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Cle Elum Improvements Project

Yakima River Basin Water Enhancement Project

Yakima Project, Washington

Status Report

U.S. Department of the Interior
Bureau of Reclamation
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Upper Columbia Area Office
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Need good Location map

Chapter 1

Introduction

The Bureau of Reclamation (Reclamation) proposes to improve the Cle Elum Dam spillway to provide additional water storage, to provide shoreline protection of Lake Cle Elum, and to construct juvenile fish passage facilities at Cle Elum Dam. This status report describes the findings of Reclamation's studies to date.

Location and Setting

The Yakima River Basin is the second largest sub-basin of the Columbia River Basin in Washington State. The Yakima River originates high in the Cascade Mountains, then runs 200 miles through the Yakima Valley to join the Columbia River near Richland, Washington. Its headwaters drain about 6,150 square miles of the eastern slopes of the Cascades. The Yakima Project storage reservoirs have an active capacity of more than 1 million acre-feet of water, most of which is dedicated to irrigation (Mongillo and Faulconer 1982, Mullan 1986).

Cle Elum Lake is the largest of the four irrigation storage reservoirs in the Yakima River system, and is considered to have the largest volume of fish spawning and rearing habitat in and above the reservoir. Cle Elum Dam is the only apparent physical barrier to the restoration of salmonid populations to Cle Elum Lake.

Purpose, Scope, and Objectives of Study

This study has three main purposes:

- to increase the reservoir pool in Cle Elum Lake 3 feet, thus storing an additional 14,600 acre-feet of water. This additional storage water would be dedicated exclusively to instream flows for fish and wildlife in the Yakima River Basin.
- to provide for Cle Elum shoreline protection
- to provide juvenile fish passage facilities at Cle Elum Dam

The Cle Elum Improvement Project (CLIP) study goals were to provide a detailed cost estimate for each of the authorized project elements, including the increase of the reservoir pool at Cle Elum Lake, the shoreline protection, and the fish passage facilities at Cle Elum Dam.

Authority for Action

Congress initially authorized the Yakima River Basin Water Enhancement Project (YRBWEP) by the Act of December 28, 1979 (P.L. 96-162), to address the water resource needs of the basin. The act authorized the Secretary of the Interior (Secretary) to undertake a feasibility level study of the proposed YRBWEP. Additional studies led to enactment of Title XII, Phase 2 of the YRBWEP, Public Law 103-434, passed on October 31, 1994. Congress enacted YRBWEP to:

- Protect, mitigate, and enhance fish and wildlife through improved water management; improved instream flows; improved water quality; protection, creation, and enhancement of wetlands; and by other appropriate means of habitat improvement

- Improve the reliability of the water supply for irrigation.

Under YRBWEP, a programmatic environmental impact statement (PEIS) was prepared that considered the actions possible in the basin to protect, mitigate, and enhance fish and wildlife and to improve the reliability of the water supply for irrigation through improved water conservation and management and other appropriate means. The PEIS provides "umbrella" coverage to implement the general provisions of Title XII. Consequently, the PEIS did not discuss site-specific impacts (Interior 1999). Additional NEPA compliance for specific actions is required as appropriate.

Section 1206 of Title XII of this act authorizes the appropriation of $2,934,000, cost indexed to September 1990 prices to (1) modify the radial gates at Cle Elum Dam to provide an additional 14,600 acre-feet of storage capacity in Lake Cle Elum, (2) provide for shoreline protection of Lake Cle Elum, and (3) construct juvenile fish passage facilities at Cle Elum Dam, plus such additional amounts as may be necessary which may be required for environmental mitigation.

Section 1206 also authorized to be appropriated to the Secretary such sums as may be necessary for that portion of the operation and maintenance of Cle Elum Dam determined to be a Federal responsibility.

Chapter 2

Need for Action

This chapter defines the problems, needs, and opportunities toward which plan formulation is directed.

Needs at Cle Elum Dam and Reservoir

A need exists in the Yakima River Basin to protect, mitigate, and enhance fish and wildlife. The natural ecosystem contained communities of native species that evolved in a snowmelt, groundwater, and lake storage river system subject to seasonal flow variability. The fish fauna included about 28 native species (Patten et al. 1970; Reclamation, 1979). The ability of fish populations to thrive depends on how well their life requirements are met for each life stage. Life stages include eggs, fry, juveniles, and adults. Fish must be able to migrate, if applicable, and reproduce. **Additional instream flows** are needed in the Cle Elum River to meet the fish needs in the river and the basin.

The shores of Cle Elum Lake are eroding because of the soil texture, topography, and varying levels in the lake. Operation of Cle Elum Lake creates a fluctuating water surface elevation that is conducive to erosion. **Shoreline protection** would alleviate the erosion of the soil into the lake.

Cle Elum Dam was built in the early 1930s without any provision for migrating juveniles or adults, and it blocks the access of fish to considerable spawning and rearing habitat. The high (165 feet) earth and concrete dam increased the maximum surface area of the lake from about 3,000 to 5,000 acres at full pool.

