Submitted to:
U.S. Army Corps of Engineers
Portland District
Portland, OR

Submitted by:
AECOM
Redmond, WA
60148335.401
June 2010

Willamette Downstream Fish Passage Design Requirements Report

Final Submittal

Contract W9127N-10-D-0002, T.O. 003

(Photos courtesy of Bonneville Power Administration)

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Executive Summary

Purpose

The National Marine Fisheries Service (NMFS) 2008 Willamette Biological Opinion (BiOp) describes several downstream fish passage Reasonable and Prudent Alternative (RPA) measures that need to be evaluated and implemented within the next 15 years. NMFS considers these measures essential to recovery of Endangered Species Act (ESA) listed fish in the Willamette basin.

The RPA measures require assessment and implementation of interim downstream fish passage operations and construction of facilities at certain dams. Lookout Point Dam is identified in the RPA measures as a priority for investigation of head-of-reservoir collection, with a construction completion date of December 2021. Cougar Dam is also identified as a priority, with a construction completion date of December 2014. Currently, there are known data gaps and uncertainties for design and implementation of fish passage/collection systems at Cougar and Lookout Point dams and the other Willamette Valley high-head dams.

The purpose of this report is to compile and synthesize the knowledge base regarding downstream juvenile migrant passage at high-head dams and present relevant facilities or components that are applicable to the Willamette Projects as well as identify critical research, monitoring and evaluation needed to design effective fish passage. The intent is to provide design requirements for use in the development of the required passage facilities.

Process

The literature search focused on downstream passage systems at high-head dams in the Northwest but did not exclude lower head facilities or those located outside of the identified region that were relevant systems or had relevant components. Successful facilities, failed facilities, and designs that never made it past a conceptual stage were all captured and analyzed. This report presents projects that have dealt with the issues presented by high-head downstream fish passage or have components that would be applicable as potential solutions to those problems. Relevant projects are grouped by location of applicability in the reservoir system, i.e. in-tributary, in-reservoir, at-dam. Also presented are several facilities that had specialized features that the authors felt warranted inclusion, as they presented unique solutions to problems that will be encountered in developing downstream passage at Willamette Projects. The projects captured in this review, organized by location and identified by owner are:

<u>In-Tributary Systems</u>

- Leaburg Diversion – Eugene Water and Electric Board
- Cowlitz Riverine Collector Concept – Tacoma Power
- Cougar In-Tributary Concept – USACE, Portland District
- Wapato Irrigation Diversion – Yakama Indian Nation
- Upper Swift Juvenile Collector Concept – PacifiCorp
- Willamette Falls Hydroelectric Project – Portland General Electric

In-Reservoir Systems

- Upper Baker – Puget Sound Energy
- Cougar Mid-Reservoir Concept – USACE, Portland District

At-Dam Systems

- Carmen-Smith Hydropower Project – Eugene Water and Electric Board
- Round Butte Selective Water Withdrawal and Fish Collection Facility – Portland General Electric
- Cougar Dam Abandoned Fish Collection Facility – USACE, Portland District
- Green Peter Abandoned Fish Collection Facility – USACE, Portland District
- Fall Creek Abandoned Fish Collection Facility – USACE, Portland District
- Howard Hanson Design – USACE, Seattle District

Specialized Features from Selected Projects

- Bonneville 2nd Powerhouse Corner Collector – USACE, Portland District
- Round Butte Abandoned Fish Collection Facility – Portland General Electric
- North Fork and River Mill Bypass System – Portland General Electric
- White River: Lake Tapps Diversion – Cascade Water Alliance (formerly owned by Puget Sound Energy)

Each project is presented in Section 3, outlining the physical features of the facility, which components are applicable and the biological performance. A detailed profile for each project is also found in Appendix A. The in-depth profiles capture an extensive list of physical and biological parameters including description of involved components and facility biological performance results.

Analysis of Collection Strategies to Meet Biological Objectives

Collection strategies were analyzed in terms of: type of collector, location where it could be employed, whether the collector type is predicted to be effective at collecting two juvenile life stages (fry and smolts), and if at that location, it must accommodate upstream passage of anadromous adults or resident fish species. The analysis drew upon examples from the profiled projects, where possible, for each of the location and collector type strategies. In general, these systems have been evaluated for their ability to collect actively migrating smolts, the life stage used in most evaluations of performance. As a consequence there is a poor understanding of how efficient these collectors are, or might be, for collecting a relatively non-migratory life stage such as fry. The life stage targeted for collection will likely determine which strategy (in-reservoir or in-tributary) is implemented at the projects.

