

RECLAMATION

Managing Water in the West

Value Planning – Final Report

Cle Elum Dam Fish Passage Facility

A10-1953-6903-100-00-0-0 (Cle Elum VE)

Yakima Project, Washington



**Department of the Interior
Bureau of Reclamation
Pacific Northwest Region**

July 6, 2009

Table of Contents

Executive Summary	2
Value Study Team Members	3
Acknowledgement of Design Team and Consultation Assistant.....	4
Value Method Process.....	4
Current Description	5
Figure C-1 – Location Map	17
Figure C-2 – Upstream and Downstream Passage Plan	18
Figure C-3 – Intake Structure Plan, Elevation, and Section.....	19
Figure C-4 – Downstream Passage Outlet Plan and Section	20
Figure C-5 – Intake and Downstream Passage Conduit Profile	21
Figure C-6 – Upstream Passage Profiles and Sections.....	22
Figure C-7 – Cofferdam Site Plan.....	23
Figure C-8 – Upstream Passage Adult Trap/Barrier Plan.....	24
Figure C-9 – Upstream Passage Trap and Haul Site Plan	25
Special Criteria Summary	26
Owner, Users, and Stakeholders List	27
Function Analysis.....	28
F.A.S.T. Diagram	33
Cost Model and Estimate Information.....	34
Proposal No. 1 – Use of Spillway as Barrier Dam & Right Bank Fish Facility	39
Figure 1-1 – Spillway as Barrier Dam	41
Proposal No. 2 – Install HDPE trash racks instead of steel.....	42
Proposal No. 3 – Move Downstream Passage Intake Structure to Shoreline.....	43
Figure 3-1 – Proposed Intake Structure Location	44
Proposal No. 4 – Concrete Fixed Angle Wall Exclusion Weir Barrier Dam	45
Figure 4-1 – Sulphur Creek Wasteway Barrier Designs	46
Figure 4-2 – Sulphur Creek Wasteway Barrier Designs	47
Figure 4-3 – Sulphur Creek Wasteway Barrier Designs	48
Figure 4-4 – Sulphur Creek Wasteway Barrier Designs	49
Figure 4-5 – Sulphur Creek Wasteway Barrier Photo.....	50
Proposal No. 5 – Obermeyer gates across top portion of barrier dam	51
Figure 5-1 – Downstream View of Obemeyer Gate	53
Proposal No. 6 – Tunnel Through Right Abutment	54
Figure 6-1 – Photo of Original Construction, Cle Elum Dam	56
Figure 6-2 – Photo of Original Construction, Cle Elum Dam	57
Design Issues	58
Disposition of Ideas.....	59
List of Consultants	61
Data and Documents Consulted.....	61
Design Team Presentation Attendance List.....	62
Value Study Team Presentation Attendance List	64

Executive Summary

The Value Study Team met beginning on June 8, 2009, for a 5-day study of the Cle Elum Dam Fish Passage project. The estimated cost of the baseline concept is \$53,707,000 (not including mobilization, unlisted items, or contingencies). The Team developed 6 proposals, which are summarized (in random order) below. If all the cost avoidance proposals are accepted, their maximum cost avoidance potential is \$36,086,000. Note that in calculating the maximum potential cost avoidance, the cost of the study (\$50,000) was deducted only once.

Independent Proposals: The following proposals are independent of all other proposals and could be accepted or rejected individually without affecting other proposals.

Proposal No. 2. Install HDPE trash racks instead of steel. The estimated cost avoidance of this proposal is \$522,000 before deducting any study and/or implementation costs.

Proposal No. 3. Move Downstream Passage Intake Structure to Shoreline. The estimated cost avoidance of this proposal is \$16,105,000 before deducting any study and/or implementation costs.

Proposal No. 6. Tunnel Through Right Abutment. The estimated cost avoidance of this proposal is \$11,021,000 before deducting any study and/or implementation costs.

Interdependent Proposals: Of the proposals developed by this study team, Proposal Nos. 1, 4, and 5 are related. Of these proposals, portions of each are redundant. Acceptance of one proposal would preclude full acceptance of another proposal listed below.

Proposal No. 1. Use of Spillway as Barrier Dam & Right Bank Fish Facility. The estimated cost avoidance of this proposal is \$8,488,000 before deducting any study and/or implementation costs.

Proposal No. 4. Concrete Fixed Angle Wall Exclusion Weir Barrier Dam. The estimated cost avoidance of this proposal is \$3,419,000 before deducting any study and/or implementation costs.

Proposal No. 5. Obermeyer gates across top portion of barrier dam. The estimated cost avoidance of this proposal is \$779,000 before deducting any study and/or implementation costs.

In addition to the proposals listed above, the Value Planning team identified 8 items which should be considered during the final design process. These items are included in the "Design Issues" table shown on page 57.

The VE Team had 3 ideas identified during the brainstorming phase that may be of benefit to the project, but did not have the expertise or the time to develop them into Proposals. These ideas have been referred to the design team for further consideration and are included in bold text in the table titled "Disposition of Idea" starting on page 58.

Value Study Team Members

Name/Title/Discipline	Address/Phone Number/E-mail
Kevin J. Kramer Civil Engineer Value Study Team Leader	Bureau of Reclamation, PN-6110 1150 N. Curtis Road, Suite 100, Boise ID 83706-1234 Phone: 208-378-5242 FAX: 208-378-5205 Email: kkramer@usbr.gov
Eduardo Lopez-Owsley Civil Engineer Team Member	Bureau of Reclamation, PN-3512 1150 N. Curtis Road, Suite 100, Boise ID 83706-1234 Phone: 208-378-5186 FAX: 208-378-5305 Email: elopez@usbr.gov
Jack Touseull Civil Engineer Team Member	Bureau of Reclamation, 86-68312 PO Box 25007, Denver CO 80225-0007 Phone: 303-445-2346 FAX: 303-445-6472 Email: jtouseull@usbr.gov
Dale Lentz Civil Engineer Team Member	Bureau of Reclamation, 86-68460 PO Box 25007, Denver CO 80225 Phone: 303-445-2143 FAX: 303-445-6324 Email: dlentz@usbr.gov
Tony Hargroves Maintenance Supervisor Team Member	Bureau of Reclamation, YAK-5410 1917 Marsh Road, Yakima WA 98901 Phone: 509-575-5848 x245 FAX: 509-454-5612 Email: thargroves@usbr.gov
Don Stelma Geologist Team Member	Bureau of Reclamation, BFO-3230 1375 SE Wilson Ave, Suite 100, Bend OR 97702 Phone: 541-389-0233 FAX: 541-389-6394 Email: dstelma@usbr.gov
Brian Saluskin Biologist Team Member	Yakama Nation, 800 Spring Chinook Way, PO Box 836, Cle Elum WA 98922 Phone: 509-945-6701 FAX: 509-674-1940 Email: passagebio@qwestoffice.net
David Child Biologist Team Member	Yakima Basin Joint Board 2807 W. Washington Ave., Yakima, WA 98903 Phone: 509-607-1396 FAX: 509-965-1675 Email: dcconsult@dreamflyfishing.com
Joel Hubble Biologist Team Member	Bureau of Reclamation, CCAO-1121 1917 Marsh Road, Yakima WA Phone: 509-575-5848 x371 FAX: 509-575-5847 Email: jhubble@usbr.gov

Acknowledgement of Consultation Assistant

The Value Study Team wishes to express thanks and appreciation to those listed on the Consultation Record of this report. Their cooperation and help contributed significantly to the technical foundation and scope of the team's investigation and final proposals.

The goal of the Value Method is to achieve the most appropriate and highest value solution for the project. It is only through the effort of a diverse, high-performing team, including all those involved, that this goal can be achieved. This study is the product of such an effort.

Value Method Process

The Value Method is a decision making process, originally developed in 1943 by Larry Miles, to creatively develop alternatives that satisfy essential functions at the highest value. It has many applications but is most often used as a management or problem-solving tool.

The study process follows a Job Plan that provides a reliable, structured approach to the conclusion. Initially, the team examined the component features of the program, project or activity to define the critical functions (performed or desired), governing criteria and associated costs. Using creativity (brainstorming) techniques, the team suggested alternative ideas and solutions to perform those functions, consistent with the identified criteria, at a lower cost or with an increase in long-term value. The ideas were evaluated, analyzed and prioritized, and the best ideas were developed to a level suitable for comparison decision making and adoption

This report is the result of a "formal" Value Study by a team comprised of people with the diversity, expertise, and independence needed to creatively scrutinize the issues. The team members bring a depth of experience and understanding to the discipline they represent; and an open and independent enquiry of the issues under study, to creatively solve the problems at hand. The team applied the Value Method to the issues and supporting information, and took a "fresh" look at the problems to create alternatives that fulfill the client's needs at the greatest value.

Current Description

Cle Elum Dam is located at the lower end of a natural lake on the Cle Elum River, 8 miles northwest of the city of Cle Elum, Washington. Construction was completed in 1933. The earthfill dam forms a reservoir with a capacity of 436,900 acre-feet, with 427,930 acre-feet available for use. Cle Elum Reservoir is operated to meet irrigation demands, flood control, and instream flows for fish. The prime flood control season extends from mid-November through mid-June. Cle Elum Reservoir is the largest storage facility in the Yakima River Basin, and is the main resource for meeting the large irrigation demands in the Lower Yakima Basin. The reservoir also provides the majority of Yakima system carryover storage in normal water years.

The earthfill dam includes the main Cle Elum Dam, a dike adjacent to the left abutment of the dam, and three small saddle dikes. The dam has a maximum structural height of 165 feet and a crest length of 1,800 feet including the main dike, and has 1,411,000 cy of embankment material. About a mile of two-lane paved road provides access from State Highway 903 to the left abutment of the dam. From there, an unpaved road travels along the dam's crest to provide access to the gate house and spillway and then down along the left side of the spillway to provide access to the river channel downstream.

Cle Elum Dam is equipped with a gated spillway (sill elevation 2223.00) with capacity of 40,000 ft³/s at reservoir water surface elevation 2240 feet. The spillway consists of five radial gates (each 37 feet wide by 17 feet high) and a concrete-lined open channel in the right abutment. The gate control deck includes a 14-foot-wide bridge to provide access across the spillway. The single lane bridge is currently limited to AASHTO H10-44 loading. This load limit results partially from the lack of shear connections between the reinforced concrete deck and the wide-flange beams that support it, and partially from the lack of lateral support for the wide-flange beams. The concrete chute portion of the spillway has vertical walls and is hour-glass shaped in plan view. The concrete stilling basin has vertical sidewalls and a dentated lower sill. The river channel is heavily riprapped for about 150 feet downstream from the stilling basin.

The outlet works consist of a gated control tower and a reinforced concrete conduit through the right abutment of the dam. The trashrack-protected inlet structure is located about 765 feet upstream from the dam's centerline. The reinforced concrete outlet conduit is 14 feet in diameter and 2,108 feet long. The gate chamber and a 250-foot section of conduit immediately upstream from the gate chamber are lined with steel plate. The outlet conduit terminates in the left wall of the spillway, just above the stilling basin, approximately 880 feet downstream from the dam axis.

Current Description

Flow through the main outlet is regulated by two slide gates (sill elevation 2112.25 feet). Each gate is 5 feet wide by 6.5 feet high. At maximum gate opening, the gates are capable of releasing a total of 4,600 ft³/s at reservoir water surface elevation 2240; however, the normal August maximum release is around 3,200 ft³/s. The slide gates have a minimum required operating opening of 0.10 foot to prevent cavitation. There are also two 14-inch gate valves (invert elevation of 2127.90 feet) located in the same outlet works structure. These gate valves can be used to bypass the main slide gates and make small releases (90 ft³/s or less) when the main gates are closed.

Cle Elum Lake is operated to meet irrigation demands, flood control, and instream flows for fish. The prime flood control season extends from mid-November through mid-June. Cle Elum Lake regulates about 20 percent of the entire runoff about Parker gage (RM 103.7). With the largest storage capacity in the Yakima River Basin, it is the main resource for meeting the large irrigation demands in the Yakima River Basin.

Cle Elum releases are greatest in July and August in order to meet most of the Lower Yakima River Basin diversion demands during these months. Late season irrigation demands (mid-September) are met primarily from Rimrock Lake. The normal 3,200 ft³/s summer releases from Cle Elum is reduced during the Flip-Flop operation to a minimum flow range of 200 to 300 ft³/s to support both spawning and irrigation demands on the upper Yakima River basin system. This allows Reclamation to meet a target flow range (200 to 300 ft³/s) in the Cle Elum River during winter for spring Chinook salmon incubation and early rearing. The 5 percent and 95 percent exceedance flows for reservoir releases are 2,946 ft³/s and 103 ft³/s, respectively.

The reservoir typically reaches its lowest elevation in September or October when the irrigation season ends. In the winter months, water is released to meet downstream demands and to maintain flood control space. In the spring, water is stored in the reservoir to regulate downstream flows for flood control and to store water for irrigation demands later in the year. The highest reservoir elevations generally occur in the May to July period, depending on the annual water supply. Full pool is at elevation 2240.

In order to perform maintenance on the outlet works gates, the upstream guard gates must be closed. To perform work in the outlet conduit, the main gates must be closed. Either action allows no flow into the river downstream. Therefore, the required maintenance on the main gates is attempted only when the lake is above spillway crest (elevation 2223); otherwise, pumping is necessary to maintain downstream flows. Maintenance of the guard gates must be done when the reservoir is below elevation 2120.5 or lower than the top of the outlet intake structure and requires pumping. The ramping rate for operations is 2-inches per hour as measured at the first gage downstream from the dam.

Current Description

Baseline Concept: Fish passage facilities include both downstream juvenile and upstream adult passage (refer to figures C-1 through C-9). The downstream passage facilities include a multi-level intake structure and a 7-foot diameter conduit through the right abutment of the dam that would discharge fish flows into the spillway stilling basin. The juvenile passage facilities are designed to make surface releases of fish passage flows in the range of 100 to 400 ft³/s. These releases would be made whenever reservoir water surface levels are between elevations 2190 and 2240. The downstream passage facilities would generally be operated from early April to late June, depending on reservoir conditions.

The upstream adult fish passage facilities include a barrier dam spanning the width of the Cle Elum River, a fish ladder, and a collection facility. These facilities would be located immediately downstream from the spillway stilling basin. The barrier dam is designed to block upstream fish movement and to direct fish to the ladder entrance. Adult fish moving into the collection facility would be detained for a short time in a holding area. When enough fish have been collected, biologists would selectively measure, weigh, examine, take scale samples and other samples, and mark the fish. They would then transport the fish by truck to selected release sites in the reservoir or upstream tributaries. The upstream passage facilities would generally be operated beginning sometime in March and extending into December. Peak upstream movement of adult salmon would be expected from June through November.

Juvenile Downstream Passage Features. The proposed new juvenile downstream passage intake structure would be located about 500 feet upstream from the existing outlet works gate house, just above the spillway inlet channel. The fish passage conduit would pass under the spillway inlet channel and along the right abutment side of the spillway chute retaining wall and would discharge to the spillway stilling basin.

Foundation materials. Foundation material for both downstream and upstream passage facilities can generally be described as glacial till and glacial outwash. The glacial till is characterized by a heterogeneous mixture of mostly sub-rounded to rounded igneous and metamorphic cobbles and gravel, with sand and fines, and a few boulders. The till lacks stratification. The glacial outwash is typified by well-sorted, stratified gravel, sand, and fines in layers or lenses. The foundations under the multi-level intake structure consist of a 5-foot cap of impervious silt underlain by lakebed sediments of silt, sand, and gravel. The consolidated outcrops on the right abutment consist of about 65 percent non-plastic fines, 30 percent fine sand, and 5 percent fine gravel.

The upstream two-thirds of the outlet conduit would be founded on poorly graded sands which are pervious. The downstream one-third of the conduit will pass through glacial outwash, gravels, and cobbles, which are highly permeable. The proposed design takes these factors into consideration by providing a suitable impervious cap over the backfilled area, and a low permeable zone on the dam axis, followed by a sand filter zone, with pervious downstream zones in the compacted backfill.

Current Description

Intake Structure. The intake structure would consist of a rectangular concrete tower with multi-level intake gates (see figure C-3). The long axis of the intake structure would parallel the reservoir ground surface contours. The gates would allow release of fish passage flows at any time that the reservoir water surface is in the upper 50 feet of the pool. Downward opening gates would be used to provide surface release, or weir flow, to attract fish from the reservoir into the intake structure. Fish would then spill over a series of weirs and pools depending on the water surface elevation of the reservoir. The pools would be deep enough to provide sufficient energy dissipation to protect the fish. The drop structure concept would control the potential drop at all times and would also permit open channel flow in the outlet conduit. The intake structure would be located upstream from the spillway inlet channel to avoid excavating and maintaining a deep channel leading to the intake structure. The structure is oriented to minimize excavation. The excavated area would be backfilled to the original ground contours. The structure footing would be placed on a 36-inch layer of compacted select material.

A trashrack with 1-foot bar spacing would be placed on the upstream side of the gates. Juvenile fish would easily pass through the trashrack openings, but larger debris would be blocked from entering the structure. The plan includes an automated trashrake system to handle debris that accumulates on the trashrack.

Special ramped and converging entrance approaches would be used to gradually increase the approach velocity and provide a smooth transition for the fish as they pass from the reservoir pool over the gates and into the passage facility. Roller gates are proposed instead of slide gates to reduce friction because of the large size and weight of the gates. The gates would be cable controlled for opening and closing without long operating stems. The lowest gate would be upward opening to eliminate a gate recess below grade and to limit the amount of excavation required for the foundation.