The Yakima River system historically supported large runs of anadromous salmonids that contributed significantly to the Columbia River harvest. Habitat destruction and overfishing drastically reduced run abundance by the early 1900s. Subsequently, salmon runs were extirpated (exterminated) from upper reaches of the Yakima River Basin by the construction of irrigation storage reservoirs without fishways at Cle Elum, Kachess, Keechelus, and Bumping Lakes. Juvenile **fish passage facilities** are needed, particularly at Cle Elum Dam, because passage at this dam would provide more habitat for anadromous fish than at any other Yakima River Basin dam.

Opportunities for Improving Salmonids

An April 2000 report entitled *Cle Elum Lake Anadromous Salmon Restoration Feasibility Study: Summary of Research* by the National Marine Fisheries Service, concluded that potential habitat available in Cle Elum Lake and upstream in the Cle Elum River could sustain a viable population of sockeye salmon. (Flagg, et al. 2000). The study recommended releasing sockeye salmon fry (from Lake Wenatchee broodstock) into Cle Elum Lake over several years and monitoring the success of their outmigration as smolts and their return as adults.

This report made the following conclusions:

- Culture of sockeye salmon fry for reintroduction into Lake Cle Elum is feasible.
- Sockeye salmon fry released into Cle Elum Lake survived overwinter and grew well; however, lake fertilization with nitrogen, phosphorus, and trace elements would increase carrying capacity.
- Spawning habitat upstream from Cle Elum Lake, in the Cle Elum, Cooper, and Waptus Rivers could probably support tens of thousands of returning anadromous salmonids. Elimination of one passage barrier on each of the three streams would open up miles of anadromous salmon spawning habitat.
- Planted sockeye salmon smolts congregated near the outlet to Cle Elum Dam in an apparent attempt to outmigrate. However, Cle Elum Dam was an obstacle to outmigration success.
- Under the current spilldeck configuration of Cle Elum Dam, the fill/spill cycle of Cle Elum Lake appears to be out of synchrony with the need for safe surface passage of salmon fry from the reservoir.
- Sockeye salmon fry need a surface running-river exit channel or conduit to provide for successful migration past the dam. The fry will not dive to a submerged orifice exit.
- Study results underscore the need to accommodate for mid-April peak outmigrations of sockeye salmon passing Cle Elum Dam to maximize downstream survival.
- A safe surface running-river exit route for smolts past Cle Elum Dam during the early spring (late-March to early May) outmigration window normal for Columbia River sockeye salmon stocks could be provided at Cle Elum Dam using one of several options. A NMFS tower design with a netted lead to guide fish to the outlet is one option. An outlet conduit

with sets of vertical slide gates on the face of the dam is another option. A floating gulper trap with pumped attraction flows is another option.

- A smolt passage system configured for maximal smolt passage at Cle Elum Dam during the preferred early spring outmigration window would probably need to operate down to elevations of 33 feet below the current spilldeck elevation of 2223 feet (i.e., down to elevation 2190 feet). Comparatively, under historic fill/spill reservoir operations (probability based on the 59-year period from 1935 to 1993), if a smolt passage system had operated from full pool (currently elevation 2240 feet) down to the floor of the spilldeck (elevation 2223 feet), it would have been available for smolt outmigration by the end of April about 40 percent of the time. If the smolt passage system had operated from full pool elevation down to elevation 2190 feet, it would have been available for smolt outmigration by the end of April about 83 percent of the time (i.e., most years).

- No downstream (outmigration) blockages to migration of sockeye salmon occur in the Yakima River system downstream of Cle Elum Dam during the normal late-March to early-May period of smolt outmigration for sockeye salmon.

- In 1991, 1992, and 1993, a total of 35 adult sockeye salmon were observed returning upstream through the Yakima River system as a result of the Cle Elum Lake study releases, representing the first returns of sockeye salmon to the Yakima River Basin in more than 60 years. These returns were encouraging about the potential for salmonid recolonization of lost habitat above Cle Elum Dam.

- Although the study concentrated on sockeye salmon, the results should apply to all anadromous salmonid runs that historically used Cle Elum Lake and the upper Cle Elum River above the reservoir. This study may also be generally applicable to other nearby impounded irrigation reservoirs.

Of all the reservoirs in the basin, Cle Elum is the best option for providing passage because of an abundance of habitat that could be made available. Initial investigations suggest that suitable habitat exists for many species native to Cle Elum Lake including ones that have been extirpated as a result of damming the lake. These species include bull trout, steelhead, sockeye, chinook, and coho salmon.

Chapter 3

Resources and Other Factors

This chapter provides a general discussion of existing and projected conditions that could affect the formulation of alternatives to address the identified needs. Physical, statutory, social, institutional, and environmental constraints that limit the capability of resources to meet these needs are included, as appropriate.

Cle Elum Dam Risk Analysis

The *Cle Elum Dam Risk Analysis Report* was completed in December 1999. That report evaluates the safety of Cle Elum Dam under current reservoir pool operating conditions and with the additional 3 feet of reservoir pool contemplated by the proposed Cle Elum Improvement Project.

