). Coarse-grained sediment (sand and gravel) would likely be deposited in the lowest reach of the Williamson River where the channel slope flattens. Since the conveyance capacity of the lower Williamson River is large, no problems with sediment deposition in this reach are anticipated. In addition, a reservoir sediment toxicity assessment performed by Reclamation found no evidence of toxic

materials or heavy metals within the sediment which would be of any concern, and the sediment was classified as suitable for unconfined aquatic disposal.

CONSTRUCTION

A construction contract for removal of Chiloquin Dam was awarded in February 2007 to Slayden Construction Group of Stayton, Oregon. Construction of the pumping plant on the Williamson River must be completed by April 15, 2008, in order to provide sixty days of operational testing by MPID before removal of the dam can begin. All dam removal work is to be completed by November 28, 2008 (except for seeding). The pumping plant requires a screened intake structure, three vertical turbine pumps, and a 42-inch-diameter discharge pipeline, as shown on Figure 3. The total project cost is estimated at \$18 million for design, construction, environmental compliance (including permitting and monitoring), and mitigation, including nearly \$9 million in contract costs for removal of the dam and for construction of the new pumping plant and conveyance systems, and compensation to MPID for future operation and maintenance of the pumping plant. Reclamation will administer and manage the construction contract for BIA.

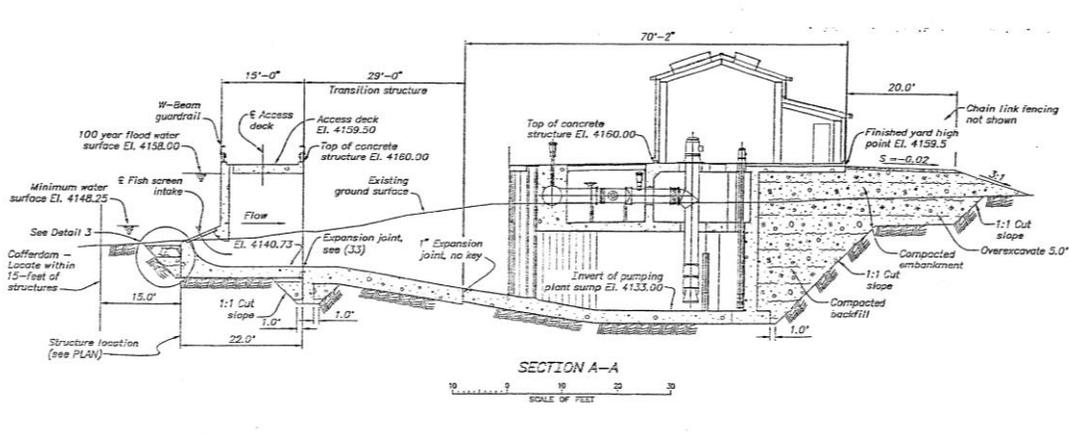


Figure 3. – Section through proposed pumping plant with screened intake.

CONCLUSION

The removal of Chiloquin Dam, including the construction of a small pumping plant on the Williamson River for water deliveries to the MPID Main Canal, was approved to provide upstream and downstream passage for endangered sucker fish on the Sprague River, using a collaborative process between Federal and State agencies, Klamath Indian Tribes, and others. Final designs and specifications were prepared by Reclamation, and a construction contract for removal of Chiloquin Dam was awarded in February 2007, for completion by December 2008. This is an important first step in the recovery of the traditional fishery rights reserved for the Klamath Indian Tribes on the Sprague River; however, additional restoration work in the upper Sprague River watershed will also be required. The U.S. Fish and Wildlife Service and the Klamath Tribes are spending

considerable efforts on habitat restoration projects involving fish screens, bank stabilization, cattle fencing, reconnecting the Sprague River to the floodplain, and recreating the natural channel form and function upstream of the damsite. Funds have been secured for developing a sediment budget model, conducting additional stream geomorphology studies, and monitoring vegetation resources in the future.

REFERENCES

“Chiloquin Dam Conceptual Design and Cost Estimate for Upstream Fish Passage Facilities,” CH2M-HILL, March 1996.

“Chiloquin Dam Fish Passage Study – Klamath River Basin, Oregon,” Bureau of Reclamation, Klamath Falls, Oregon, August 2003.

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