Each of the five drop bays are 20-feet long by 20-feet wide and 20-feet deep with inflow controlled by 8-foot-wide by 16-foot-high roller gates with the exception of the bottom gate, which is 8 feet wide by 8 feet high. Eighteen-foot-wide sills with 4 feet of flow depth (at 400 ft³/s) would control drops from bay to bay. The top three bays would have 10-foot drops while the fourth bay will have a 9-foot drop. All intake gates would be on the same side of the structure for ease of trashrack cleaning.

Eight-foot-wide gates would be used to reduce the structure footprint size, make the gates easily transportable, and reduce cost. Metal stair access would be provided with landings at every 10-foot bay drop. The drop structure design would result in an Energy Dissipation Factor (EDF) of 7 to 26 foot-pounds per second per cubic foot (ft-lbs/s/ft³) for the design flows of 100 ft³/s to 400 ft³/s which are consistent with criteria established from other downstream fish passage facilities on the Yakima River system.

Current Description

In addition to roller gates, the structure would contain a set of Stoplog guides for each gate. This would allow bulkhead gates to be placed on the upstream side of the roller gates to block flow from entering the intake structure if the roller gates need to be removed for maintenance or repair, or if a roller gate fails during operation. A gantry crane with 15-ton capacity would be provided on the intake structure to allow installation of the bulkhead gates and removal of the roller gates.

Access to the intake structure would be provided by a 16-foot wide by 370-foot long bridge extending from the crest of the dam. The access bridge would be supported by an abutment near the dam crest, the intake structure, and two intermediate concrete bridge piers.

Included in the budget for the design data collection and final design of these facilities is a proposed hydraulic model study. This study would be conducted by Reclamation's Technical Service Center, Hydraulic Investigations and Laboratory Services Group during the first year of design data collection and final design. The purpose of the study is to evaluate the hydraulic conditions of the hydraulic drop intake structure, pipe conduit, and conduit outfall and the potential effects on juvenile fish. The study will make recommendations for modifications to the configuration of the juvenile downstream passage system if necessary.

Fish Passage Conduit. A reinforced concrete conduit would carry passage flows from the upstream intake structure to be discharged into the spillway stilling basin. The concrete conduit would be cast in place using cut-and-cover methods. The depth of cut would vary from 75 feet to 20 feet with a 15-foot-wide working space at the invert and 3:1 side slopes. The excavation for the conduit around the right abutment of the dam would be through native ground with no excavation through dam embankment materials. The cut-and-cover method of installation would eliminate the uncertainties connected with tunneling. The conduit would be placed on a 30-inch layer of compacted select material. Proper backfill with appropriate filter zones and materials would minimize the potential for any seepage or piping.

Current Description

The 1,520-foot-long conduit would have an inside diameter of 7 feet, and a minimum wall thickness of 21 inches. The outside of the conduit would be formed in a horseshoe shape with rounded top and a 1h:10v (horizontal : vertical) batter on the side walls to facilitate compaction of embankment around the conduit. The upstream invert elevation at the intake tower would be 2182 and the downstream invert would be at elevation 2175 (a slope of 0.0046 foot per foot [ft/ft]). The conduit would be non-pressurized and would have an open channel flow capacity of about 400 ft³/s with a maximum velocity of about 12 feet per second (ft/s). The downstream end of the fish passage conduit would transition over a 10 foot length from a round section to a 7-foot-wide by 7-foot-high rectangular flume section. The flume would narrow to a 4-foot-wide section that would extend down a steeper slope and then transition to a flatter slope before discharging at the base of the existing stilling basin wall.

The natural seepage barrier on the reservoir side would be disturbed by excavation for the intake structure and fish passage conduit. The excavated material – consisting of a mixture of silt, sand, gravel, and cobbles – would be processed as needed. A 2-foot-deep impervious cap consisting of a mixture of excavated materials and 5 percent imported bentonite material would be compacted over the excavated area. A 1-foot protective layer of cobbles would be placed over the impervious cap. At the centerline of the existing spillway gates, an impervious core measuring 12 feet wide at the top to 25 feet wide at the bottom with 1:10 side slopes would be constructed from a mixture of 5 percent imported bentonite material and sandy excavated material. The impervious core would extend the full width of the excavated prism from elevation 2240 to a depth 6 feet below the conduit. This zone would be followed by an 8-foot-wide sand filter zone consisting of imported material from a commercial source. An additional sand filter diaphragm backed by a gravel drain would be incorporated on the downstream end of the conduit to address any potential seepage or piping issues.

Fish Passage Conduit Outlet. The fish passage conduit would discharge at the base of the spillway into the spillway stilling basin. A chute at the end of the conduit would project through the top of the existing stilling basin retaining wall and would be supported independently from the retaining wall. The hydraulic drop from the chute to the tail water would be about 3.5 feet at 400 ft³/s discharge when the upstream passage barrier gates are in the raised position. The downstream fish passage conduit would have no effect on spillway capacity and no changes would be required to the operation of the spillway.

Current Description

The outfall from the fish passage conduit will enter the spillway stilling basin upstream from the upstream passage barrier dam. This location was selected for two reasons. One is that the barrier dam with the gates raised will provide a receiving pool for the discharge from the fish passage conduit that will be a minimum of 10 feet deep. The second reason is that there will be times of the year when both the downstream and upstream passage facilities are in operation (the upstream passage facility would generally be operated from early April to late June, depending on reservoir condition and the downstream passage facility would generally be operated beginning sometime in March and extending into December).

Locating the outlet from the downstream passage conduit downstream from the barrier dam may provide a false attraction to upstream migrating adult fish. This would be especially true if the normal operational releases from the reservoir were 400 ft³/s or less, because the total release flow would be made through the downstream passage system which would provide no attraction flow to the trap facility.

Adult Upstream Trap and Haul Features. The barrier and collection facility would be located about 150 feet downstream from the dentate of the spillway stilling basin (refer to Figure C-2). The collection facility would be located on the left side of the river.

Barrier Dam. A vertical drop hydraulic barrier controlled by overshot weir gates would span the width of the river just downstream from the spillway stilling basin (refer to Figures C-2 and C-8). The barrier would serve as a directional device to lead adult migrating fish to the fish ladder entrance on the left side of the river. The barrier also would provide hydraulic head to deliver operational water to the collection facility. When the collection facility is not in use, the barrier gates would be in their fully-down position.

The variable-crest barrier was chosen to provide enhanced operation and flood conveyance ability. It would use a vertical hydraulic drop of 10 to 12 feet to prevent upstream passage beyond the collection facility. Tailwater elevations at the spillway stilling basin would be raised by 10 to 12 feet during operation of the barrier. This increase in the tailwater elevation at the base of the spillway would not impact spillway operations. The discharge capacity of the outlet works at higher flows would be reduced by the higher water surface elevation on the end of the outlet works. The loss in outlet works discharge capacity would be offset by the additional discharge capacity of up to 400 ft³/s from the downstream passage conduit. If additional outlet works discharge capacity is required, the barrier gates would need to be lowered to reduce the water surface elevation at the end of the outlet works. In major flood control releases, the barrier gates would be lowered as needed to avoid overtopping the stilling basin walls.

If the downstream passage system is in operation at the same time that the barrier gates are in the raised position, the juvenile fish migrating downstream that are discharged from the downstream passage conduit would enter the pool upstream from the barrier gates. The fish would then spill over the barrier gates to continue downstream migration.

Current Description

The barrier would be oriented at an angle of about 55 degrees to the river flow to direct upstream migrants toward the fish ladder entrance at the collection facility. The barrier would be about 298 feet long with 25 overshot gates and electric gate operators, supported by 24 concrete piers between the gates. Each overshot gate would be 10 feet wide by 10 feet high. The barrier structure, with a footprint size of about 298 feet by 44 feet by 29.4 feet high, would be similar in size to the Harper Diversion Dam in central Oregon. A concrete operating deck and elevation 2140 would provide access to the gates.

Adult Collection Facility. The proposed adult collection facility design would be similar to the existing collection facility found at Roza Diversion Dam on the Yakima River. Fish would swim up the ladder into the adult fish collection facility. When adequate numbers of fish are collected in the facility, they would be placed into a fish transport truck which would deliver them to upstream locations in and around the reservoir watershed. The barrier and adult collection facility would be operated from early March to late December.

Power for operating the collection facility would be extended from the existing outlet works gate control house to the collection facility. The holding pool, fish lock, handling and sorting facilities, offices, etc. would be enclosed in a building. The collection facility would include a gravel surfaced parking area and a 7-foot-tall security fence around the perimeter of the facility. An existing access road northeast of the site would be improved to provide access for construction and operation of the collection facility. The components of the collection facility include:

- Auxiliary flow system – the auxiliary flow system would provide gravity flows of about 180 ft³/s to attract upstream migrating salmonids to the ladder entrance. The major auxiliary flow system features are listed below:
 - Trashrack – a 26-foot-wide by 7-foot-tall vertical trashrack with 1-inch clear openings would keep debris from entering the system. The trashrack is sized to provide a maximum approach velocity of 1 ft/s.
 - Wood bulkhead weir – a 10-foot-wide wood bulkhead weir would be used to reduce excessive hydraulic head. The maximum flow depth over the weir would be about 3 feet. Water dropping across the weir would dissipate a hydraulic head of about 7.5 feet.
 - Control gates – two 6-foot by 6-foot manually-operated slide gates, located just downstream of the weir, would be used to regulate auxiliary flow.
 - Auxiliary culvert – this is actually an opening as the auxiliary water passes under the fish ladder invert. The opening would be 5 feet high by 7 feet wide.
 - Diffuser – a 10-foot-high by 18-foot-wide vertical bar diffuser with 1-inch clear openings is located at the downstream end of the auxiliary flow system. This diffuser would provide maximum velocities of 1 ft/s to minimize false attraction of fish to the large volume of auxiliary flow. The fish would then be able to more easily locate the higher velocities (but smaller volume) of the ladder flow.

Current Description

- Pool and weir fish ladder – a pool-and-weir ladder similar to the Roza Dam ladder would be used to move migrating adults into the collection facility. The ladder would have twelve pools, each 8 feet long by 4 feet wide by 4 feet deep and would be placed on a 10 percent slope. Each weir would have a center notch 2 feet wide by 1 foot deep. All ladder flow would pass through the notches with a 1.0 foot of head drop across each weir. The ladder flow would vary between 4.3 ft³/s and 6.4 ft³/s depending on Forebay and tailwater conditions. The lower four weirs will drown out under high river flow conditions. Forebay elevations (holding pool) would range from 2129.0 to 2127.0 and tailwater elevations (as measured below the barrier gates) would range from 2119.0 to 2115.6 for high and low flow conditions. Ladder flows would be supplied by the collection facility supply pump and/or gravity flow. The ladder pool EDF of 3.12 ft-lbs/s/ft³ at maximum ladder flow meets agency criteria for energy dissipation. A hydraulic drop of 0.95 foot will occur across all 12 weirs at the low-flow condition.
- Holding pool – the holding pool would be 20 feet long by 8 feet wide with an operating depth range of 4 to 6 feet. The pool design is based on the holding pool at the Roza Dam collection facility. It would have sufficient volume to hold 20 Chinook salmon, 25 Coho salmon or steelhead, or 50 Sockeye salmon for a 72-hour period.
- Fish Lock – an 8-foot by 8-foot fish lock-and-braille system would be used to move fish from the holding pool to the anesthetic tank. The fish would be crowded into the lock and the water elevation in the lock would be raised using the pump system. A bottom Braille would lift the fish to the top of the lock where they would pass over a false weir into a flume leading to the anesthetic tank.
- Flume – The flume would be 2.0 feet wide by 1.25 feet high.
- Anesthetic tank – 5 feet long by 1.5 feet wide by 2 feet deep.
- Recovery tank – 3 compartments each 4 feet long by 1.6 feet wide by 2 feet deep. Each compartment would have a 4-inch overflow pipe to the building drain.

Current Description

- Water supply to fish lock, holding pool, ladder, and flume – The water supply system allows for both gravity and pumped flow with two separate systems.
 - Gravity supply – The barrier Forebay head is sufficient to supply the holding pool and fish ladder with water. The system is sized for 6.4 ft³/s. The 18-inch diameter high-density polyethylene gravity delivery pipe would have a maximum design velocity of 3.6 ft/s. A 4-foot-wide by 2-foot-high slide gate at the upstream end of the pipe would control flow. A 3-foot by 3-foot wall diffuser would reduce energy as flows enter the holding pool.
 - Pumped supply – A 17-horsepower (HP) centrifugal pump would supply screened water to the flume and fish lock through a 12 inch diameter delivery pipe. The pump would also provide a continuous flow of water to the anesthetic tank and recovery tank. The pump and delivery line would be sized to deliver 6.4 ft³/s. No more than 3 ft³/s would be sent down the flume during normal operations. Manually-operated 6-inch butterfly valves would be used to split the pumped flow between the flume, holding pool, and fish lock as desired. A 4-foot by 4-foot trashrack designed to an approach velocity of 1 ft/s would protect the pump intake. Pumped flows would be screened through a 30-inch-diameter by 38-inch-long pump screen attached to the pump intake. The maximum approach velocity at the screen would be 0.4 ft/s or less. Two 3-foot by 3-foot wall diffusers would reduce energy as flows enter the holding pool and fish lock.
- Loading slab and flume – a 22-foot-long by 14-foot-wide concrete loading slab would provide access for the fish transport trucks. Fish could be transported from the recovery tank and loaded into the truck by hand or through the loading pipe. The slab would be set at maximum elevation 2132 and would drain to a central floor drain.
- Building with office, bathroom, and drain field pipe – a pre-fabricated metal building would enclose the collection facility. It would have exterior dimensions of 78 feet by 33 feet with 16-foot-high exterior walls. The insulated building would have all the necessary electrical lighting and control systems and would include a 10-foot by 10-foot office and a 7.5-foot by 11.5-foot bathroom. A potable water supply and drain field would be provided. The drain field would consist of a 2,500 gallon septic tank and 162 feet of 6-inch drain pipe.
- Potable water system with drilled well – a single 6-inch diameter well about 60 feet deep would be located immediately outside the building to provide water for potable use.

Current Description

- Fish transport truck – a truck would be supplied for the collection facility. The following assumptions are based on information provided by Wells Hatchery staff.
 1. The truck would have a 20-year economic life.
 2. Gross vehicle weight of 35,000 lbs with a single rear axle.
 3. Vehicle manufacturer – Freightliner.
 4. 1,500 gallon aluminum tank with fiberglass interior liner and 2-inch polyethylene insulation.
 5. Tank to have two removable interior baffles.
 6. Three hinged doors (42 inches long by 30 inches wide) with seals on top of tank.
 7. Tank shape to be rectangular with tank bottom tapering 5 inches from front to back and sloped from sides to center for complete drainages.
 8. Truck body length – 15 feet with 210-inch wheelbase.
 9. Truck to have diesel engine and automatic transmission.
 10. 18-inch by 12-inch slide gate on the inside rear of tank.
 11. Oxygen delivery system to consist of 60 pounds per square inch (lb/in²) compressed cylinders with easily replaceable ceramic stone diffusers.
 12. Three fresh flow aerators spaced equally within the compartments of the tank.
 13. Two separate discharge chutes for juveniles and adults.
 14. Truck fish haul capacity is 25 to 30 adult Chinook salmon at 25 pounds per fish.

Access Roads. Juvenile Downstream Passage Facilities. Access to the dam and proposed project site is from Ronald Washington along Highway 903. Access to the right bank of the dam would be provided by a new county road and bridge across the Cle Elum River. The county road and bridge are designed and were scheduled for construction in 2007, but have been delayed two years. It is assumed that this county road and bridge will be in place by 2010 and that they will be able to handle any construction traffic loads associated with the project. The new road would be extended from the town of Ronald to cross the river about 1.2 miles downstream from Cle Elum Dam. No easements will be needed for use of this road, but special permits will be required for movement of large construction equipment.

Adult Upstream Collection Facilities. An existing two-lane paved road connecting to Highway 903 provides access to the left abutment of the dam. A narrow gravel access road departs from the paved road at a point about 1,800 feet east of the dam. This access road would be improved to provide access for construction vehicles to the collection site and to the left side of the barrier dam during construction. The access road would later be used for operation and maintenance of the collection facility.

Current Description

Road improvements would include about 2,600 feet of widening and grade improvement and about 1,000 feet of new road alignment at a 10 percent grade. The road section would be 24 feet wide with 8 inches of gravel surfacing. Cross drainage would be provided by 24-inch-diameter corrugated metal pipes at about 250 feet intervals along the road alignment. Excavation would be common with no rock removal anticipated. The average cross slope is about 2 percent. The entire access road would be located on federal land.

Construction of the right side of the barrier dam would require access on the right side of the river using the same access road as used for the downstream passage facilities. In addition, about 550 feet of new access road would be constructed at a 10 percent grade from the existing road down to the barrier.