The risk analysis report concludes that Cle Elum Dam poses an acceptably low level of risk to the current downstream population at risk. The report also finds that the 3-foot additional head resulting from the proposed raise of the reservoir normal water surface to elevation 2243 feet (proposed action) would have negligible effect on the probability of failure and risk for each of the dam failure modes analyzed. The radial gate analysis found that the two lowermost horizontal wide flange beams (W24x94), which stiffen the faceplate of the gates, are undersized and slightly overstressed for the current normal water surface (elevation 2240 feet).

Among the risk analysis report recommendations are the following two recommendations that directly relate to the proposed CLIP:

- Before increasing the hydrostatic loading on the spillway gates, particularly from that proposed by the 3 feet of additional reservoir storage, the radial gates horizontal wide flange beams should be reinforced. The proposed spillway gate flashboards should not be installed until the flange beams have been properly reinforced.

- Consider filling in the low areas of the right abutment, which would raise the topography of the reservoir rim in this area to bring it up to elevation 2250 feet (i.e., the crest of the dam embankment). Also, Reclamation

should consider adding riprap to the shoreline in this vicinity to reduce wave-induced erosion.

The costs of filling in the low areas of the dam's right abutment would seem to be a responsibility of the Dam Safety Program modification budget. This action may need to be taken (filling of low spots) regardless of whether the proposed CLIP is pursued and implemented. The issue needs further analysis by the Dam Safety Program. The horizontal wide flange beams on the spillway radial gates must be reinforced whether or not CLIP is implemented. Any such repairs Reclamation undertakes under the Safety of Dams program should be coordinated with the Yakima Area Office to ensure proper allocation of costs between programs and to ensure that improvements are made with proper timing to minimize costs and maximize benefits to the public. Filling of low spots on Cle Elum Dam's right abutment should be done in concert with CLIP-related shoreline protection activities. Reinforcement of radial gate horizontal wide flange beams should be done in concert with CLIP-funded installation of flashboards on the radial gates, unless, of course, Reclamation decides not to proceed with the CLIP.

Environmental Considerations

Before the CLIP study can be completed and implemented, National Environmental Policy Act environmental compliance must be completed. NEPA compliance in this case would probably entail preparing an environmental impact statement. A cultural resources survey and recreational impacts would be determined and mitigated. The U.S. Forest Service (USFS) staff would likely perform a class III cultural resources survey. USFS would like as much advance notice as possible of a Reclamation decision to proceed with CLIP implementation so that it may allocate staff time and resources to complete the class III survey.

Other environmental efforts also include consultation with the Fish and Wildlife Service, the National Marine Fisheries Service, and State fish and wildlife organizations.

Engineering Considerations

Reclamation surveyed and mapped the Cle Elum Lake shoreline, defining the new takeline required for land acquisition, assuming the reservoir would be raised 3 feet. Reclamation also identified areas needing shoreline protection and identified sources of riprap for that protection.

Reclamation contracted for a LIDAR (aerial photography and more) flight to provide topographical mapping of the entire Cle Elum Lake area to 2-foot contour level accuracy. The flight was completed in the fall of 2000, with the data mapping delivered to Reclamation thereafter. These LIDAR data would allow

Reclamation to complete a HEC-RAS inundation analysis to determine if a segment of the USFS French Cabin Creek Road immediately west of the Cle Elum River bridge, where the road crosses the Cle Elum River valley upstream of Cle Elum Lake, would be affected. In the worst-case scenario, the bridge would have to be replaced or raised. The bridge replacement cost estimated is provided in the cost estimate.

Land Acquisition

Reclamation identified existing land ownership boundaries, obtaining title reports for all Cle Elum Lake shoreline properties and determining what acreage Reclamation would have to acquire in implementing CLIP. Detailed survey maps for parts of three sections (sections 2 and 4 of T.20 N., R. 14 E.W.M. and section 34 of T. 21 N., R. 14 E.W.M.) were provided showing the proposed new takeline required for CLIP implementation. These detailed survey maps and cost estimates were completed for the areas of subdivided shoreline that have the most serious shoreline erosion problems and for the properties most likely to be significantly affected by the project. Reclamation's analysis estimates that complete acquisition of nine parcels/ownerships would be required. The additional acquisitions would be partial acquisitions, leaving the owners with economic remainders. These acquisitions are required to establish a 300-foot wide strip of Federal ownership around the shoreline of Cle Elum Lake.

Where the lakeshore lands are not developed and remain largely in a natural forested state, a more simple analysis was performed to assess land acquisition acreage and costs. Much of the remaining non-Federal land along the Cle Elum Lake shoreline is owned by Plum Creek Timber Company. A more detailed analysis of the land acquisition needs and costs of these lands would be required if Reclamation decides to proceed with CLIP.

Cost Ceiling

Section 1206 of Public Law 103-434 authorized appropriations of $2,935,000 (at September 1990 prices) for the Cle Elum Improvement Project as described in this report. Other operation and maintenance appropriations were also authorized as may be necessary for that portion of the operation and maintenance of Cle Elum Dam determined by the Secretary to be a Federal responsibility.