The in-tributary strategy focuses on the collection of fish before they enter the reservoir. Some reservoirs are known to have high predator populations that reduce juvenile survival rates and eventual adult production. Data collected at multiple Willamette Projects show that the fish population entering reservoirs is composed primarily of smaller fish (<60 mm). Smaller fish are more susceptible to injury and mortality from collection, handling, transport and release than fish of greater size. In addition, smaller fish have lower juvenile-to-adult survival rates than larger fish. The in-tributary strategy achieves the primary objective (maximize adult production) by assuming the decreased survival rates associated with collection and fish size can be overcome by capturing the maximum number of juveniles possible. Proposed facilities therefore need to be sized to handle large numbers of smaller fish.

In contrast, the in-reservoir strategy takes the approach that juvenile losses associated with entry into, and passage through, the reservoir are acceptable given the expected benefits of allowing juveniles to rear in this environment. The two primary benefits are that larger fish size at migration (80- 160 mm) may increase life-history diversity, and be less susceptible to injury and mortality associated with collection, handling and transport than the smaller fish caught in-tributary. Passage facilities need to be sized to handle smaller numbers of larger fish if an in-reservoir strategy is selected.

Fish Collection Issues and Solutions Applicable to the Willamette Projects

The physical and operational characteristics of dams in the Willamette system provide a unique suite of design challenges to be overcome in delivering the desired performance. The challenges vary with the fish collection system location, i.e. in-tributary, head-of-reservoir, mid-reservoir, forebay, and at-dam and the specific components of the system, i.e. guidance, collection, dewatering, bypass/conveyance, and outfall/release.

- In-tributary location designs must primarily deal with the issues associated with a flashy (highly variable) in-flow hydrograph. Secondarily, they need to provide upstream fish passage and address the distance that fish must be conveyed to reach a release facility, even if release is to be made in the river immediately below the dam.
- Head-of-reservoir facilities must overcome the most design obstacles of any location: hydrograph, upstream fish passage, distance from collection to release location, and impact of range and rate of reservoir elevation change both on water level and longitudinal location of the head-of-reservoir.
- Mid-reservoir locations deal with the impacts of range and rate of reservoir elevation change on guidance, collection and bypass/conveyance, the impact of total project head on bypass/conveyance and release, and the added complication of upstream fish passage.
- Forebay, and at-dam locations deal only with the impacts of range of reservoir water level on guidance, collection and bypass, and the impact of total project head on bypass and release.

In all likelihood, as a result of the number of design issues associated with the in-tributary and head-of-reservoir locations, we found only conceptual designs, no operating examples of these types of systems. The only applicable technology from existing facilities we found for in-tributary systems were not from fish collection systems, but from exclusion systems intended to prevent fish from entering power intake or irrigation canals.

Two full scale production facilities at Upper Baker and Round Butte Dams, with a high level of applicability to the Willamette Projects have recently come online. The success of the Upper Baker Floating Surface Collector (FSC) has spawned several very similar designs that are being implemented currently (Lower Baker, Swift).

While the lessons learned from projects that have been implemented successfully are valuable, we may also learn valuable lessons from the concepts or alternatives that haven't been selected for construction as well as the facilities that have been abandoned because of performance deficiencies. For example, concern over debris impacts and inability to capture all downstream migrants during peak flow events at in-tributary facilities has prevented any of these concepts from being implemented. The debris concern emphasizes the need to include capability to deal with heavy debris and sediment load in designs. The biological performance concern points out the need to clearly define biological performance goals prior to the design process.

While none of the facilities profiled can be directly applied to the Willamette Projects, the successes and failures experienced in the process of each design provide an excellent road map to help direct the Willamette effort. Each project's specific site physical (available land, utilities, road access, etc) and biological (life stage, reservoir rearing, temperature control, goals, etc) parameters will determine what of the features brought forward in this report are applicable. Many of the features will be directly applicable while others will need to be modified.