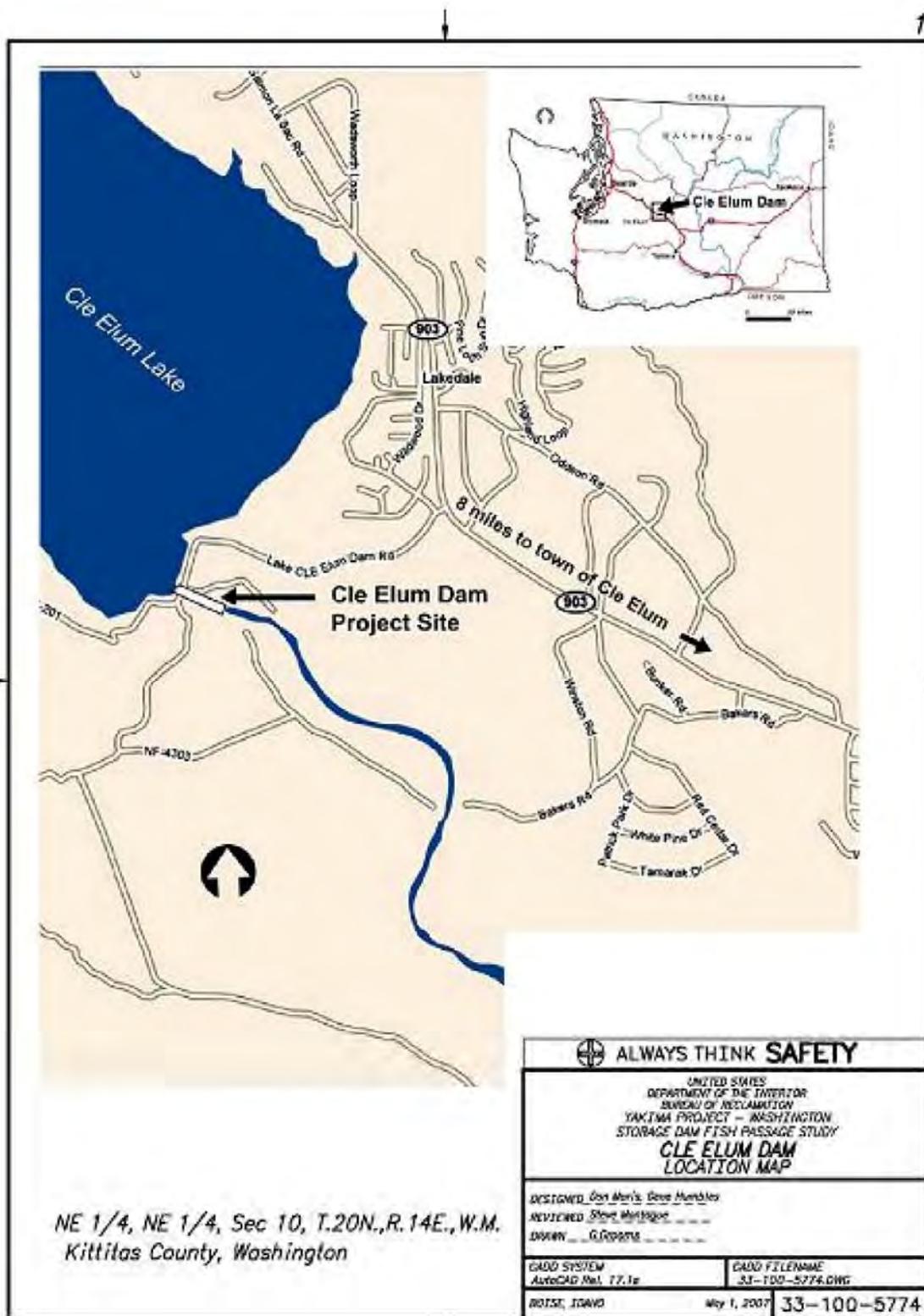
Monitoring and Control Features. The existing Cle Elum Dam is on Reclamation's Hydromet system so that reservoir surface elevation, outflow, outlet gate settings, and resultant inflow data can be accessed at any time. The new fish passage roller gates would be integrated into the same system of control as the present outlet gates. Monitoring of the adult barrier head differential would be required. Head differential sensors would also be connected to the Hydromet system.

Power. Puget Sound Energy delivers power to the left end of the dam with a 12.5 kilovolt (kV) line. Each of the two 7200 Volt legs feeds a 7200/4160 Volt, 75 Kilovolt Amps (kVA) transformer, open delta. This provides a 3-phase, 4160 Volt, 100 kVA feed to a transformer that steps down to 240 Volt, 3-phase power at the dam. There is also a 30 Kilowatt (kW), 240 Volt, 3-phase backup generator at the dam.

Juvenile Downstream Passage Facilities. Power to operate the roller gates, gantry, and other electrical equipment would be provided by connecting to the power supply at the existing gate house control building. A new 600-foot-long cable would be installed underground from the gate house to the access bridge and would be supported on the bridge girders to the intake structure. Power requirements would not change since only one gate would be operated at any given time for either the existing outlet works or the new fish passage intake. Power to operate the trash rake would still be within the capacity of the existing power supply.

Adult Upstream Collection Facilities. The proposed barrier gates will require 460 volt, 3-phase, 60-Hertz (Hz) power supply. For this study, it is anticipated that power at the dam site will be extended approximately 1,000 feet from the existing gate house control building down to the adult collection facility and barrier site. Four wooden poles would support the 3-phase conductors and ground wires.