The cost estimates provided in chapter 4 clearly are significantly above these amounts. For Reclamation to proceed with the CLIP, Congress would need to authorize an increase in the cost ceiling.

Chapter 4

Alternatives Considered

This chapter presents the process and a criterion normally used to formulate the alternatives, describes the recommended interim plan and how it was selected, and presents the other alternatives considered, which is primarily a discussion of the fish passage options.

Plan Formulation Process

Reclamation usually considers a range of possible alternatives to meet the purpose of and need for the proposed action in a systematic manner to ensure that all reasonable alternatives are evaluated. Reclamation's plan formulation process consists of the following major steps:

- Identifying existing and projected problems and needs
- Evaluating resource capabilities
- Formulating alternative plans to solve problems and meet needs with available resources
- Analyzing the alternative plans to determine the advantages and disadvantages of each
- Selecting the preferred plan from among viable alternatives

For this project, the radial gate modification and shoreline protection actions were added to several options to provide fish passage at Cle Elum Dam.

The No Action Alternative would also usually be considered, as required by CEQ regulations implementing NEPA; however, the No Action Alternative would not provide any additional flows and would not meet the purpose of and need for the proposed action.

The *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (Principles and Guidelines) mandate consideration of four tests of viability for each alternative. The four tests

assess the completeness, effectiveness, efficiency, and acceptability of the alternative plans.

Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. *Effectiveness* is the extent to which an alternative plan alleviates the identified problems and achieves the specified objectives. *Efficiency* is the extent to which an alternative plan is the most cost-effective means of alleviating the identified problems and realizing the specified objectives. *Acceptability* is the workability and viability of the alternative plans with respect to acceptance by the public and compatibility with existing laws, regulations, and public policies. Alternatives that meet a minimum standard under all four tests are to be considered viable plans and investigated in greater detail.

Recommended Interim Plan

Fisheries biologists recommend that Reclamation provide interim fish passage past Cle Elum Dam using a least cost alternative as a pilot project, described in the sections below. Also included in the alternative would be shoreline protection and modification of the radial gates to raise the reservoir pool by 3 feet, providing an additional 14,600 acre-feet of water for instream flows for fish and wildlife. The following overview section describes only the fish passage facilities.

Plan Concept Overview

Under this alternative, Reclamation would use the existing trap facilities at Roza Dam (or construct new facilities below Cle Elum Dam) to trap and haul adult sockeyes for release above Cle Elum Dam. This alternative would include construction of a stand-alone intake structure with an overspill gate adjacent to (west of) the existing dam/spillway to release water for salmon fry emigration from Cle Elum Lake during the spring. This gravity intake/overflow gate would connect to the existing spillway and, at a minimum, should operate from the full pool elevation (currently elevation 2240 feet) down to the base of the current spillway at elevation 2223 feet. Alternatively, constructing the new stand-alone intake structure and overspill gate to operate from full pool elevation down to elevation 2210 feet would provide fish passage capability at Cle Elum Lake 65 percent of the time between March 1 and June 30.

This fish passage facility could be used for downstream migration past Cle Elum Dam by reestablished populations of sockeye salmon, coho salmon, bull trout, steelhead, and spring chinook salmon, as all of these species would normally be attempting to migrate downstream during the spring high-flow period (March through June) in the Yakima River Basin.

Plan Accomplishments

This pilot project would allow Reclamation to evaluate the success of the interim fish passage facilities and to further investigate fish passage alternatives at Cle Elum Dam. Reclamation may then choose, at future expense, to modify and improve the facilities providing fish passage past Cle Elum Dam, similar to those discussed under Other Alternatives Considered.

Fishery Benefits

Installation of these fish passage facilities at Cle Elum Dam would provide several benefits to the public. Providing anadromous fish passage into Cle Elum Lake and upstream river segments would potentially restore the extirpated sockeye salmon to the Yakima River Basin, would potentially restore fish access to the historic spawning grounds once used by Endangered Species Act (ESA)-threatened steelhead and candidate spring chinook salmon, would potentially provide spawning habitat to coho salmon (a species which also historically used this habitat), and may also benefit resident populations of ESA-threatened bull trout.

Other Benefits

A new open channel by-pass conduit constructed in the right abutment of Cle Elum Dam to provide for fish passage could also double as a second outlet conduit to release irrigation water from Cle Elum Lake, during any period when repairs would be required on the main reservoir outlet tunnel. Currently, only the one main outlet tunnel allows for the release of water from the reservoir when the reservoir pool is below the bottom of the spillway, at elevation 2223 feet. Thus, Reclamation currently would not be able to release water from Cle Elum Lake to satisfy its contract water users for a time if emergency repairs were needed on the main outlet tunnel during the irrigation season.

Detailed Plan Description

This section provides more detail about the alternative selected. Reclamation designed an interim fish passage facility using the available life history information on anadromous fish and the designs the contractor presented as possible fish passage facilities. The approach is simple, focused, and flexible.

Radial Gate Modification

The modification to the radial gates includes fabricating and installing five 3-foot high by 37-foot wide stiffened flashboards for the five radial gates on the Cle Elum Dam spillway.