Some of the key design features that will be applicable to the Willamette Projects, organized by facility location include:

In-tributary:

- Guidance – Inflatable dams with traditional ladders for upstream passage
- Collection – Off-channel collector locations with trash boom and trash rack protection, rock chutes, and sediment settling basins
- Dewatering – V-screens
- Bypass/Conveyance/Release – Truck transport or long pipeline

In-reservoir:

- Guidance – Partial or full exclusionary nets
- Collection – Pumped FSC or gulper
- Dewatering – V-screens
- Bypass/Conveyance/Release – Truck transport or long pipeline

At-dam:

- Guidance – Fish concentrating flow pattern and behavioral guidance structure (BGS)
- Collection – Multi-level collection intakes or floating collection entrances
- Dewatering – V-screens
- Bypass/Conveyance/Release – Pumping and crane lift hoppers to truck transport, fish collection well and brail with crane lift of hoppers to truck transport, long pipeline, or controlled release fish elevator pipe

Data Gaps for Cougar and Lookout Point Dams

A list of physical data (bathymetric, geotechnical, hydrologic, hydraulic and existing structure designs, etc.), project operations information, and biological data (species, run timing, migration routes, reservoir survival, etc.) that is needed to design and evaluate passage alternatives was compiled during the course of the literature review. Due to their high priority and short deadlines, available data for the Cougar downstream passage project and Lookout Point head of reservoir prototype project were compared to the list, data gaps identified, and studies recommended to fill the gaps.

Similar biological data gaps were identified for both projects. Data are needed to determine whether in-tributary or in-reservoir juvenile collection is the most appropriate strategy for achieving biological objectives.

High priority recommendations for physical studies were identified as follows:

<u>Cougar Dam</u>

- Forebay CFD modeling to examine 3-D circulation patterns in the forebay and tower cul-de-sac regions to guide design orientation of a collector and any guidance enhancing devices

<u>Lookout Point Dam</u>

- Tributary bathymetric cross section survey and river hydraulic modeling to determine potential flood impacts of collectors at in-tributary locations

High priority recommendations for biological studies were identified as follows:

<u>Cougar Dam</u>

- Juvenile to adult survival study

<u>Lookout Point Dam</u>

- Juvenile to adult survival study
- Juvenile migration timing, size and abundance at head of reservoir

1.0 Introduction

1.1 Project Background

The Willamette Project consists of 13 multipurpose dams, shown in Figure 1-1, five fish hatcheries, and approximately 42 miles of revetments in western Oregon's Willamette River basin. The U.S. Army Corps of Engineers (USACE) operates and maintains the dams and revetments, the Bonneville Power Administration (BPA) markets the hydropower generated at the dams, and the U.S. Bureau of Reclamation (USBR) sells a portion of the water stored in project reservoirs for irrigation. The Willamette Project adversely affects Upper Willamette River Chinook and Upper Willamette River steelhead by blocking access to a large amount of their historical habitat upstream of the dams and by contributing to degradation of their remaining downstream habitat (NMFS 2008c). The three federal "Action Agencies" named above have consulted with National Marine Fisheries Service (NMFS) on the effects of the configuration, operation, and maintenance of the Willamette Project on aquatic species listed under the Endangered Species Act (ESA) and proposed measures in their Proposed Action Plan to address these effects. In their 2008 Willamette Biological Opinion (BiOp), NMFS (2008c) presents a Reasonable and Prudent Alternative (RPA) with additional measures which, combined with the Proposed Action, NMFS considers essential to allow for survival of the species with an adequate potential for recovery, and avoid destruction or modification of critical habitat. The RPA includes short- and long-term measures for fish passage, water quality, flows, water contracts, habitat enhancement, and hatcheries, as well as related coordination studies and monitoring. Specific short-term RPA measures include providing passage at three dams and temperature control at another, adjustments to downstream flows, improving water quality, improving hatchery practices, screening irrigation diversions, and conducting habitat mitigation. The U.S. Fish and Wildlife Service (USFWS) also published a Willamette BiOp (USFWS 2008) that considered the Action Agencies' proposed action, as modified by the NMFS' RPA, as the proposed action for its analysis.

The dams targeted for downstream fish passage facilities to safely pass emigrating Chinook salmon in the Willamette Project, with the specified implementation dates are: Cougar Dam by 2014 (RPA measure 4.12.1); Lookout Point Dam by 2021 (RPA measure 4.12.2) ; and Detroit Dam by 2023 (RPA measure 4.12.3) (NMFS 2008c). As a first priority, assessment and implementation of interim downstream passage facilities is identified at certain dams with a decision required on feasibility of a prototype head of reservoir collection system at either Lookout Point Dam or Foster Dam by the end of 2010 (RPA measure 4.9). A decision on feasibility of implementing a permanent downstream passage system at Cougar Dam is also required by the end of 2010 (RPA measure 4.12.1). Design of passage facilities will consider listed anadromous fish in the Willamette basin, bull trout, listed by USFWS, as well as other resident fish and Pacific lamprey.