Figure C-1. Location Map



DATE AND TIME PLOTTED
 JUNE 14, 2008 11:00
 PLOTTED BY:
 ENKUNINGBOT

Figure C-2. Upstream and Downstream Passage Plan

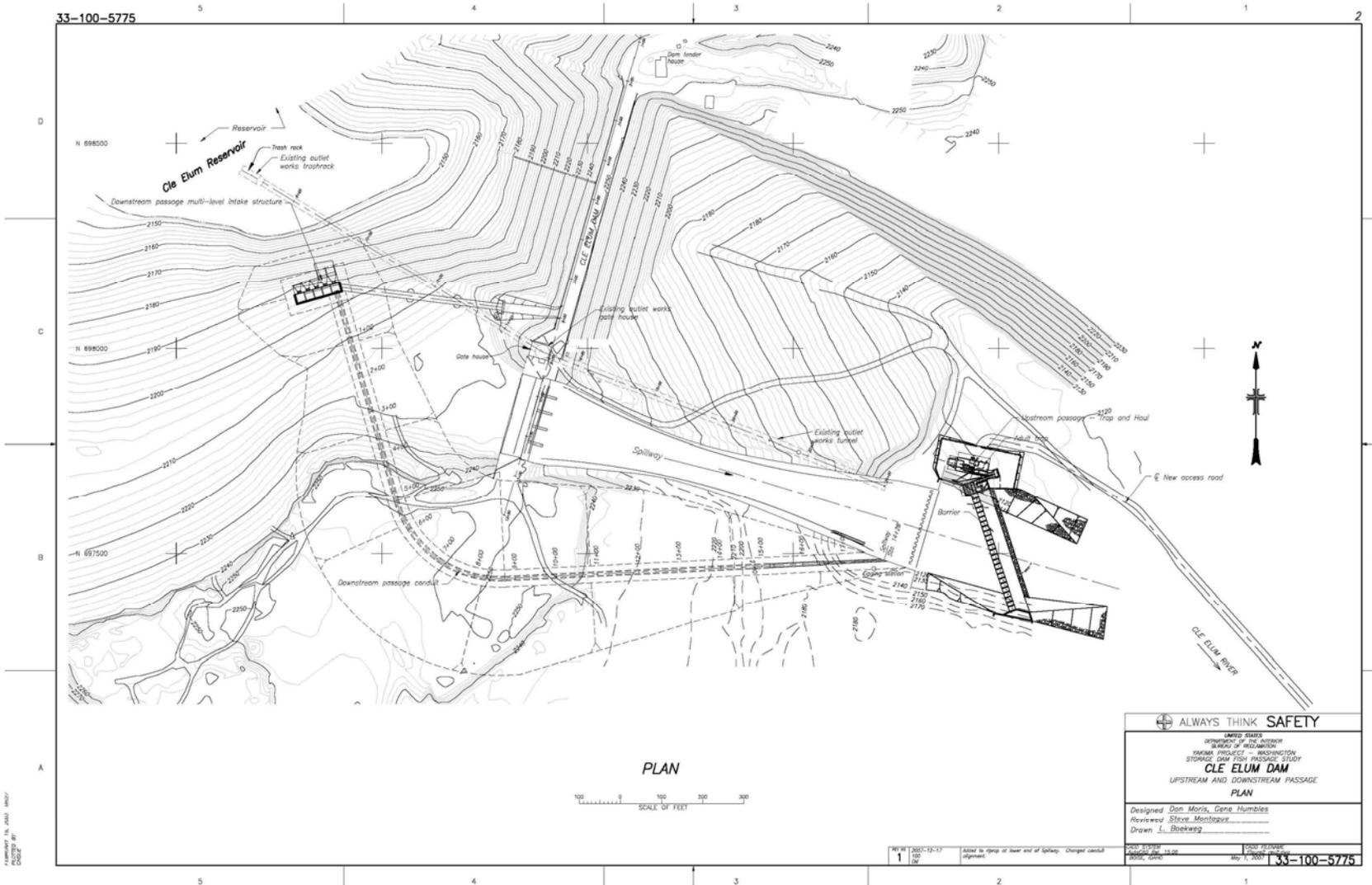


Figure C-3. Intake Structure Plan, Elevation, and Section

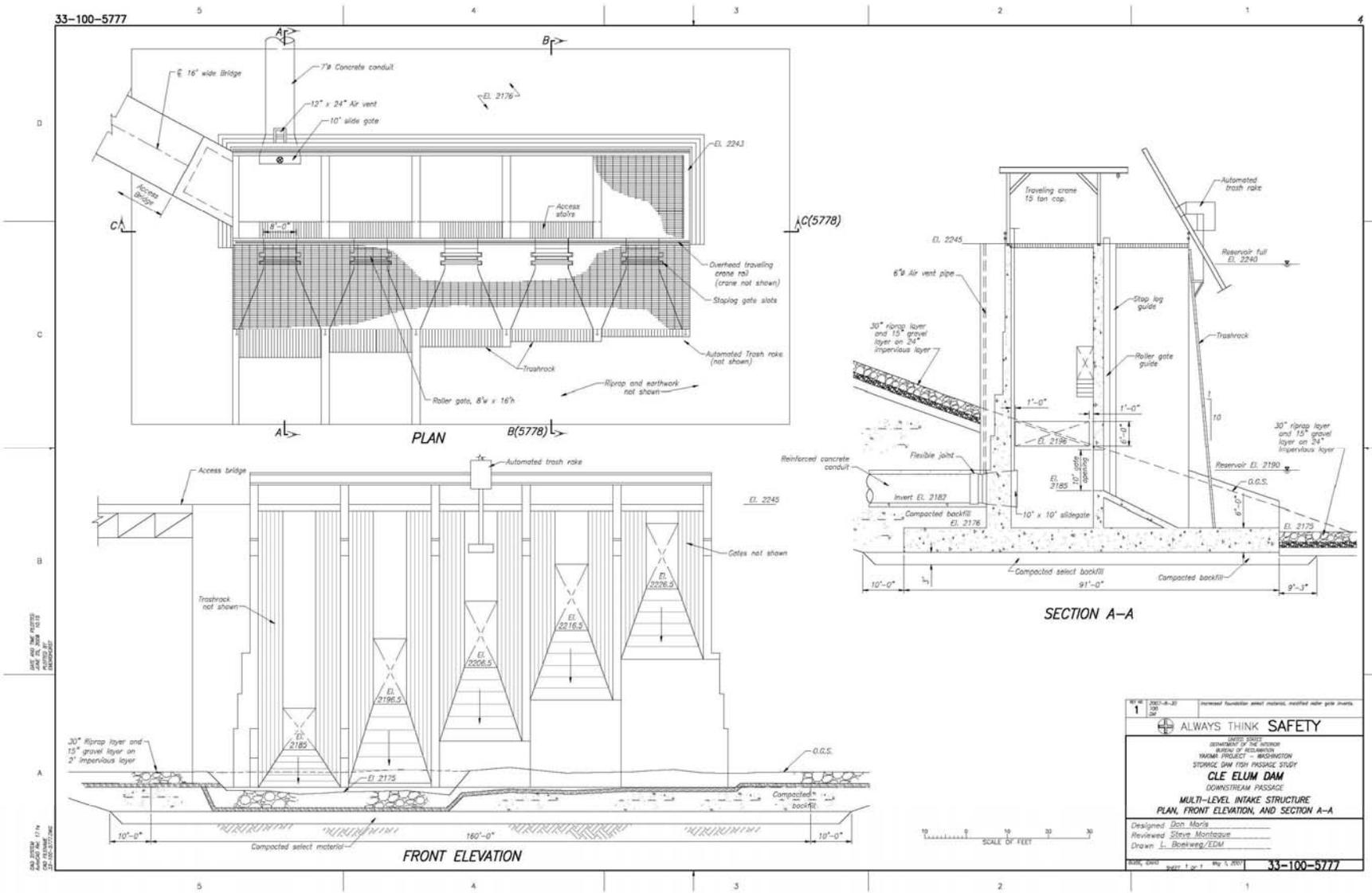


Figure C-4. Downstream Passage Outlet Plan and Section

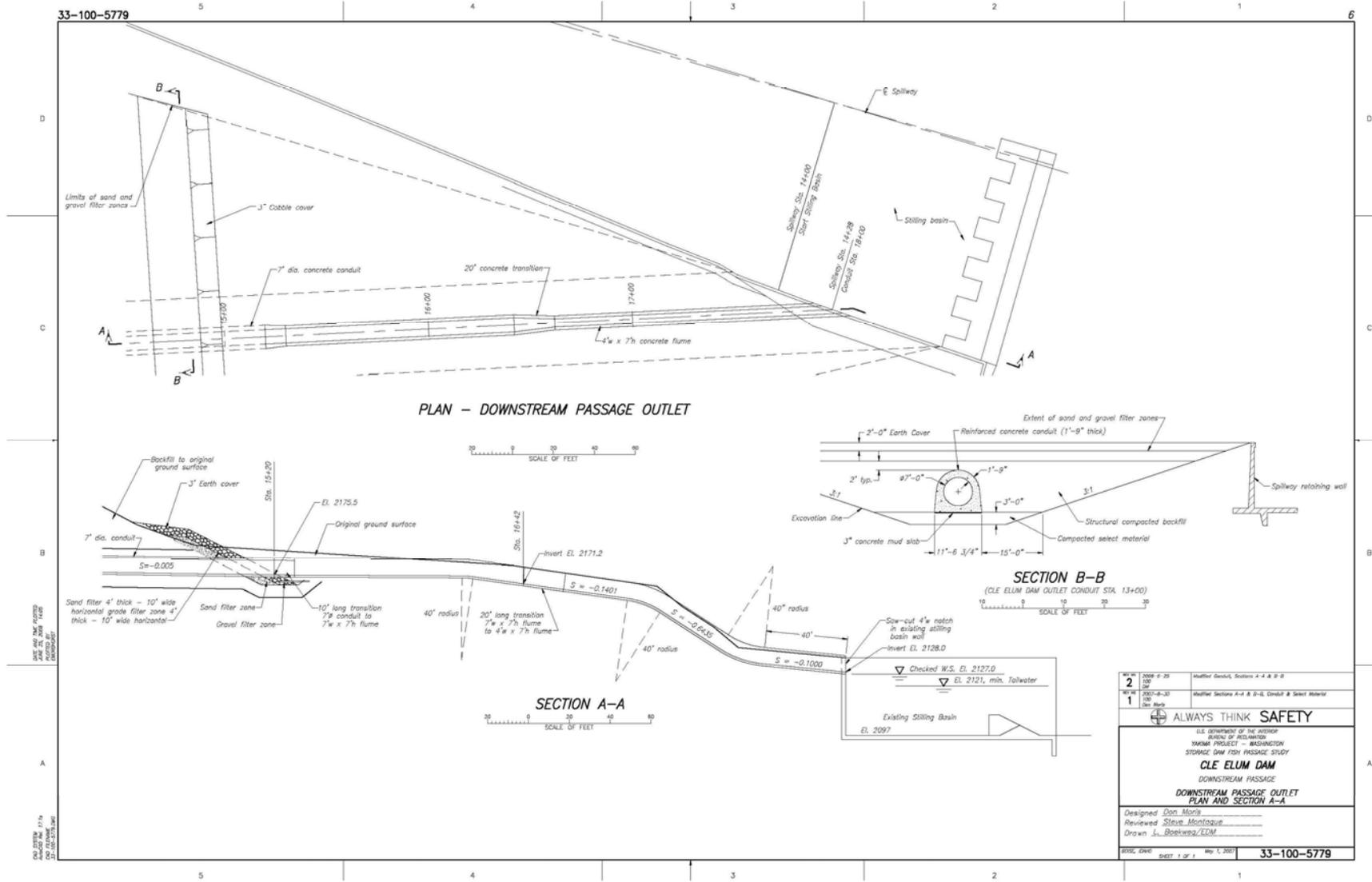


Figure C-5. Intake and Downstream Passage Conduit Profile

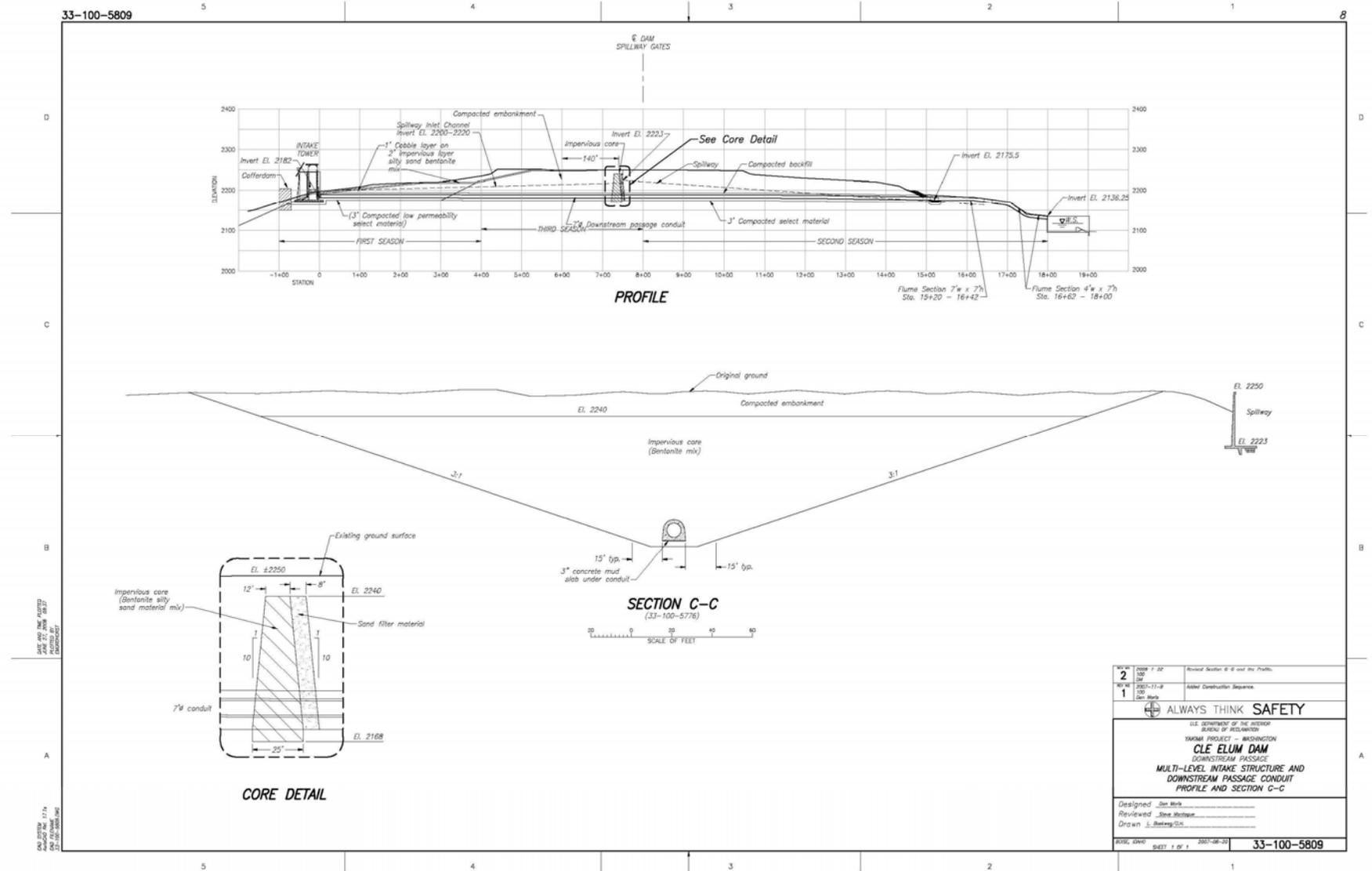


Figure C-6. Upstream Passage Profiles and Sections

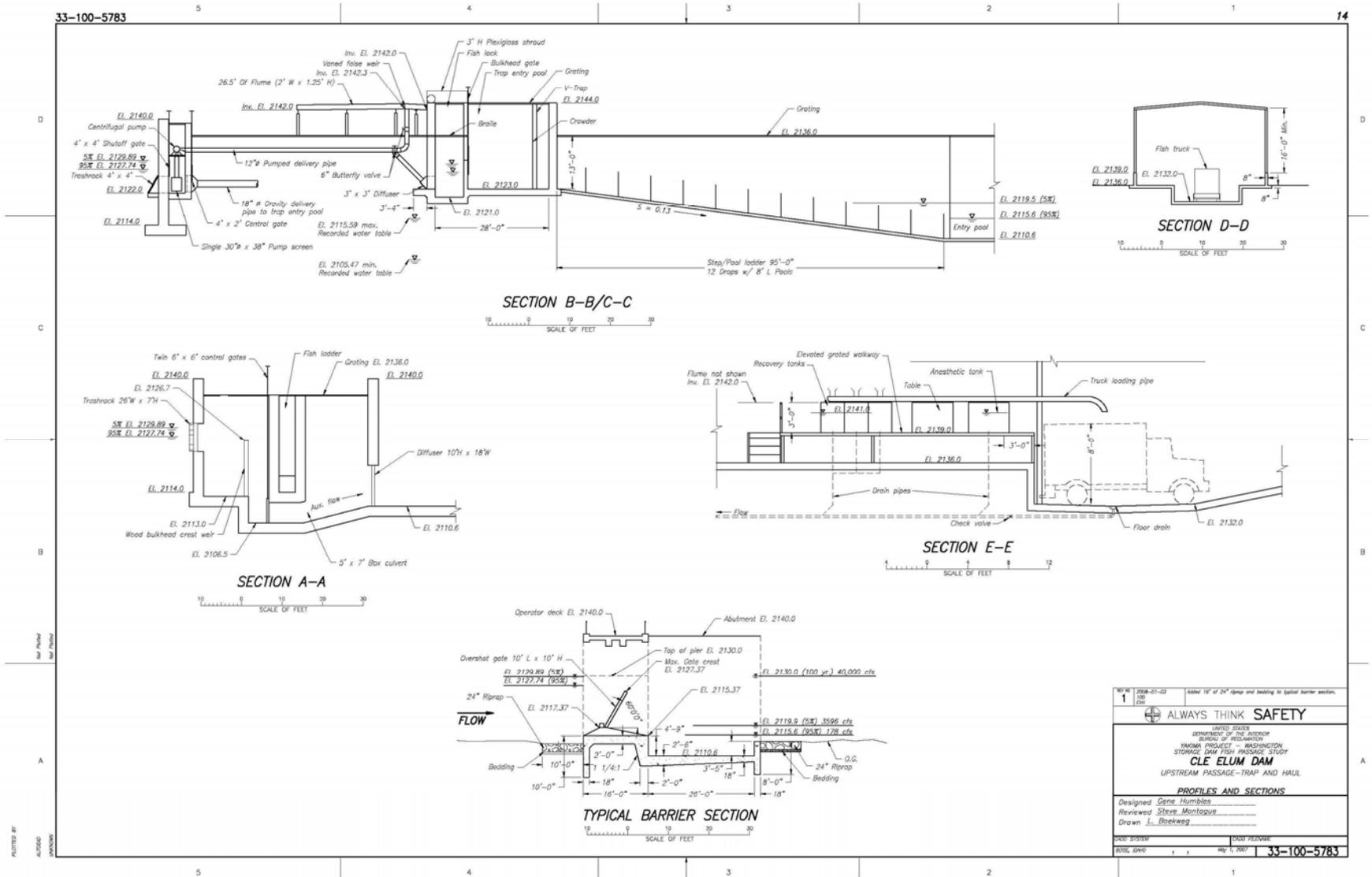
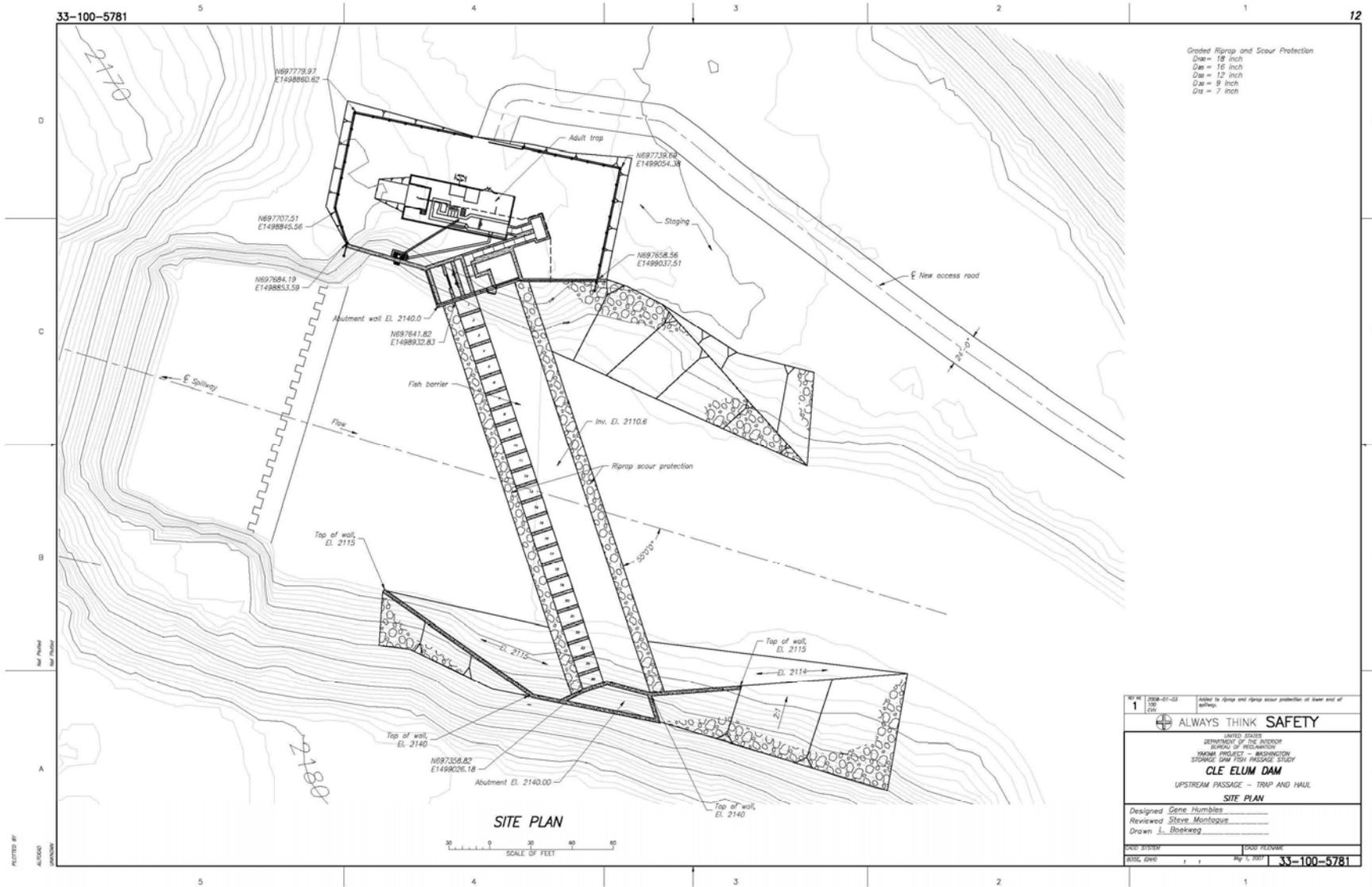


Figure C-9. Upstream Passage Trap and Haul Site Plan



Special Criteria Summary

Code Requirements

Occupational Safety and Health Administration; Reclamation Safety and Health Standards; National Environmental Protection Agency; State Environmental Protection Agency; Army Corps of Engineers Permitting; International Building Code; Hydraulic Projects Approval – Washington Department of Fish and Wildlife; County Shoreline & Critical Areas and Sanitation Codes.

Restrictions and Limits

Winter work – low reservoir level – for downstream passage intake and conduit; conduit excavation has to be backfilled prior to the end of each season; maintain minimum releases from reservoir; cofferdam for upstream passage facility to be constructed during non-spawning season; Safety of Dams issues regarding excavation, seepage, and tunneling.

Owner, Users, and Stakeholders List

Identification and Issues Determination

Owner (Identification of the owner or owners)	Owner Issues (Identification of issues important to every Owner)
Bureau of Reclamation	Fish Passage
	Mitigation Requirements
	Enhance Fisheries
	Improve Water Enhancement
User (Identification of the user or users)	User Issues (Identification of issues important to every user)
Bureau of Reclamation	Fish Passage
Yakama Nation	Improve Water Enhancement
	Enhance Fishery
Stakeholder (Identify of the stakeholder or stakeholders)	Stakeholder Issues (Identification of issues important to every Stakeholder)
Bureau of Reclamation	Fish Passage
Yakima Basin Irrigation Districts	Improve Water Enhancement
Washington Dept of Fish and Wildlife	Enhance Fishery
National Oceanic and Atmospheric Admin.	
U.S. Forest Service	
U.S. Fish and Wildlife Service	
Washington Department of Ecology	
Army Corps of Engineers	

Function Analysis

Component	Active Verb	Measurable Noun
Cofferdam	Exclude	Water
	Allow	Construction
	Isolate	Worksite
	Protect	Workers
	Expose	Foundation
	Dewater	Worksite
Excavation	Allow	Construction
	Define	Footprint
	Establish	Grade
	Expose	Foundation
	Stabilize	Slopes
	Create	Waste
	Create	Backfill
	Define	Uncertainties
	Remove	Timber
	Confirm	Conditions
Backfill about Structures	Seal	Foundation
	Cover	Conduit
	Hold	Water
	Use	Materials
	Stabilize	Structure
	Control	Erosion
	Fill	Hole
	Prevent	Leakage
	Ballast	Structure
Structural Concrete	Create	Opening
	Pass	Water
	Support	Equipment
	Create	Foundation
	Prevent	Erosion
	Direct	Water
	Control	Fish
	Support	Bridge
	Retain	Water
	Allow	Passage
Roller Gates	Control	Water
	Adjust	Elevation
	Control	Fish
	Increase	Maintenance
	Create	Attraction
	Move	Water

Function Analysis

Component	Active Verb	Measurable Noun
15-ton Overhead Gantry Crane	Allow	Maintenance
	Lift	Equipment
	Lower	Equipment
Trash Racks and Trash Rakes	Exclude	Debris
	Protect	Structure
	Pass	Fish
	Increase	Maintenance
	Remove	Debris
	Prevent	Entrance
Riprap Slope Protection	Prevent	Erosion
	Stabilize	Slopes
	Prevent	Vegetation
	Protect	Structure
Access Bridge, Grating, Handrails	Allow	Access
	Protect	Workers
	Allow	Maintenance
Bulkhead Gates	Allow	Maintenance
	Allow	Access
	Block	Water
Diffuser	Pass	Water
	Attract	Fish
	Block	Fish
Building	Protect	Equipment
	Secure	Facility
	Secure	Equipment
	Protect	Fish
	Protect	Workers
	Exclude	Weather
Access Roads & Gates	Allow	Access
	Allow	Maintenance
	Allow	Construction
	Transport	Fish
	Secure	Site
Transport Truck	Move	Fish
	Move	Water
	Aerate	Water

Function Analysis

Component	Active Verb	Measurable Noun
	Release	Fish
Recovery & Anesthetic Tanks	Preserve	Fish
	Protect	Fish
	Collect	Data
	Calm	Fish
Entry Pool, Fish Lock, Flume	Hold	Fish
	Collect	Fish
	Direct	Fish
	Control	Water
	Sort	Fish
	Attract	Fish
Barrier Dam	Direct	Fish
	Pass	Juveniles
	Dissipate	Energy
	Pass	Water
	Retain	Water
	Create	Pool
	Catch	Debris
	Control	Releases
	Attract	Fish
Fish Ladder, Collection, & Transportation	Move	Fish
	Collect	Fish
	Collect	Data
	Regulate	Flow
	Enhance	Fishery
	Attract	Fish
	Improve	Roads
	Protect	Public
	Educate	Public
Multi-Gated Intake Structure	Attract	Fish
	Move	Fish
	Collect	Debris
	Control	Flow
	Increase	Outflow
	Increase	Maintenance
	Reduce	Aesthetics
	Access	Conduit
	Secure	Bridge
	Allow	Passage

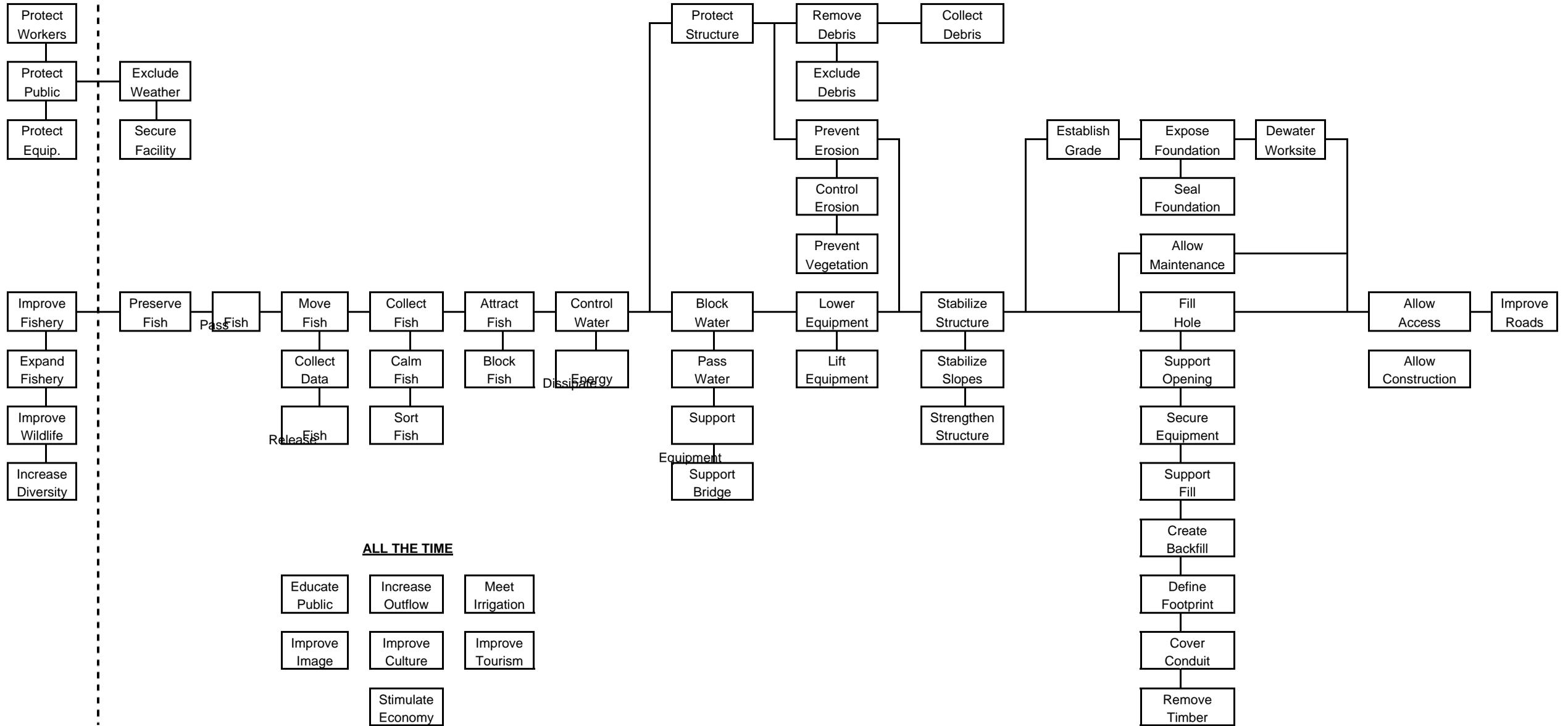
Function Analysis

Component	Active Verb	Measurable Noun
	Improve	Fishery
	Increase	Habitat
7' Diameter Conduit	Pass	Fish
	Pass	Water
	Increase	Outflow
	Support	Opening
	Support	Fill
Overall Fish Passage Project	Pass	Fish
	Enhance	Fishery
	Stimulate	Economy
	Improve	Image
	Expand	Fishery
	Meet	Regulations
	Improve	Culture
	Improve	Tourism
	Fertilize	Lake
	Educate	Public
	Create	Employment
	Satisfy	Users
	Increase	Diversity
	Improve	Wildlife
	Increase	Predation
	Improve	Production
	Meet	Irrigation
	Enhance	Water