Upstream Inundation Impacts

As a result of increasing the lake level by 3 feet, some of the surrounding lands may be inundated. A segment of the USFS French Cabin Creek Road may be affected immediately west of the Cle Elum River bridge where the road crosses the Cle Elum River valley upstream of Cle Elum Lake. Under a worst-case scenario, the bridge would have to be replaced/raised. Aerial photograph data (LIDAR flight) has allowed a determination of what lands may be affected. These lands would be identified and discussed in a future NEPA compliance document.

Shoreline Protection

This part of the project would involve placing riprap along the shoreline where erosion has been a problem. Clearing some trees, earthwork, material production, shoreline placement, and other items are involved with this aspect of the project.

Fish Passage

Adult passage above the dam, particularly for coho, poses little problems. A weir could be deployed just downstream of the dam to capture returning adults, who would then be placed in a fish truck and released above the dam. Flows are generally low (200 cfs) and stable below the dam during the time when coho adults are present (October through December). High flows can occur, but coordination with Cle Elum Lake operators can ensure safety to the trap and operators.

The capture and passage of adult sockeye could occur at one of two places—Roza Dam or below Cle Elum Dam. Roza Dam has facilities already in place to capture adult salmon and can operate at various flow levels. High flow release from Cle Elum Lake (3,000 cfs) in July and August (expected return time of adult sockeye) may preclude capture below the dam.

Costs associated with upstream passage of adult fish would mainly involve expenditures for personnel. Initial annual cost would be approximately $250,000. Equipment and in-kind services could be borrowed or agreed upon to make this work through the "testing phase." Adults would not need to be collected until 2 years after the first juveniles are released. A more permanent weir or ladder could be constructed to operate in all or most flow scenarios if results are promising.

Sockeye and coho emigrate in the spring and early summer when the reservoir is at or near full pool. Both species would use surface water spills when emigrating from the reservoirs as long as there is sufficient attraction flow. Modification to the operations and facilities of Cle Elum Dam can provide conditions favorable to passage. This design has been modified from the "Multi-Level Gravity Intake

with Open Channel Bypass Conduit" (on page 20) to function at all reservoir levels, which would cost $15 to 20 million. This design would provide passage for fish migrating in the spring at much less cost. A stand-alone intake structure with an overspill gate could be constructed adjacent to the existing dam / spillway to release most of the bypass water during the spring. This gravity intake would connect to the existing spillway. Attraction flow should be sufficient as the outlet works and overspill gate are relatively close guiding the fish to the same general area. Given an option, fish will generally choose to follow a surface release as opposed to a submerged outlet works. Any overflow gate should be designed to operate, at a minimum, from the full pool elevation (currently at elevation 2240 feet or 2243 feet with the 3-foot raise) down to the bottom or base of the current spillway elevation (2223 feet). At this time, it is believed that this design may cost about $5 million; however, engineering designs and costs need further investigations.

Under current operational guidelines, the reservoir was at or above the spillway level (2223 feet) from March 1 to June 30 about 46 percent of the time (from 1938 to present). March 1 to June 30 is the time period when emigration of sockeye and coho are expected from the reservoir. If Cle Elum Lake were raised 3 additional feet, then operational guidelines would likely increase that percentage of time when the reservoir is at the spillway elevation. A closer examination of current operations may reveal additional strategies to increase the percentage of time the reservoir is at the spillway elevation.

Another possibility would be to construct the above-envisioned new stand-alone intake structure and overspill gate so that it would operate from full pool elevation down to elevation 2210 feet. This option would provide fish passage capability at Cle Elum for the upper 30 to 33 feet of operational pool elevation, which would result in the potential for surface release nearly 65 percent of the time between March 1 and June 30. It would also provide reservoir operators a second outlet structure for releasing irrigation water or water to maintain downstream target flows during any period when the existing outlet tunnel might need emergency repairs.

Project Costs

The estimated cost of this alternative for interim adult fish passage facilities is about $250,000 annually. The cost of this juvenile outmigration facility is estimated to be $5 million; however, engineering designs and costs need further investigations. This and other costs for the full CLIP are outlined in table 1.

Cle Elum Improvements Project (CLIP) Cost Estimate Summary Report
July 19, 2002, update

Dam safety related cost estimate	$ 0
Engineering cost estimate	
Shoreline protection costs	$7,385,000
Radial gate modification costs	135,450
Upstream inundation impacts costs	1,020,200
Total estimated CLIP engineering costs	**$8,540,650**
Environmental cost estimate	
NEPA / Environmental compliance costs	$ 918,000
Cultural resources costs	275,000
Contingency costs on the two items above @ 25 percent	298,250
Recreation costs	1,312,000
Total estimated CLIP environmental costs	**$2,803,250**
Land-related cost estimate	
Ken Todd's detailed land acquisition cost estimate	$4,170,000
Additional lands acquisition cost estimate	910,200
Land-related staff time and travel costs	263,000
Total estimated CLIP land-related costs	**$5,343,200**
Fish passage cost estimate[1] plus O&M of $250,000 annually	**$5,000,000**
[1]Pilot fish passage project estimate (least cost interim alternative)	
Total estimated costs for the CLIP	**$21,687,100**
Plus $250,000 in annual adult fish capture costs at Roza Dam	

Note: Pilot fish passage project costs are the least cost alternative for providing interim fish passage past Cle Elum Dam. Additional future funding may be needed to modify or improve pilot project fish passage facilities and operations to maximize fish passage success past Cle Elum Dam.