While successful technologies have been developed and implemented for downstream fish collection and passage at dams throughout the Columbia and Snake River basins as described by ENSR/AECOM et. al. (2007), these applications were for the most part at run of river projects with low to moderate heads (40 to 120 ft) and reservoir pool operating ranges of a few feet. Determining feasibility of, and designing for, downstream fish passage at many of the Willamette Project dams presents a much greater challenge because the heads are much higher (250 ft at Lookout Point to 450 ft at Cougar and Detroit) and the reservoirs are operated for irrigation storage and flood control over a much broader pool range (a maximum of 115 ft at Lookout Point to 183 ft at Cougar).

Figure 1-1 Willamette Basin Map (Courtesy of USACE)

1.2 Objectives

The USACE, Portland District required basic information to provide a foundation for the studies of feasibility of downstream fish passage for the Willamette Project dams and to provide a basis for subsequent design activities if the passage systems were deemed feasible. This Willamette Downstream Fish Passage Design Requirements Report satisfies that need by meeting the following objectives stated in the scope of work:

- Gain a thorough understanding of the current technology and challenges related to downstream high-head dam fish passage.
- Identify critical research, monitoring, and evaluation needed to design effective fish passage at Cougar and Lookout Point dams.

1.3 Study Approach and Report Organization

The report objectives were met by performing a literature review of a selection of previously designed passage systems and synthesizing and analyzing the information obtained.

The basic information required for design of a fish passage project is presented in Chapter 2. The descriptions provided in this chapter were developed by: considering a conceptual model for how a fish passage system is developed, listing the biological and physical information required, and presenting the timeframe typically required for development, with supporting timelines from existing projects, several of which are profiled.

Chapter 3 summarizes pertinent information for the reference projects profiled in detail in Appendix A. It should be noted that not all of the reference projects fit the description of high-head dam fish passage systems, as systems applicable to in-tributary locations and components of systems that may be applicable to high-head dams may be found in lower-head systems.

In Chapter 4 we analyze and synthesize the information from the project profiles so common design challenges and the corresponding design features and approaches can be identified. Recommendations concerning the transportability of these design features to the Willamette Project dams are made.

The biological and physical information available for Cougar and Lookout dams are reviewed in Chapter 5 in a tabular format that allows an easy assessment of suitability of the information available to identify data gaps. Recommendations are made for additional studies to acquire baseline biological and physical data upon which designs may be based.

Finally, Chapter 6 presents the list of references used in preparing this report.

Notes from the project progress review meetings are included in Appendix B and the review comments, with evaluations and back checks, of the 30 and 90 percent submittals are included in Appendix C.

1.4 Collector Terminology

In our analysis, we have found it useful to use a consistent set of definitions for the various locations that collectors may be situated in the reservoir/dam complex and for the different components that comprise a fish collection system. The following sections provide these definitions.

1.4.1 Location

The following locations are shown schematically in Figure 1-2.

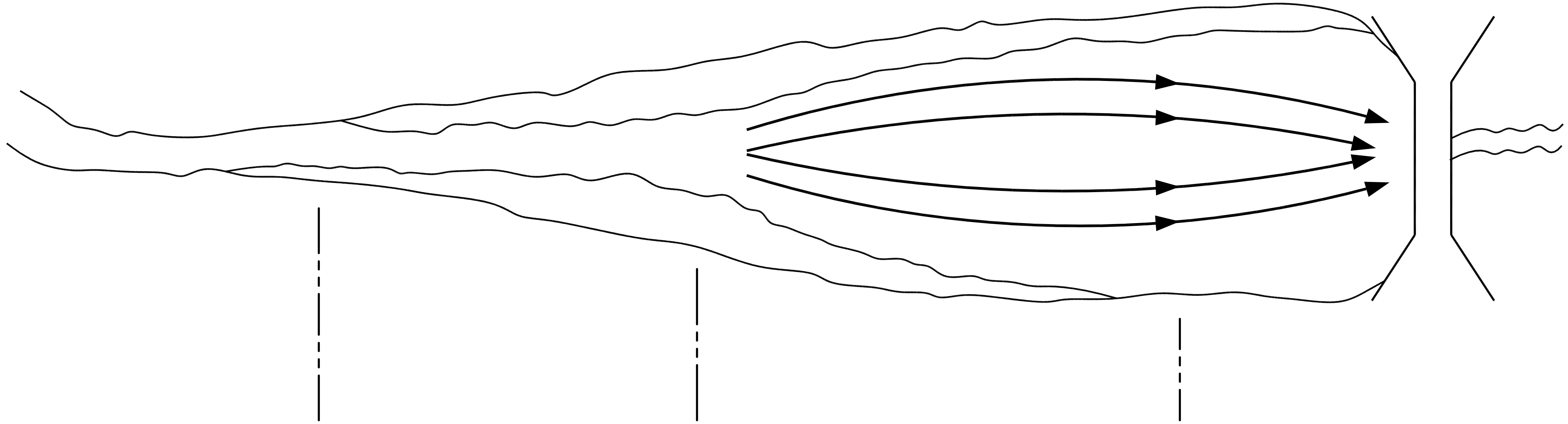
In-tributary locations are located upstream from the backwater influences of the reservoir, i.e. where water level is a function only of the tributary flow rate and are not influenced by the variation in the downstream reservoir water level.