Function Analysis System Technique (FAST)

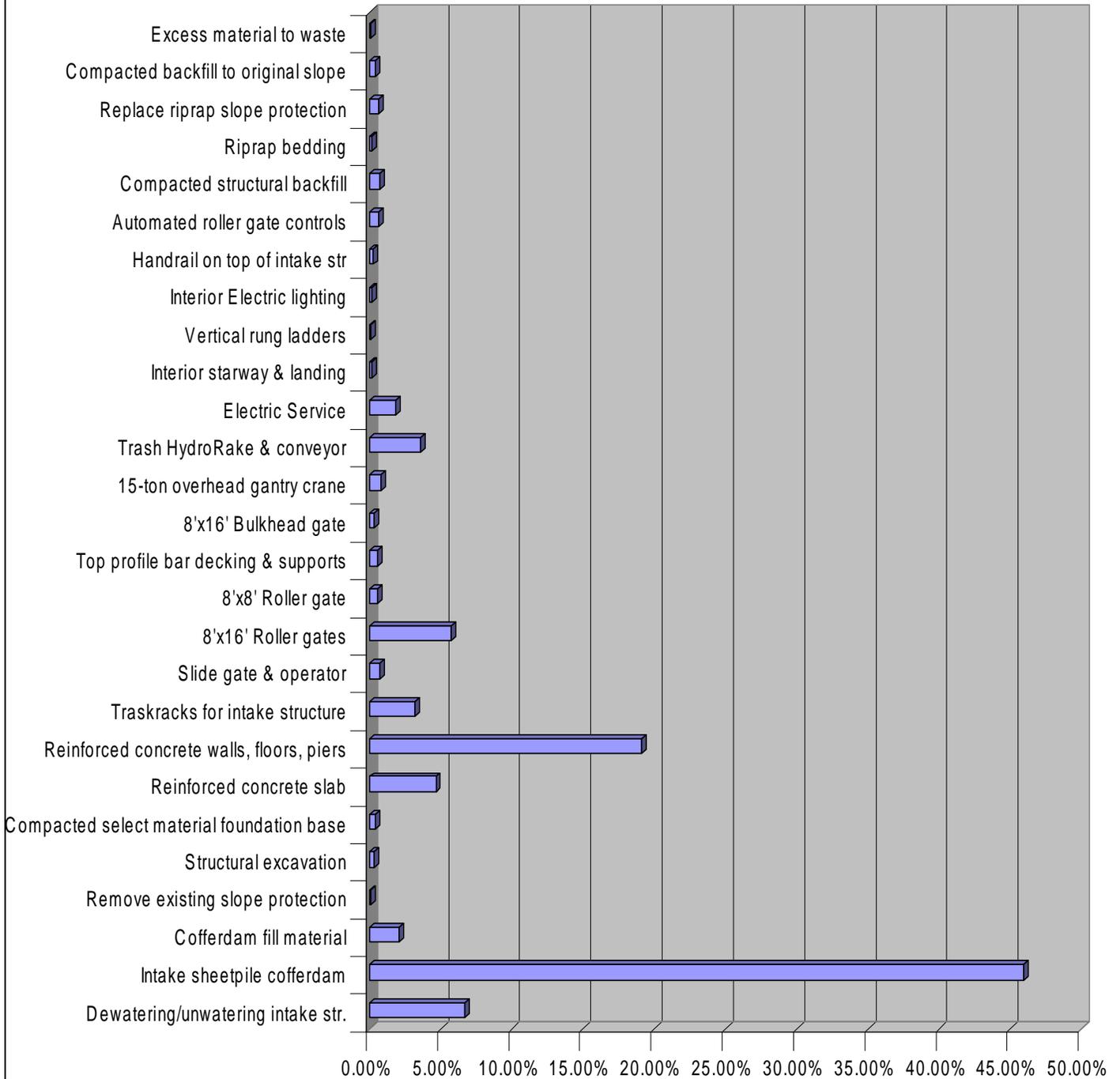
The Value Study Team used the function analysis process to generate a Function Analysis System Technique (FAST) diagram, designed to describe the present solution from a function point of view. The FAST diagram helped the Team identify those design features that support critical functions and those that satisfy noncritical objectives. The FAST diagram helped the Team focus on a common understanding of how project objectives are met by the present solution.

F.A.S.T. Diagram



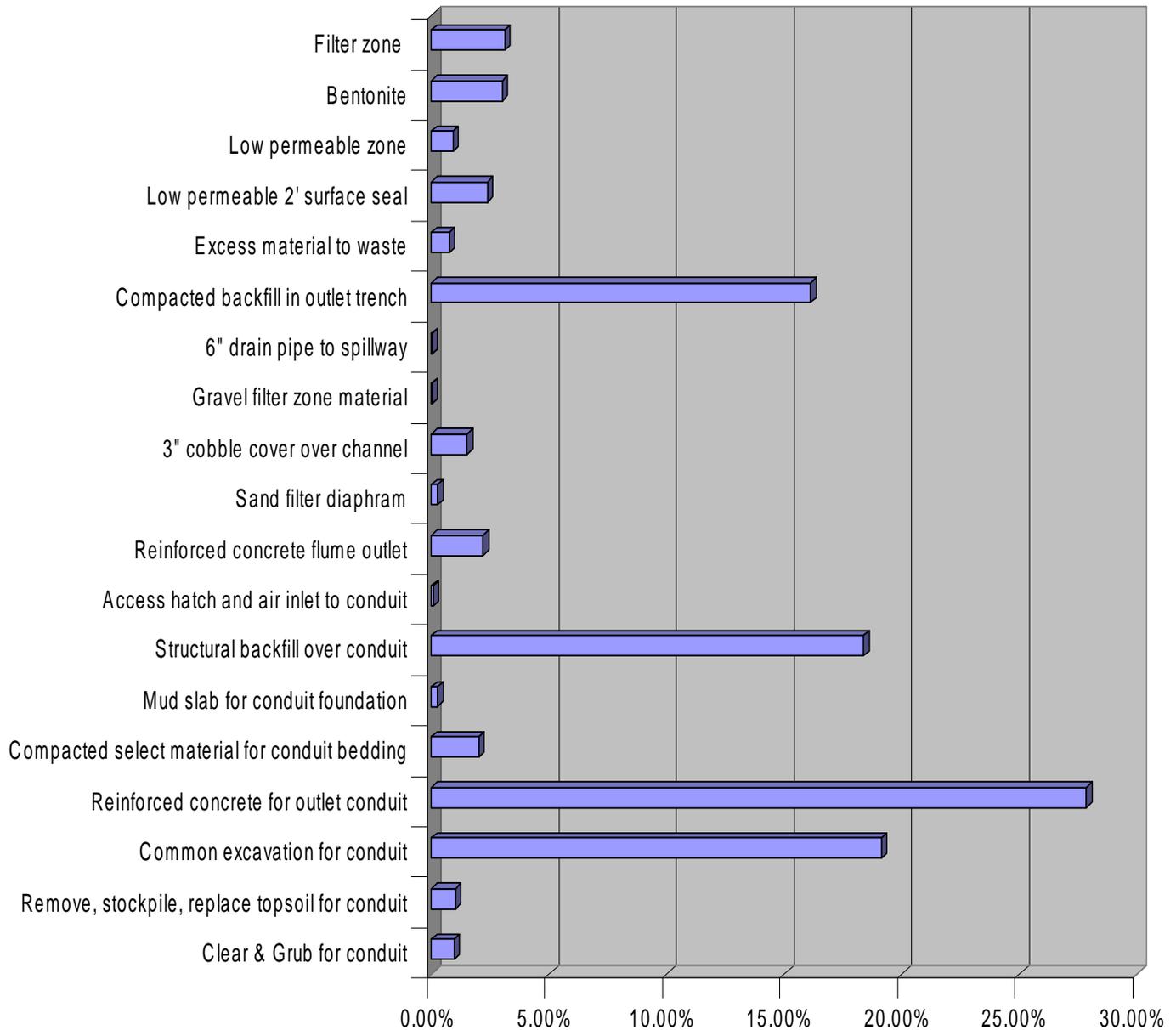
COST MODEL

Multi-Level Gated Intake Structure



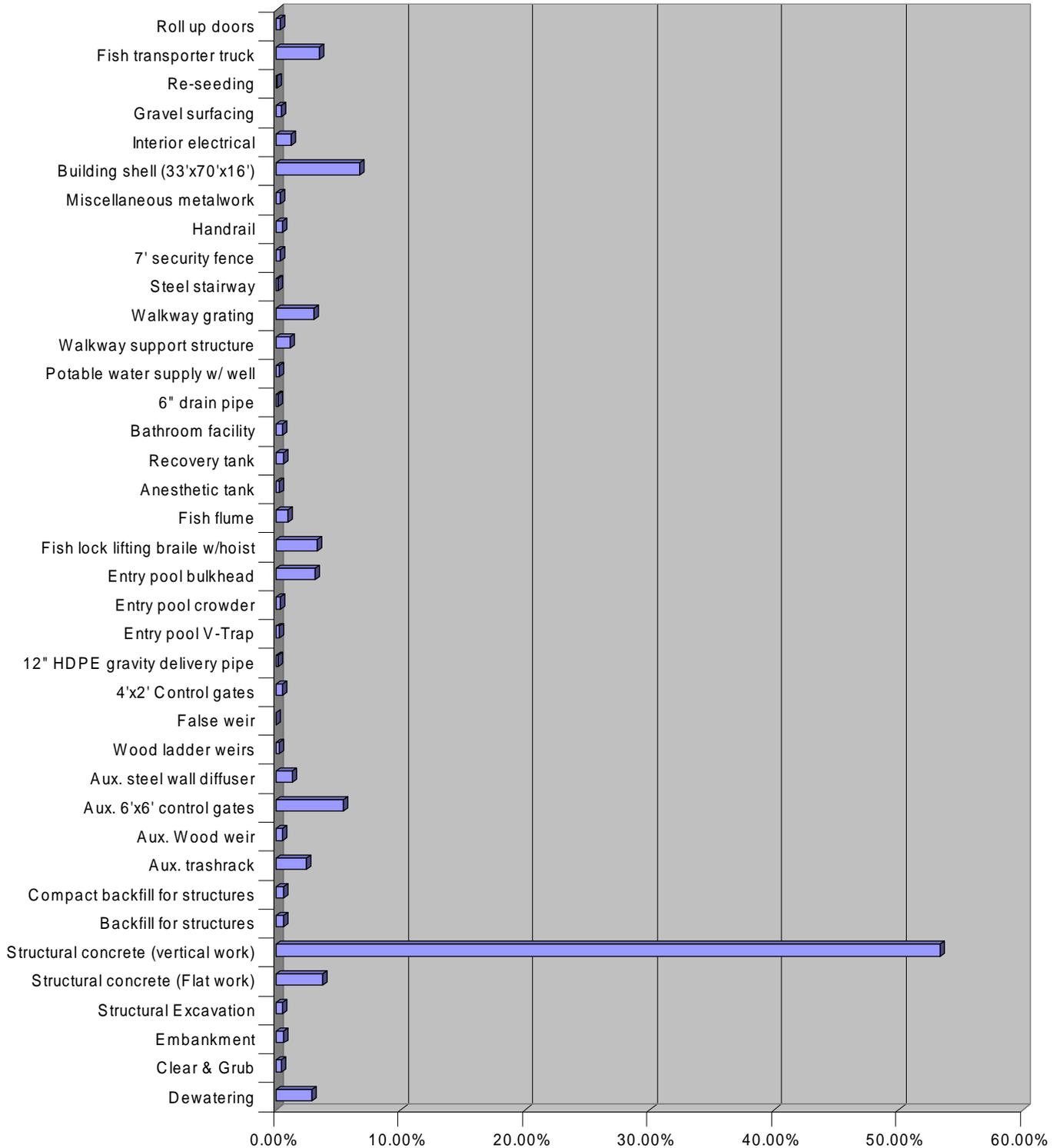
COST MODEL

7' Diameter Concrete Fish Passage Conduit



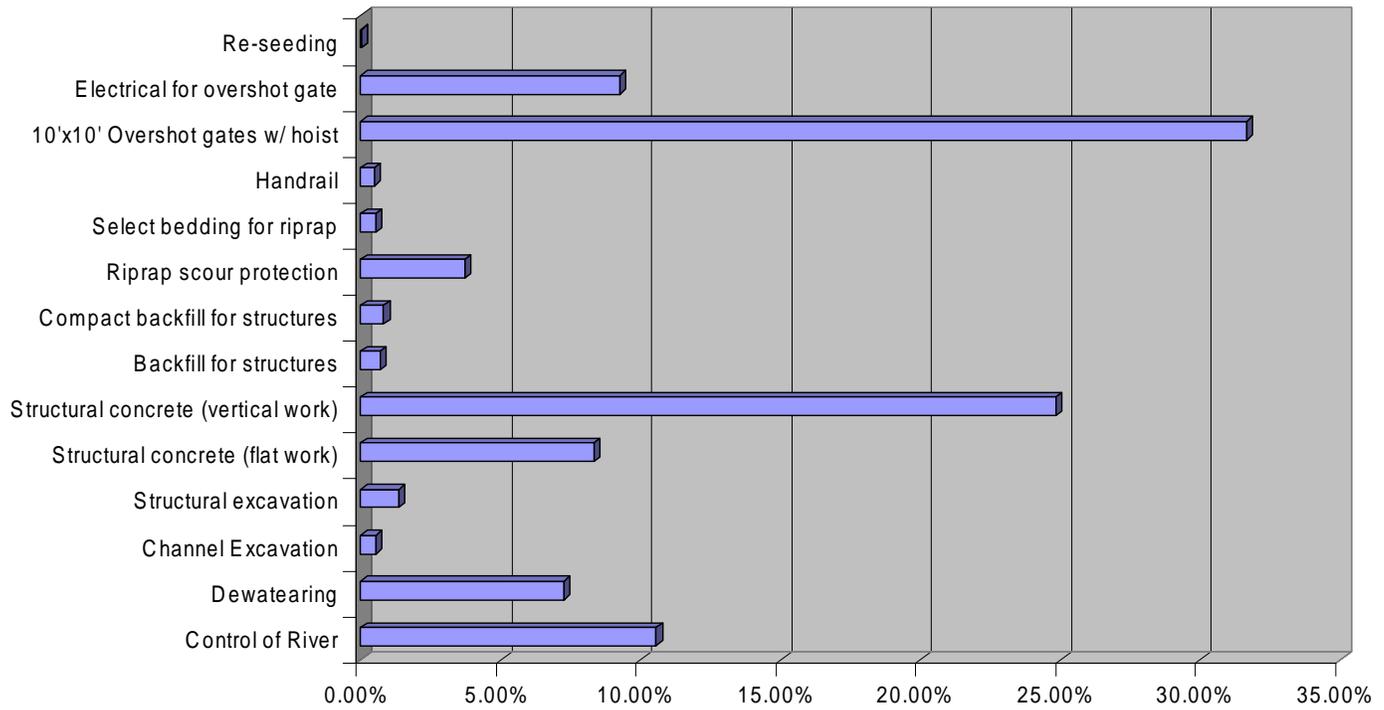
COST MODEL

Fish Ladder, Collection, Transportation Facilities

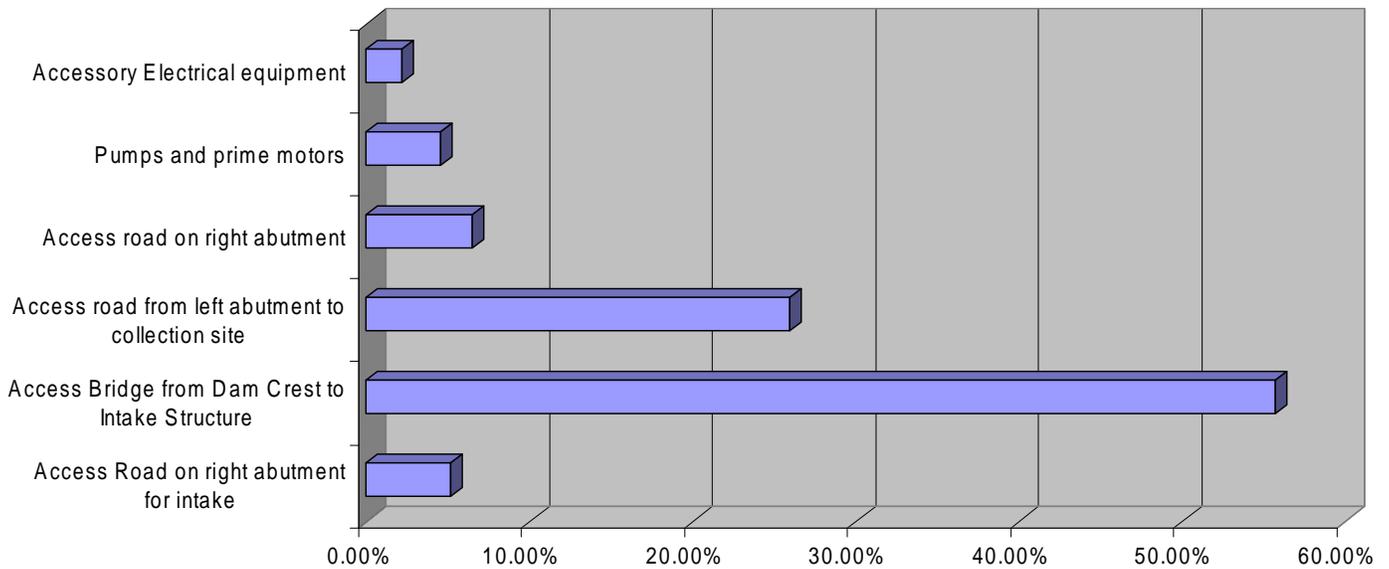


COST MODEL

Gated Overflow Barrier Dam



Miscellaneous Items



Cost Model and Estimate Information

The Value Study Team cost model is based on the conceptual design estimates provided by the design team for the preferred project design. The cost model was developed by the Value Study Team and was used to focus on features with the greatest potential for cost avoidance and to highlight areas of value mismatch. Unit prices were reviewed by the Value Study Team members, to ensure reliability and applicability.