Evaluation and Plan Selection

This section briefly compares and evaluates the alternatives that were considered in detail and explains why the recommended interim plan was selected.

Under a complete feasibility study, the Principles and Guidelines mandate consideration of four tests of viability for each alternative. The tests assess the completeness, effectiveness, efficiency, and acceptability of the alternative plans.

The No Action Alternative is not complete or effective. It does not provide the desired effects as no action is taken, nor does it alleviate the instream flow problem.

The other alternatives for fish passage at Cle Elum Dam are very preliminary, expensive, and an unproven technology. However, using the available life history information (primarily from NMFS studies) and the designs the contractor (Harza 1999) presented, seasonal passage could be designed for the Cle Elum Dam. Therefore, the more practical and least costly alternative was chosen for a pilot

study. It is the only alternative that would meet the four tests of viability at this time.

Other Alternatives Considered

The other alternatives for this project (other than No Action) consist of various plans for fish passage over Cle Elum Dam and the two actions that are identical for all alternatives—modifying the radial gates at Cle Elum Dam and shoreline protection. The fish passage study prepared by a contractor in its final report in December 1999 presented three general design concepts for downstream passage and two upstream passage concepts. The downstream juvenile salmon passage options analyzed are (1) surface attraction and pressurized bypass, (2) surface attraction to a trap and haul facility, and (3) surface outlet to an open channel bypass. Upstream adult passage options analyzed are (1) fish ladder to a trap and haul facility and (2) fish ladder with a slide to the lake.

Each downstream fish passage concept includes four system components—an entrance and attraction component, a bypass, a sorting/monitoring facility, and an exit. Each upstream fish passage concept also includes four system components—fishway entrance, fishway, fishway exit, and a trap and haul component.

The contractor provided several feasible conceptual designs for upstream and downstream fish passage at Cle Elum Lake. The designs were to pass fish at all reservoir levels and would cost about $10 to $35 million (about $5 to $20 million for downstream and $5 to $15 million for upstream passage). These cost estimates appear to be quite expensive for a largely unproven technology.

Total Surface Attraction and Pressurized Bypass for Downstream Passage

This concept is based on constructing a new intake tower over the existing outlet channel. The general approach is to use surface attraction in combination with a pressurized bypass to pass fish around the dam. In option A, all or most of the flow through the dam would be used for surface attraction of the migrants. Option B would use a portion of the flow. In both options, the opening to the intake would adjust to the fluctuating water surface with a single gate or series of multiple gates.

Option A: An intake tower would be constructed over the existing outlet tunnel bypass pipeline. Operation of the existing intake would remain, giving the flexibility to balance flow for downstream temperature control requirements. The surface attraction intake flow would be controlled by operation of a telescoping gate, which would adjust to the lake level. Flow through the tunnel would continue to be controlled by the existing gate. An extension would be attached to

the downstream end of the outlet tunnel. The tunnel extension would manifold into two or three separate penstocks, each with an "Eicher" type-high velocity screen. The inclined Eicher screen would pass fish from the primary outflow to the bypass pipeline located at the top of the penstock. From this point, the bypass pipeline would still be under pressure head from the water surface in Cle Elum Lake. The bypass pipelines would cross over to the south side of the river downstream of the spillway.

Generally, open channel, non-pressurized flow conditions are required in bypass pipelines. The alignment of the bypass pipeline is an example of a transition from pressurized flow to open channel flow, using the topography of the site. The pressurized pipeline travels uphill to a high point equivalent to the maximum water surface in the lake. At this point, the bypass pipeline transitions to a shallow sloped alignment, which traverses the dam slope to the river exit. Automated knife gates control the bypass transition at lower water surface elevations, in this concept at 10-foot intervals. At each interval, the gate passes fish through a wye fitting off the primary bypass conduit through a smooth transition to the open channel conduit. The open channel bypass exits to the river downstream of the main outlet flow.

Option B: A new intake tower would be constructed over the outlet tunnel, with a single pressurized exit bypass pipeline. This option would be designed to take a portion of the total flow, screening the bypass flow in the new surface intake structure. The horizontal inclined screen would adjust vertically with the weir gates and the lake water surface. Attraction flow would be returned to the outlet tunnel through the intake structure. The bypass pipeline would be aligned to pass to the south side of the spillway to undisturbed natural earth. Bypass flow and fish would be transported through the new bypass pipeline. The bypass would be depressurized in a similar manner to that described in option A, but without the need for an Eicher screen.

Floating Surface Attraction to a Trap and Haul Facility for Downstream Passage

This concept would implement a floating surface attraction facility, similar to the "gulper" type collector used on the Puget Sound Energy Baker Lake project in western Washington. The facilities would be based on a surface collector housed on a floating barge, which would continuously adjust to the water surface. Attraction flows would be in the range of 10 to 20 percent of the total flow through the dam. Either pumps or gravity flow would create the attraction flows. Both options would implement truck haul of fish as the bypass option.