Cost Avoidances estimates and the original design concept estimates are of the same general level of development, although these costs may vary as final designs are pursued.

Proposal No. 1

Proposal No. 1. Use of Spillway as Barrier Dam & Right Bank Fish Facility

- Proposal Description: The Cle Elum Dam spillway will function as the barrier to upstream migrating fish. The existing spillway will replace the need for the proposed adult barrier dam, which is angled downstream approximately 150 (left bank) – 300 (right bank) feet. The adult fish ladder and collection facility (AFLCF) will be located on the right bank next to the spillway, sited over the juvenile bypass pipe (see figure 1-1). The fish bypass water will be used to provide flow to the fish ladder and for attraction flow down to reservoir elevation 2190', which extends from mid-March – mid-August for an average water year. Below reservoir elevation 2190' (mid-August – mid-November) flow for fish ladder and attraction flow will be provided by a pump (possibly gravity flow). An additional feature to the facility will be the capability for juvenile sampling (hands-on and Passive Integrated Transponder (PIT) tag detection).
- Critical Items to Consider:
 - Additional design work to the facility is required to accommodate juvenile sampling/PIT tag detection and to use the fish bypass water to provide flow to the fish ladder, including attraction flow.
 - An additional staging area on the right side will need to be identified.
- Ways to Implement: Prepare the site to accommodate the adult and juvenile facility. The excavation required for installation of the fish bypass pipe will also serve for preparation of the pad for the AFLCF.
 - Excavated material that would have been used to backfill over the fish bypass pipe will be disposed of off site.
 - Construct the AFLCF that has been modified to accommodate juvenile collection capabilities. New features to include the juvenile sampling capabilities and PIT tag detection.
 - Install a large system to dewater and remove juveniles prior to use of water for the ladder and the new adult fish ladder attraction flow pipe feature.
- Changes from the Baseline:
 - Eliminate the fish barrier dam.
 - Move the AFLCF from the left bank to the right bank.
 - Use the fish bypass water to serve flow to the adult fish ladder and for attraction flow when discharge through the juvenile conduit.
 - Add stilling basin on the outlet of the bypass pipe to reduce velocities and a fish screen to remove the juveniles.
 - Add juvenile sampling/PIT tag detection capabilities.
 - Add a dewatering system for juveniles.

Advantages	Disadvantages
<ul style="list-style-type: none"> • Eliminates the fish barrier dam • Eliminates the need to pump water to serve the adult fish ladder from mid-March to mid-August by use of the juvenile bypass water (100-400 cfs). • Provide juvenile sampling/detection capabilities. • Juvenile fish do not have to pass over the barrier dam (instead of upstream to the barrier dam). • Access roads are less steep. 	<ul style="list-style-type: none"> • Some additional excavation and disposal of backfill material to accommodate the facility on the right bank. • The potential issue of adult fish not readily finding the ladder entry. • Slightly longer haul to release fish. • Attraction flows may not be sufficient and cause delays in migration caused by excessive turbulence during outlet works operations. • Juveniles must pass through the bypass pipes in the dewatering system and be handled. • All debris from the reservoir that enters the intake structure will be sent to the juvenile facility.
Potential Risks	
None Identified.	
Cost Item	Non-Recurring Costs
Original Baseline Concept	\$13,145,000
Value Concept	\$4,657,000
Cost Avoidance	\$8,488,000

Figure 1-1. Spillway as Barrier Dam

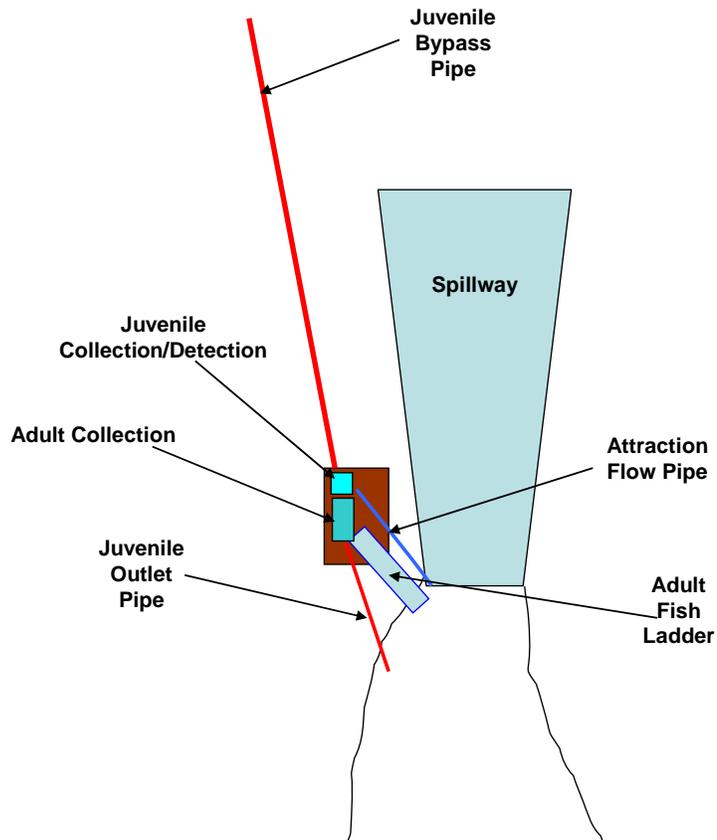


Figure 1. Proposal No. 1. Use of Spillway as Barrier Dam & Right Bank Fish Facility.

Proposal No. 2

Proposal No. 2 Install HDPE trash racks instead of steel.

- Proposal Description: Replace both the upstream and downstream passage steel trash racks called out in the original design with trash racks made of High Density Polyethylene (HDPE). These HDPE trash racks are currently installed at Black Canyon Dam (approximately 10 years) and Boise Diversion Dam (approximately 7 years). They have performed very well over the time they have been in use, even when exposed to the sunlight. The spacing between the slats can be specified to any dimension. The weight of the trash rack is substantially less than the baseline concept. The HDPE Trash racks could be purchased by a separate contract and assembled and installed by Reclamation personnel.
- Critical Items to Consider: Whether or not the trash rack cleaning and conveyance system that is called for in the current design will work with the HDPE trash rack. Several commercially available trash rake and cleaning systems are available if the one in the baseline concept would not work with HDPE.
- Ways to Implement: The trash racks in the current design would be replaced with HDPE trash racks. Since this type of trash rack was included in the Boise Diversion Dam specifications, potential suppliers should be easily determined.

Advantages	Disadvantages
<ul style="list-style-type: none"> • High impact strength. • Light weight. • Easy to maintain and repair. • Corrosion resistant so painting is not required. • Resist icing. • Can reduce the size of the superstructure members and the hoist. • More fish-friendly. 	<ul style="list-style-type: none"> • May require additional lateral support that could impede passage for juvenile fish.
Potential Risks	
None Identified	
Cost Item	Non-Recurring Costs
Original Baseline Concept	\$53,707,000
Value Concept	\$53,185,000
Cost Avoidance	\$522,000

Proposal No. 3

Proposal No. 3 Move Downstream Passage Intake Structure To Shoreline.

- **Proposal Description:** Similar to baseline concept, primary differences include:
 - moving intake closer to the right shore;
 - eliminating the cellular sheetpile cofferdam by performing excavation in a manner that leaves in place native material between the reservoir and the structure excavation to act as a water barrier;
 - eliminating the need for an access bridge;
 - shortening the downstream passage conduit by approximately 400 feet;
 - steepening excavation slopes from 3:1 to 1.5:1; and
 - constructing of an approach channel with an impervious liner and slope protection.

The intake structure design and upstream passage features remain unchanged from baseline concept.

- **Critical Items to Consider:** The ability to insure the approach channel remains impervious to reservoir seepage and erosion; determine if the in place native material will function as a water barrier for the cofferdam; confirm groundwater characteristic in the excavation areas (applies to excavation slope angles and potential dewatering needs).
- **Changes from the Baseline:** Changes from baseline include the elimination of the cellular sheetpile cofferdam and elimination of the access bridge to the intake structure; and a reduction of excavation and backfill quantities for the downstream passage conduit.

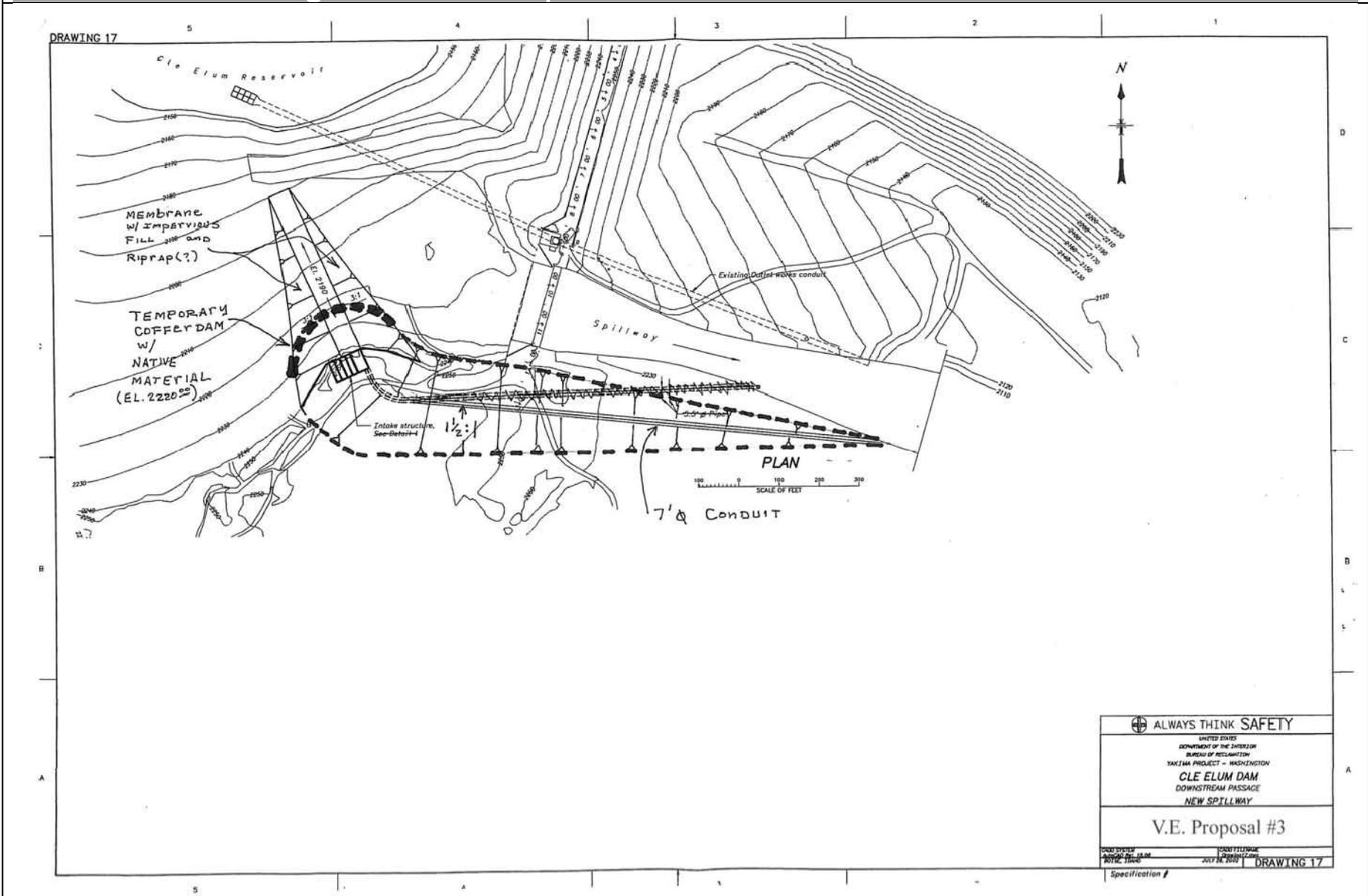
Advantages	Disadvantages
<ul style="list-style-type: none"> • Potential shortening of the construction period. • Less excavation and backfill. • Eliminates the access bridge from the top of the dam and excavation of the dam crest. • May provide better attraction of juvenile to the facility if fish migrate by following the shoreline 	<ul style="list-style-type: none"> • Will need to identify a riprap source for the intake approach channel. • The approach channel will need to be maintained. • May require special treatment of the approach channel to cut-off potential seepage

Potential Risks

None Identified

Cost Item	Non-Recurring Costs
Original Baseline Concept	\$53,707,000
Value Concept	\$37,602,000
Cost Avoidance	\$16,105,000

Figure 3-1. Proposed Intake Structure Location



Proposal No. 4

Proposal No. 4 Concrete Fixed Angle Wall Exclusion Weir Barrier Dam

- Proposal Description: The barrier dam will be composed of concrete with a fixed angle wall to function as an exclusion weir fish passage barrier. The barrier would consist of a 10 ft. top spill drop from the weir crest to a velocity apron to discourage fish from securing the depth to jump from. The designs could be similar to the attached Sulphur Creek Wasteway Barrier the Sunnyside Valley Irrigation District and the Roza Irrigation District constructed in the winter of 2007-08.
- Critical Items to Consider:
 - Flow modeling to analyze if the alternative is plausible with the current flow scenarios and elevations of Cle Elum River events. An adjustable crest may be necessary to allow passage of flood events from the dam and low flow fish barrier.
 - Flow modeling to determine if attraction flows will be sufficient for the upstream fish passage – trap and haul facility.
- Changes from the Baseline:
 - The proposal does not require electrically operated overshot gates, or the operator deck.
 - The proposal does not require the concrete piers as identified in the current designs.
 - The proposal would require three receding orifices through the concrete barrier about 5 ft apart from one another with the largest being closest to the entry pool of adult fish ladder. These orifices would allow attraction flow for adult trap facility (the determination if orifices are necessary can be made during the final design process).

Advantages	Disadvantages
<ul style="list-style-type: none"> • Fewer maintenance activities. • Large woody debris passage. • Fewer moving parts or more self-sufficient. • Provides a proven fish passage barrier. 	<ul style="list-style-type: none"> • No water flow control with overshot weir gates. • Less attraction flow. • No foot access across barrier dam.

Potential Risks

None Identified

Cost Item	Non-Recurring Costs
Original Baseline Concept	\$9,086,000
Value Concept	\$5,667,000
Cost Avoidance	\$3,419,000

Figure 4-1. Sulphur Creek Wasteway Barrier Designs

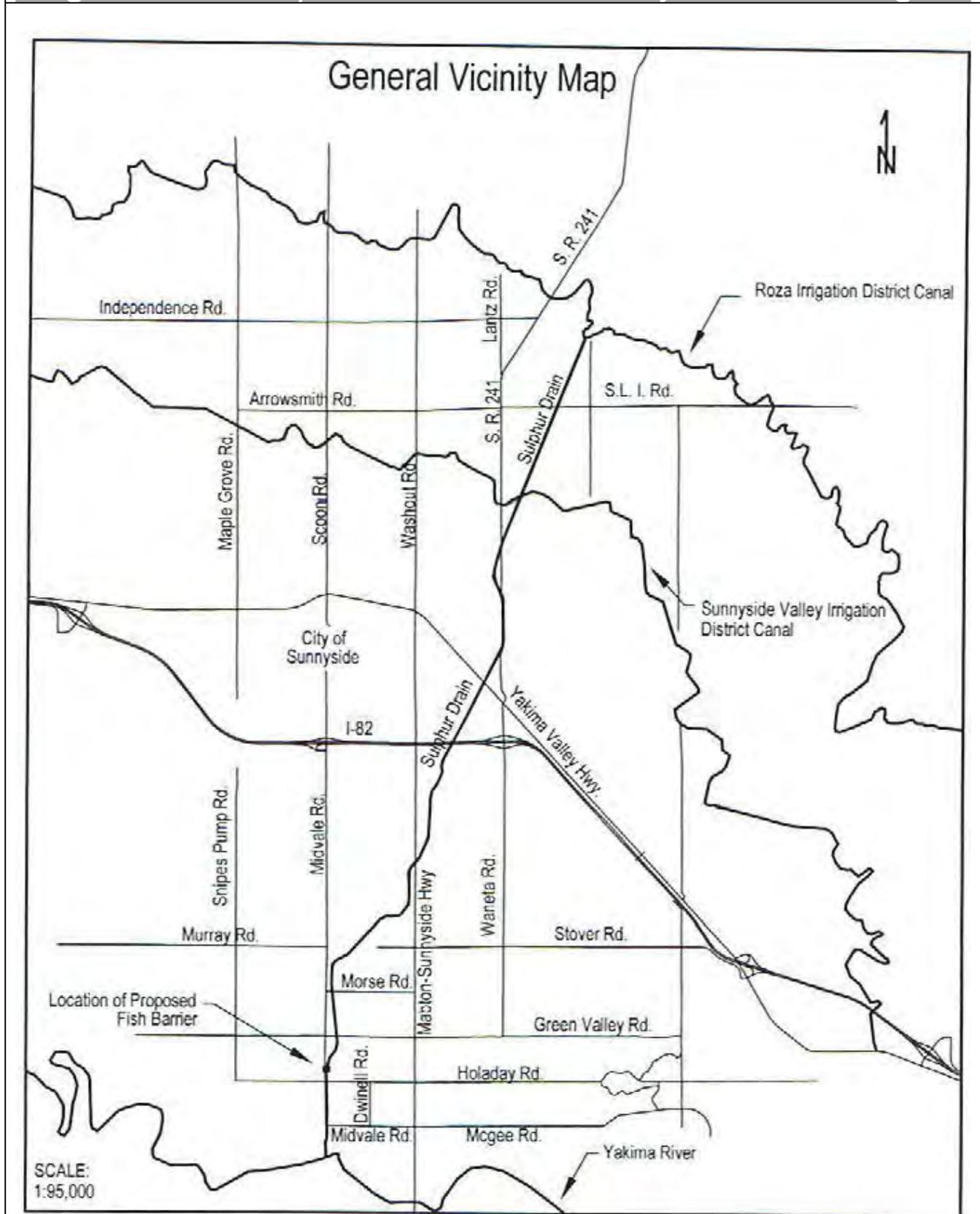
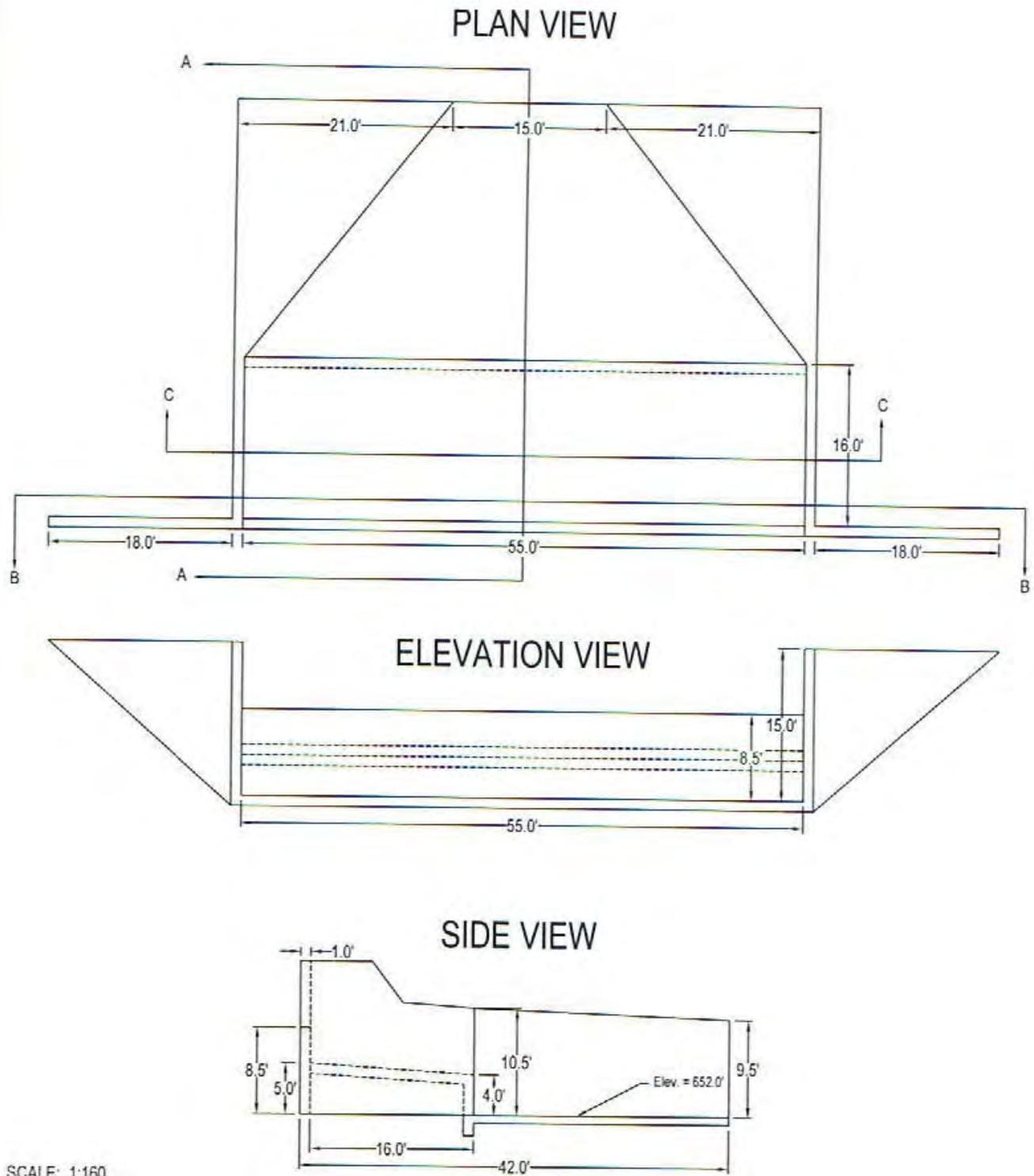
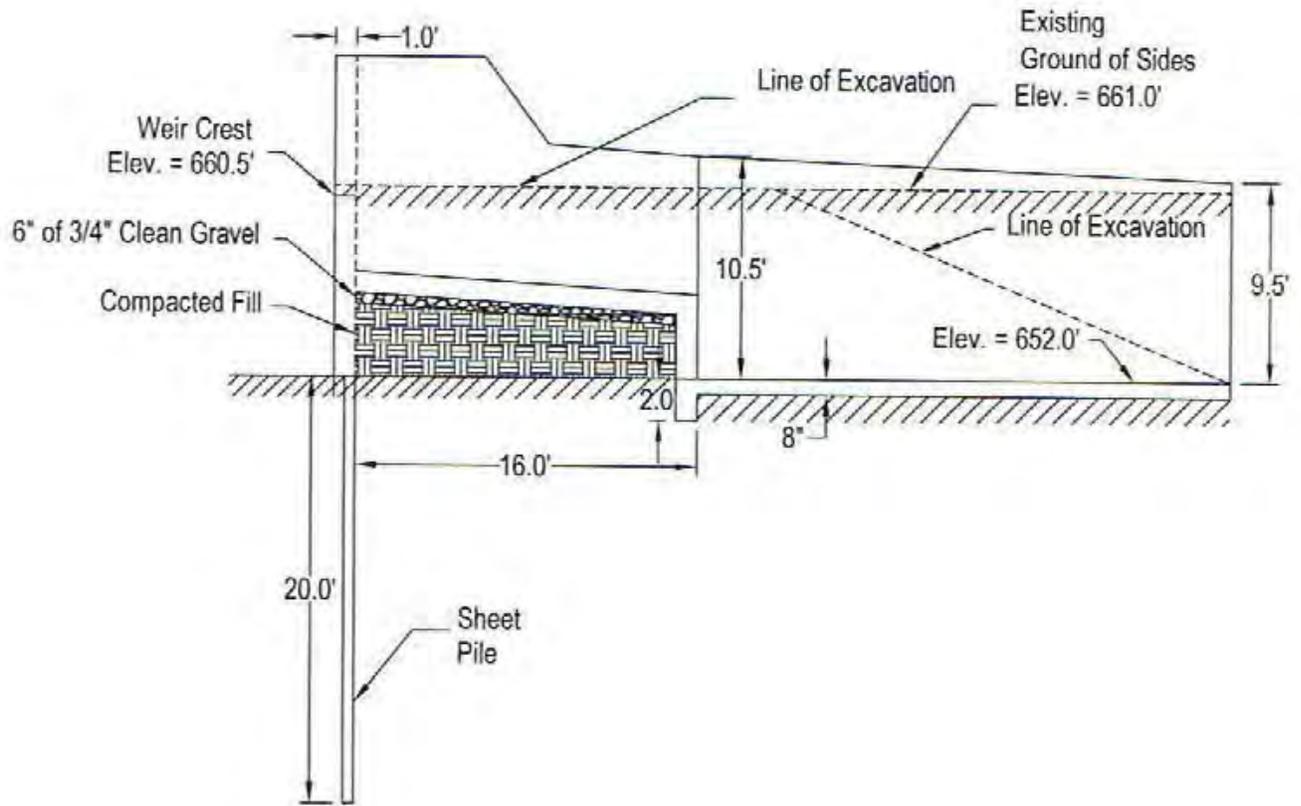


Figure 4-2. Sulphur Creek Wasteway Barrier Designs



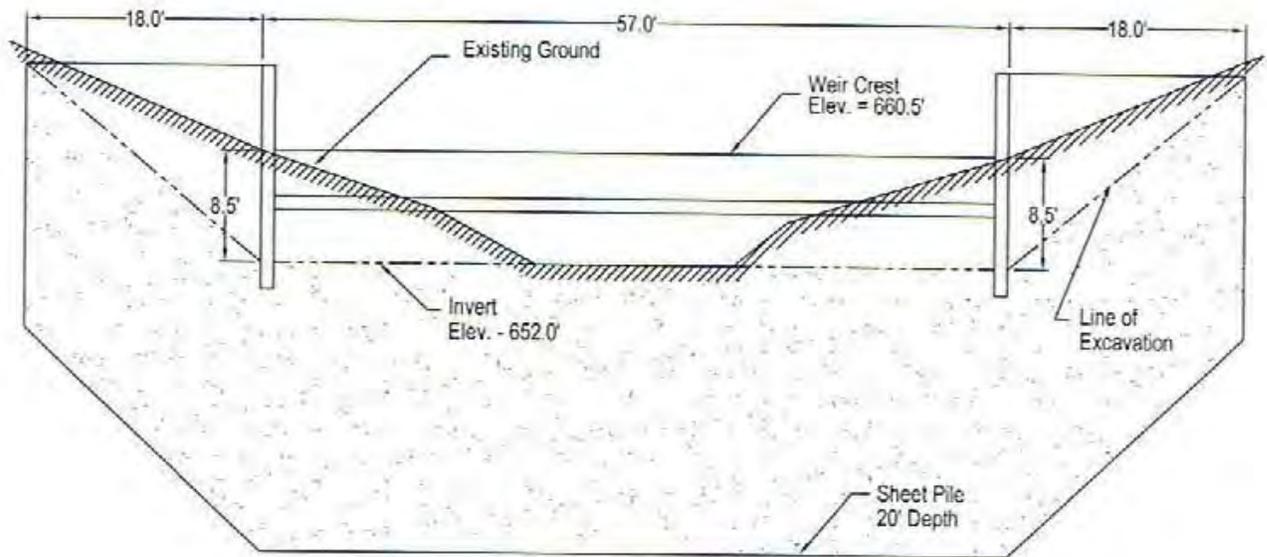
CROSS SECTION A-A



SCALE: 1:96

Figure 4-4. Sulphur Creek Wasteway Barrier Designs

CROSS SECTION B-B



SCALE: 1:156

Figure 4-5. Sulphur Creek Wasteway Barrier Photo



Proposal No. 5A and 5B

Proposals No. 5A & 5B Obermeyer gates across top portion of barrier dam

- Proposal Description: Replace the baseline concept of a barrier dam topped with overshot weir gates, piers, hoists and operator deck with Obermeyer gates. Proposals 5a and 5b are the same except 5a retained the original proposed 10 foot height and 5b is the next size smaller (8 foot height).
- Critical Items to Consider: Consider the loss of the baseline access across top of barrier dam for barrier operations, maintenance or spillway (normal or emergency) releases. Consider issues of eight foot versus ten foot height Obermeyer gates and any ancillary modifications to concrete base structure design to maintain the baseline objectives and performance. Comparison of maintenance issues and costs between baseline and this proposal. Assure that channel flows would not be changed to the detriment of the upstream fish passage facilities or operation.
- Ways to Implement: Implementation for either proposal 5a or 5b would require comparing the maintenance and operational issues and costs with the baseline concept. Implementing a shorter height (5b) would require an assessment of the current configuration of the barrier dam and if any modification needed increases the costs. Basic performance issues would be the same.
- Changes from the Baseline: The baseline proposal has an angled, 298 foot long, fish barrier topped with 25 hinged gates, that would be lifted by a dedicated electrical hoist from elevation 2117.37 to 2127.37 feet and that are operated by an operator via an overhead operator deck. The structural base of the barrier dam would not change unless there were hydraulic issues or needed to accommodate a shorter gate height. The overshot weir gates configuration would be replaced with a continuous series of overlapping, pneumatically-operated Obermeyer gates and would not have an over head operator deck or require any intermediate piers every 10 feet.

Advantages	Disadvantages
<ul style="list-style-type: none"> • No electrical requirements on the barrier structure. However, electric power is required to operate the compressor for the Obermeyer. • Elimination of piers eliminates potential of debris hanging up on barrier dam to obstruct flow or damage structure. • No access deck or equipment to be damaged during spillway discharge. • Reduction in security access or attractive nuisance (i.e. fishing off structure) issues. • Maybe less maintenance costs. • Less obstruction to water flows. • Gates across structure can be raised or lowered simultaneously and in a shorter time frame. • Less mechanical components to fail 	<ul style="list-style-type: none"> • Would not have access across top of barrier dam for any repairs or removal of debris. • Maintenance of gates, hydraulic lines, seals, etc. may require diversion of flows. • Useful life of an Obermeyer would be less than an overshot steel plate weir gate. • Would be more difficult to repair or replace Obermeyer components than the baseline concept.
Potential Risks	
None Identified	
Cost Item	Non-Recurring Costs
Original Baseline Concept	\$9,086,000
Value Concept A	\$8,307,000
Value Concept B	\$7,376,000
Cost Avoidance A	\$779,000
Cost Avoidance B	\$1,710,000

Figure 5-1. Downstream View of Obermeyer Gate



Proposal No. 6

Proposal No. 6. Tunnel Through Right Abutment.

- **Proposal Description:** Tunnel through the right abutment to build downstream passage conduit. The tunnel would daylight near the spillway stilling basin. After the tunnel is excavated, a cast-in-place concrete liner would be constructed and any voids around the concrete conduit would be grouted on 5' intervals.
- **Critical Items to Consider:** The existing spillway is founded on the same glacial till and outwash formation as the baseline conduit alignment. Tunnel excavation techniques were used to build the middle and downstream segments of the existing outlet works and the temporary adit utilized to divert the Cle Elum River during construction of the embankment foundation (refer to Figures 6-1 and 6-2). The adit was plugged (possibly). The tunnels (the adit and the outlet works) show no, or minimal leakage. The estimated cost is derived from a 20-foot diameter bored tunnel, and may be cheaper using a 7' inside-diameter tunnel with a 12" wall thickness. Constant head pressure tests to determine the groutability would be needed. Discussions with Dick Link (PN Regional Geologist) indicate that a well test was performed (with 3 or 4 observation wells) when the outlet works mods were done in the late 1970's. The well test indicated that only small well point dewatering system was necessary. The final construction report should include the information regarding the dewatering system during this work. In addition, the downstream piezometers that were installed for Dam Safety show only minor influence from the reservoir and most fluctuation in the readings appeared to be related to the water level in the stilling basin. From these discussions, it does not appear that dewatering will be much of an issue during the tunneling.
- **Changes from the Baseline:** Instead of using cut-and cover techniques to construct downstream passage conduit through the right abutment, use a tunneling methods. A direct path between the proposed intake structure and spillway stilling basin can be bored for the conduit.

Advantages	Disadvantages
<ul style="list-style-type: none"> • Reduce construction time. • Simplify construction sequence. • Provides flexibility in conduit alignment layout design. • Minimize disturbing impermeable lakebed sediment (Qgi). • Eliminate need to excavate Panama Canal size trench through right abutment. • Greatly reduce disturbing culturally sensitive surface area. • Greatly reduce clearing and grubbing timbered area. 	<ul style="list-style-type: none"> • Potential seepage path. • Performance of tunnel liner grouting. • Grouting quantity is usually an unknown amount and difficult to quantify in the contract. • Cave-ins possible during tunneling. • Large boulders may cause difficulties with tunneling.