Option A—Flexible Alignment Surface Collector: A concrete trapping facility would be constructed to work with the floating collector. Gravity flow would be driven by the water flow from the trap facility to the existing outlet tunnel. Flow would be supplied in a similar manner to that described above in option B. In this

case, flow would enter the floating collector near the surface of the lake and pass through a flexible pipeline to the trapping facility. Guide nets would extend from the end of the collection barge to assist in guiding fish into the system. The trapping facility would be a concrete intake constructed over the existing outlet tunnel, with bypass flow separated by an adjustable height horizontal inclined screen. The floating collector, bypass pipeline, and screen would adjust together as one unit with the changing water surface fluctuations. This option would permit the floating collector to be moved to the most efficient collection location, with the flexible transport conduit adjusted accordingly. Once in the trapping and collection facility, most of the flow would continue to the outlet tunnel, with only a portion of the flow screened to a separate compartment for fish trapping and collection. Fish trapped in the compartment would be transferred to trucks by using a trap/hoist mechanism. A bridge would be constructed from the shoreline south of the spillway to the trapping and collection facility for access, and truck transport to release point(s) downstream.

Option B—Fixed Alignment Surface Collector: The surface collection barge would travel a fixed horizontal alignment, moving back and forth with changes in lake water surface elevations. Fixed guide rails would maintain collector alignment or barge mounted winches. Flow to the collector would be generated using pumps mounted on the barge. Passing the flow over an inclined screen on the barge, which would then direct fish to a holding tank on the barge, would separate fish. A concrete access ramp similar to a boat ramp would be constructed for the haul truck along the base of the lake aligned with the travel path of the barge. This would provide access for truck loading from the holding tank. A water to water transfer would be designed between the holding tank and the truck.

In either option, guide nets attached to the barge entrance would probably be required to maintain a reasonable level of effectiveness with this system. The guide nets would be designed to adjust to the fluctuations in the water surface of the reservoir.

Surface Attraction with an Open Channel Bypass for Downstream Passage

In this concept, surface attraction would be used with multiple intakes leading to separate open channel bypass conduits. A percentage of the total outflow would be used to create the attraction. Once captured by the bypass velocities, fish would be transported downstream of the spillway back to the river. Option A is a gravity flow attraction, and option B is a pumped flow option.

Option A—Multilevel Gravity Intake with Open Channel Bypass Conduit: In this option, a new intake structure would be constructed on the shoreline south of the spillway. An intake channel would be excavated from an area adjacent to the existing intake to the new intake structure. A multiple level intake would adjust

to separate bypass channels. Surface flow would pass over a telescopic weir gate into each respective bypass channel. A variable water surface would be necessary downstream of the intake gates within each channel. A series of hinged weirs would create steps to spill flow without injury to fish, while adjusting to the change in water surface elevation. The multiple transport conduits would be either box culverts or pipelines sized for open channel flow, exiting either directly to the river downstream of the spillway or indirectly to the river via a monitoring and evaluation facility.

Option B—Multilevel Pumped Intake with Open Channel Bypass Conduit: Multilevel open screw pumps would transport water and fish up over the dam (100 cfs maximum per pump, 20 feet maximum rise) in this option. An intake structure housing each of the pumps would be constructed to the south side of the existing intake and spillway. Gates would control the flow to each intake depending on the water surface elevation in the lake. As the water in the lake rises, the screw pump would become submerged until it reaches a level for transition to the new chamber opened. A short transport channel would connect the high point of the lower screw pump with the low point of the adjacent high screw pump. Fish are passed to a bypass channel at the crest of the dam, which traverses the downstream dam face. The serpentine alignment allows for open channel flow conditions in the bypass conduit back to the river downstream of the spillway.

Fish Ladder with Trap and Haul Facility for Upstream Passage

This concept would consist of a ladder leading to a trap and haul facility. The ladder entrance would most likely be located on the north side, close to both the end of the spillway and to the outlet tunnel exit. Fish ladder supply and attraction water supply would most likely be gravity supply originating from a pipeline tap into the outlet tunnel. The ladder would climb to the trap and haul facility, which would be located on fairly level terrain above the 100-year flood elevation.

Option A would include improving existing access roads to accommodate the truck route from the trapping facility to the dam crest. The design of release sites would depend on future fish management discussions and decisions. This option is probably the most feasible with the most flexibility, but with high operation and maintenance needs. Adult fish would be stressed in handling, but it can be minimized with the water to water transfer.

Option B ladder entrance location, attraction flow, and exit to the trapping facility would be identical to option A. The difference would be that a tramway would be designed to transition fish directly into the lake. The ladder exit and tram interface design is outside the scope of this report.

Fish Ladder with a Slide to Lake for Upstream Passage

In this concept, the ladder entrance would be located downstream of the spillway and existing tunnel outlet. An entrance channel would provide passage across the river to the ladder. The south bank of the river provides a location for construction that minimizes impact to the dam. The end of the spillway would need to be modified to pass flow over the transport channel. At the high point of the ladder, the last pool would contain a false weir. Fish would jump at the water flow from the false weir and pass into a slide located upstream from the false weir that would slope to the lake.