Potential Risks

During construction: Cave-ins; encountering a boulder which could delay progress.
Long term: seepage along tunnel concrete liner/soil contact.

Cost Item	Non-Recurring Costs
Original Baseline Concept	\$17,199,000
Value Concept	\$6,178,000
Cost Avoidance	\$11,021,000

Figure 6-1. Photo of Original Construction, Cle Elum Dam

P33-A37YB-2596 Yakima: Cle Elum Dam - adit portal Reclamation photo by R. J. Newell, 10/29/1931.



Figure 6-2. Photo of Original Construction, Cle Elum Dam



P33-A37YB-2701 Yakima, Cle Elum Dam - adit lining, Reclamation photo by Charles G. Anderson, 05/20/1932.

DESIGN ISSUES

1.	The baseline concept was not clear if there was storage location or transportation method planned for the bulkhead gates. This should be considered during the final design process.
2.	The Value Planning team could not determine if there was any security measures planned to protect the intake structure from boat access. This could be accomplished with a log boom or buoy system. This should be considered during the final design process.
3.	The time frame for transporting adult fish from the trap and collection facility should be considered during the design of the access road. This will affect the grading and drainage of the access roads since the transport truck will be extremely heavy.
4.	The baseline concept includes a bathroom, and septic system for the collection facility. However, the Value Planning team was unable to locate the drain field. Due to the terrain, a septic tank that is pumped out periodically may be appropriate.
5.	The estimated cost for the potable water supply may be low. Since it is dependent on the depth of the well, this should be determined during the field investigations.
6.	It was not clear if there was any storage planned for the transport truck. The Value Planning team suggests that enclosing the loading area and installing a roll-up door to allow access. This would protect the truck from the weather and vandalism.
7.	It was not clear how the debris that may collect at the barrier dam would be removed. This debris may typically be smaller material and should flush over the top of the barrier dam and overshot gates, there may be instances of larger debris going over the spillway and becoming lodged in the piers of the barrier dam.
8.	The downstream passage facility includes a trashrack and trash rake, but it was not clear to the Value Planning team how the debris would be removed from the top of the intake structure. This is usually accomplished with a conveyor and truck system, but with the limited access to the intake structure, it was not clear if this would work. This should be considered during the final design process.

Disposition of Ideas

Value Study Elements Considered as Potential Proposals and Their Disposition

Idea	Disposition
Grout the alignment of the conduit before excavating and make the side slopes steeper or vertical.	Not developed due to feasibility. Soil investigations will be performed during final design process.
Tunnel under the spillway and day-light in the stilling basin or in the spillway chute.	Developed into Proposal No. 6.
Moving the discharge point for the downstream passage conduit downstream below the barrier dam during the modeling study.	Referred to the design team for further consideration. The VE team expressed concern regarding the amount of turbulence with the baseline concept discharge point, and moving it downstream could be looked at during the modeling.
Use a non-physical barrier (bubble curtain) instead of overshot gates.	Not developed due to feasibility and reliability.
Move the fish ladder entrance upstream next to the spillway and use the steel spillway section as the barrier dam.	Developed into Proposal No. 1.
Move the upstream passage facility to the right bank and use the downstream conduit flows as the attraction flows.	Included in Proposal No. 1.
Use a catapult to move fish upstream over the dam.	Not developed due to mortality risks.
Train some pelicans to transport fish upstream and downstream.	Not developed into a proposal – pelicans are difficult to train.
Use HDPE trashracks instead of steel.	Developed into Proposal No. 2.
Transport the fish to the reservoir with a conveyor instead of a truck.	Not developed due to feasibility.
Add a power plant on the downstream passage facility, but use fish-friendly turbines.	Not developed due to feasibility and cost.
Use the existing conduit alignment and intake structure but make the last section of conduit (season 2 work) an open channel.	Not developed into a proposal. This would create a substantial amount of waste material.
Eliminate the downstream passage intake and conduit and make the interim passage permanent.	Not developed due to feasibility and the short window of operation.
Move the intake structure closer to the shoreline, dig an approach channel and eliminate the cofferdam.	Developed into Proposal No. 3.
Use HDPE pipe for the downstream passage conduit.	Not developed due to feasibility. Compaction of backfill about a circular conduit is more difficult.
Tunnel through the left abutment (or “saddle dike”) for the downstream passage instead of cutting around the right abutment.	Not developed due to feasibility and cost.
Make the downstream passage conduit a straight section of pipe – eliminate the bend.	Not developed due to feasibility and cost – this would substantially increase the length of the pipe.
Replace the trap and haul with a long fish ladder.	Not developed due to feasibility and functionality.
Use a denil type of fish ladder instead of trap and haul.	Not developed due to feasibility.
Put the ladder on the right abutment and use the flows from the downstream passage as the attraction flows.	Not developed due to feasibility.
Use trap and haul (barge) for the downstream passage instead of intake and conduit.	Not developed into a proposal. This was an option in the original concept and rejected in preference of the selected baseline concept.

Disposition of Ideas

Value Study Elements Considered as Potential Proposals and Their Disposition

Idea	Disposition
Build a garage for the transport truck, or enclose the loading station at the collection facility to protect the truck.	Referred to the design team for further consideration.
Sell the timber that is removed during excavation.	Not developed into a proposal. This would be the responsibility of the Forest Service and not Reclamation.
Cut a channel from the river to the lake to provide passage.	Not developed due to feasibility and cost.
Use the existing alignment – replace conduit with gated canal.	Not developed due to feasibility.
Make the concrete pipe thinner.	Not developed due to feasibility – this would require a structural analysis, and should be done during final design.
Construct the barrier dam with an angled concrete wall instead of overshot gates.	Developed into Proposal No. 4.
Use a picket weir instead of the barrier dam.	Not developed due to feasibility.
Move the upstream passage facility downstream.	Not developed due to feasibility and cost.
Make the intake structure floatable so it can move up and down with the reservoir.	Not developed due to feasibility.
Use an inflatable dam instead of the overshot gates for the barrier dam.	Developed into Proposal No. 5.
Construct the fish passage facilities concurrently with SOD work.	Not developed into a proposal – there is no SOD work planned.
Put the downstream passage facility through one of the saddle dikes.	Not developed due to feasibility and cost.
Put the downstream passage conduit in the existing outlet works tunnel.	This was included in the original options and is referred back to the design team for re-consideration.
Remove the maximum section of the dam and re-construct it with the downstream passage conduit in place.	Not developed due to feasibility and cost.
Incorporate the downstream passage into the existing spillway – notch 1 bay of the spillway at location of interim passage.	Not developed due to feasibility.
Shore the excavation instead of making side slopes 3:1.	Not developed into a proposal – 75 feet maximum excavation may be too deep for shoring.
Use direction drilling instead of open cut for the downstream passage conduit.	Not developed due to feasibility.
Use a tunnel boring machine (TBM) instead of open cut for the downstream passage conduit.	Included in Proposal No. 6.
Jack the downstream passage conduit instead of open cut.	Not developed due to feasibility.
Use a siphon for the downstream passage conduit.	Not developed due to feasibility.
Use a fish elevator or escalator for the upstream passage.	Not developed due to feasibility and cost.
Use pre-cast/pre-stressed pipe for the downstream passage conduit instead of cast-in-place.	Not developed due to feasibility.

List of Consultants

Consultant or Contact	Topic or Information
Steve Montague, Civil Engineer, Bureau of Reclamation (208) 378-5074.	General project information.
Eugene Humbles, Civil Engineer, Bureau of Reclamation (208) 378-5	General upstream passage information.
Rob Eckman, Obermeyer Hydro, Inc. (970) 568-9844	Information on Obermeyer gates.
Scott Willey, Biologist, Bureau of Reclamation (509) 575-5848	Information on Sulphur Creek Wasteway.
Dick Link, Regional Geologist, Bureau of Reclamation, PN-3600 (208) 378-5230	Information on dewatering during previous work on Cle Elum Dam outlet works.

Data and Documents Consulted

Title, Author, and Date	Information
Cle Elum and Bumping Lake Dams Fish Passage Facilities Planning Report, Bureau of Reclamation, September 2008	General project information.
Reclamation Project Data, Bureau of Reclamation, December 8, 1948.	General information on original dam.
Cle Elum Construction Photographs (1929 – 1933), Bureau of Reclamation	General project and construction information.
RS Means Facilities Construction Cost Data, 23rd Edition	General cost information.
RS Means Heavy Construction Cost Data, 22 nd edition	General cost information.

Design Team Presentation Attendance List June 8, 2009

Name/Title/Discipline	Address/Phone Number
	Bureau of Reclamation, PN-3239 1150 N. Curtis Road, Suite 100, Boise ID 83706-1234 Phone: 208-378-5242 FAX: 208-378-5205 Email: kkramer@usbr.gov
Eduardo Lopez-Owsley Civil Engineer Team Member	Bureau of Reclamation, PN-3512 1150 N. Curtis Road, Suite 100, Boise ID 83706-1234 Phone: 208-378-5186 FAX: 208-378-5305 Email: elopez@usbr.gov
Jack Touseull Civil Engineer Team Member	Bureau of Reclamation, 86-68312 PO Box 25007, Denver CO 80225-0007 Phone: 303-445-2346 FAX: 303-445-6472 Email: jtouseull@usbr.gov
Dale Lentz Civil Engineer Team Member	Bureau of Reclamation, 86-68460 PO Box 25007, Denver CO 80225 Phone: 303-445-2143 FAX: 303-445-6324 Email: dlentz@usbr.gov
Don Stelma Geologist Team Member	Bureau of Reclamation, 1375 SE Wilson Ave, Suite 200, Bend OR 97702 Phone: 541-389-0233 FAX: 541-389-6394 Email dstelma@usbr.gov
Brian Saluskin Biologist Team Member	Yakama Nation, 800 Spring Chinook Way, PO Box 836, Cle Elum WA 98922 Phone: 509-945-6701 FAX: 509-674-1940 Email: passagebio@qwestoffice.net
Dave Child Biologist Team Member	Yakima Basin Joint Board, DC Consulting LLC 2807 W. Washington Ave., Yakima, WA 98903 Phone: 509-607-1396 FAX: 509-965-1675 Email: dcconsult@dreamflyfishing.com
Joel Hubble Biologist Team Member	Bureau of Reclamation, CCA-1121 1917 Marsh Road, Yakima WA 98901 Phone: 509-575-5848 x371 FAX: 509-575-5847 Email: jhubble@usbr.gov
Wendy Christensen Technical Projects Manager	Bureau of Reclamation, CCA-1100 1917 Marsh Road, Yakima WA 98901 Phone: 509-575-5848 x203 FAX: 509-575-5847 Email: gchristensen@usbr.gov
Elizabeth Heether Clerical Assistant	Bureau of Reclamation, CCA-1124 1917 Marsh Road, Yakima WA 98901 Phone: 509-575-5848 x341 FAX: 509-575-5847 Email: Eheether@usbr.gov

Design Team Presentation Attendance List June 8, 2009

Name/Title/Discipline	Address/Phone Number
Candy McKinley Environmental Protection Specialist	Bureau of Reclamation, CCA-1608 1917 Marsh Road, Yakima WA 98901 Phone: 509-575-5848 x276 FAX: 509-454-5611 Email: cmckinley@usbr.gov
Lynn Holt Technical Writer	Bureau of Reclamation, CCA-1123 1917 Marsh Road, Yakima WA 98901 Phone: 509-575-5848 x372 FAX: 509-454-5612 Email: lholt@usbr.gov
Steve Montague Civil Engineer	Bureau of Reclamation, PN-3440 1150 N. Curtis Road, Suite 100, Boise ID 83706-1234 Phone: 208-378-5074 FAX: 208-378-5171 Email: smontague@usbr.gov
Duane Dobbs Dam Tender	Bureau of Reclamation, YAK-5109 1917 Marsh Road, Yakima WA 98901 Phone: 509-649-2770 FAX: 509-649-2271 Email: ddobbs@usbr.gov

Value Study Team Presentation Attendance List

June 12, 2009

Name/Title/Discipline	Address/Phone Number
	Bureau of Reclamation, PN-3239 1150 N. Curtis Road, Suite 100, Boise ID 83706-1234 Phone: 208-378-5242 FAX: 208-378-5205 Email: kkramer@usbr.gov
Eduardo Lopez-Owsley Civil Engineer Team Member	Bureau of Reclamation, PN-3512 1150 N. Curtis Road, Suite 100, Boise ID 83706-1234 Phone: 208-378-5186 FAX: 208-378-5305 Email: elopez@usbr.gov
Jack Touseull Civil Engineer Team Member	Bureau of Reclamation, 86-68312 PO Box 25007, Denver CO 80225-0007 Phone: 303-445-2346 FAX: 303-445-6472 Email: jtouseull@usbr.gov
Dale Lentz Civil Engineer Team Member	Bureau of Reclamation, 86-68460 PO Box 25007, Denver CO 80225 Phone: 303-445-2143 FAX: 303-445-6324 Email: dlentz@usbr.gov
Tony Hargroves Maintenance Supervisor Team Member	Bureau of Reclamation, YAK-5410 1917 Marsh Road, Yakima WA 98901 Phone: 509-575-5848 x245 FAX: 509-454-5612 Email: thargroves@usbr.gov
Don Stelma Geologist Team Member	Bureau of Reclamation, 1375 SE Wilson Ave, Suite 200, Bend OR 97702 Phone: 541-389-0233 FAX: 541-389-6394 Email dstelma@usbr.gov
Brian Saluskin Biologist Team Member	Yakama Nation, 800 Spring Chinook Way, PO Box 836, Cle Elum WA 98922 Phone: 509-945-6701 FAX: 509-674-1940 Email: passagebio@qwestoffice.net
Joel Hubble Biologist Team Member	Bureau of Reclamation, CCA-1121 1917 Marsh Road, Yakima WA 98901 Phone: 509-575-5848 x371 FAX: 509-575-5847 Email: jhubble@usbr.gov
Wendy Christensen Technical Projects Manager	Bureau of Reclamation, CCA-1100 1917 Marsh Road, Yakima WA 98901 Phone: 509-575-5848 x203 FAX: 509-575-5857 Email: gchristensen@usbr.gov
Elizabeth Heether Clerical Assistant	Bureau of Reclamation, CCA-1124 1917 Marsh Road, Yakima WA 98901 Phone: 509-575-5848 x341 FAX: 509-575-5847 Email: Eheether@usbr.gov
Candy McKinley Environmental Protection Specialist	Bureau of Reclamation, CCA-1608 1917 Marsh Road, Yakima WA 98901 Phone: 509-575-5848 x276 FAX: 509-454-5611 Email: cmckinley@usbr.gov

Value Study Team Presentation Attendance List

June 12, 2009

Name/Title/Discipline	Address/Phone Number
Lynn Holt Technical Writer	Bureau of Reclamation, CCA-1123 1917 Marsh Road, Yakima WA 98901 Phone: 509-575-5848 x372 FAX: 509-454-5612 Email: lholt@usbr.gov
Steve Montague Civil Engineer	Bureau of Reclamation, PN-3440 1150 N. Curtis Road, Suite 100, Boise ID 83706-1234 Phone: 208-378-5074 FAX: 208-378-5171 Email: smontague@usbr.gov
Jerry Kelso Area Manager	Bureau of Reclamation, CCA-1000 1917 Marsh Road, Yakima WA 98901 Phone: 509-575-5848 x202 FAX: 509-454-5611 Email: gkelso@usbr.gov
	Bureau of Reclamation, YAK-5700 1917 Marsh Road, Yakima WA 98901 Phone: 509-575-5848 x209 FAX: 509-454-5611 Email: wlarrick@usbr.gov
Scott Kline	Bureau of Reclamation, YAK-5003 1917 Marsh Road, Yakima WA 98901 Phone: 509-575-5848 x277 FAX: 509-454-5612 Email: skline@usbr.gov
Dawn Wiedmeier Deputy Area Manager	Bureau of Reclamation, YAK-5000 1917 Marsh Road, Yakima WA 98901 Phone: 509-575-5848 x213 FAX: 509-454-5612 Email: dwiedmeier@usbr.gov
Elizabeth Cohen Civil Engineer	Bureau of Reclamation, 86-68130 PO Box 25007, Denver CO 80225-0007 Phone: 303-445-3247 FAX: 303-445-6490 Email: bcohen@usbr.gov
Dave Gillette Geotechnical Engineer	Bureau of Reclamation, 86-68313 PO Box 25007, Denver CO 80225-0007 Phone: 303-445-2994 FAX: 303-445-6472 Email: dgillette@usbr.gov
Leslie Hanna Hydraulic Engineer	Bureau of Reclamation, 86-68460 PO Box 25007, Denver CO 80225-0007 Phone: 303-445-2146 FAX: 303-445-6324 Email: lhanna@usbr.gov
Kathy Frizell Research Hydraulic Engineer	Bureau of Reclamation, 86-68460 PO Box 25007, Denver CO 80225-0007 Phone: 303-445-2144 FAX: 303-445-6324 Email: khfrizell@usbr.gov
Eugene Humbles Civil Engineer	Bureau of Reclamation, PN-3414 1150 N. Curtis Road, Suite 100, Boise ID 83706-1234 Phone: 208-378-5252 FAX: 208-378-5171 Email: ehumbles@usbr.gov

Value Study Team Presentation Attendance List
June 12, 2009

Name/Title/Discipline	Address/Phone Number
	National Marine Fisheries Service (NMFS) 509-534-9338
John Easterbrooks	Washington Department of Fish and Wildlife 509-457-9330
Bruce Heiner	Washington Department of Fish and Wildlife 509-332-0892
David Fast	Yakama Nation 509-945-1206
Tom Ring	Yakama Nation 509-865-4946