The slide would probably be a closed conduit extending from the latter to the high water elevation, then open channel from the high water surface to the low water surface elevation. The open top flume would allow fish to exit at the lake water surface elevation. Water for the slide facility or a stress relief facility would be supplied to the high point in the ladder with multiple pumps or a single variable speed pump to overcome the fluctuating water surface elevation. This option would be simple to operate, but would have power maintenance costs associated with the pumped water supply system.

Chapter 5

Decisions to be Made

Several decisions need to be made to either move forward with CLIP implementation or to decide on other actions. This chapter discusses the factors that can influence these decisions.

Safety of Dams Activities

The December 1999 Cle Elum Dam Risk Analysis Report in December 1999 concludes that Cle Elum Dam poses an acceptably low level of risk to the current downstream population at risk, both at current reservoir pool operating conditions and with the additional 3 feet of reservoir pool contemplated by CLIP. The risk analysis report makes two recommendations for actions at Cle Elum Dam that are incorporated into this report's recommendations for action. These action items should be implemented regardless of whether Reclamation proceeds with CLIP:

- The two lowermost horizontal wide flange beams on the radial gates at Cle Elum Dam should be reinforced.
- The low areas on the right abutment of Cle Elum Dam should be filled in and riprap should be added to the shoreline in this area to reduce wave-induced erosion.

Cost Ceiling for CLIP

The CLIP cost estimate report reveals that the project would be significantly more costly to construct and implement than originally envisioned by the 1994 YRBWEP Act. The Act, section 1206, authorized about $3 million for this project to be appropriated (at September 1990 costs). The current project cost estimates are about $22 million, even with the modified least cost interim fish passage pilot project.

- Reclamation must inform CLIP proponents that Congress would have to increase the CLIP funding authorization ceiling in YRBWEP section 1206 if the project is to move forward.

Landowner Concerns

CLIP would provide 14,600 acre-feet of new storage water in most years, dedicated exclusively for instream flows to benefit fish and wildlife. The basic costs to provide this new storage water (engineering, environmental, and land acquisition costs) for the radial gates and shoreline protection are estimated to total $16.7 million, excluding fish passage costs.

CLIP implementation would be somewhat controversial among the landowners adjacent to Cle Elum Lake. Reclamation would have to acquire 9 complete parcels/ownerships along the shoreline. Many additional landowners along the shoreline would be subject to partial acquisitions to establish an adequate Federal ownership buffer to accommodate the 3-foot raise in the reservoir pool elevation. Several landowners around the southern end of the reservoir already are experiencing erosional loss of their shoreline properties, and two landowners has filed tort claims against Reclamation for damages. Raising the reservoir pool elevation by 3 feet would worsen existing shoreline erosion problems around Cle Elum Lake.

Fish Passage Issues

Reclamation is facing substantial pressure from the Yakama Nation, the Washington Department of Fish and Wildlife, and others to provide fish passage facilities at the five Yakima Project reservoirs. Yakima River Basin steelhead and bull trout populations are both listed as threatened under the Federal Endangered Species Act. Providing fish passage facilities at Cle Elum Dam would provide access to a substantial amount of upstream habitat for potential recolonization by anadromous salmonids and bull trout. More habitat would be made accessible by providing fish passage at Cle Elum Dam than would be made accessible by providing fish passage facilities at any of the other Yakima Project dams.

Recommendations if Cost Ceiling is Raised

If the cost ceiling is raised to fully implement CLIP, Reclamation should implement CLIP as authorized and envisioned, including the following activities.

- Begin and complete an environmental analysis to comply with the National Environmental Policy Act, including these actions.
    - Complete a HEC-RAS analysis, using the LIDAR flight data, to determine whether CLIP implementation would require replacement of the USFS French Cabin Creek Road bridge.

- Coordinate with USFWS and WDFW staff to ensure completion of the Habitat Evaluation Procedure (HEP) study that began at Cle Elum Lake to assess the habitat impacts.

- Assess whether any additional analysis is needed of land acquisition around the Cle Elum Lake shoreline and complete any such analysis.

- Cooperate with USFS, NMFS, Yakama Nation, Yakima-Klickitat Fisheries Project, BPA, et al, to eliminate the fish passage barriers upstream of Cle Elum Lake on the Cle Elum River and on the Cooper River, and possibly the Waptus River. Eliminating fish passage barriers upstream would maximize the amount of stream habitat that would be made accessible to anadromous salmonids and bull trout in the upper Cle Elum River basin by providing fish passage at Cle Elum Dam.

- As soon as possible after NEPA compliance, Reclamation should implement a pilot fish passage project to provide for interim fish passage past Cle Elum Dam as described in this report, including the capture of adults at the existing Roza Dam fish trap.

- Following 5 years of operation, Reclamation should analyze the success of the pilot fish passage project and modify and improve facilities, at future expense as appropriate, to maximize fish passage success.

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