- In-stream refers to the location of an in-tributary collector entrance and dewatering system within the bank-to-bank width of the tributary stream.
- Off-channel refers to the location of an in-tributary collector entrance and dewatering system outside of the bank-to-bank width of the tributary stream, i.e. in a side channel or over-bank location.

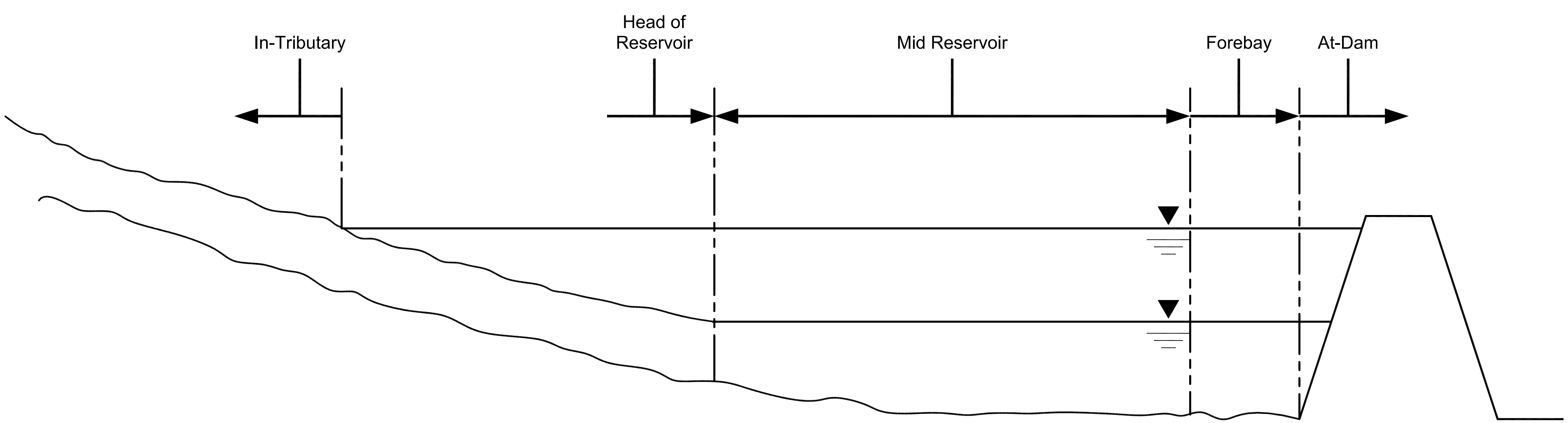
In-reservoir collectors are located downstream from the tributary, where the water level is directly controlled by reservoir operations.

- Head-of-reservoir is defined as the furthest upstream location where the water level is directly controlled by the reservoir operations. This location will vary longitudinally along the river thalweg, depending on reservoir level. For site selection for a fixed location collector, head of reservoir is defined by the lowest reservoir level at which the collector must function.
- Mid-reservoir extends from the most downstream head-of-reservoir location described above to the forebay.
- Forebay locations are where the proximity to the dam discharge facilities (turbine intakes, spillways, and regulating outlet intakes) causes the flow field to be affected by facility operations.

At-dam collectors are physically connected to the dam facilities.



Plan View
(NTS)



Profile
(NTS)

REVISIONS			
NO:	DESCRIPTION:	DATE:	BY:

DESIGNED BY: CS
DRAWN BY: CS/KM
CHECKED BY: IW
APPROVED BY: CS

ENVIRONMENT
9521 WILLOWS ROAD NE
REDMOND, WASHINGTON 98052
PHONE: (425) 881-7700
FAX: (425) 883-4473
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COLLECTOR LOCATION DEFINITIONS

Willamette Downstream Fish Passage Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

SCALE: Not to Scale
DATE: 06/09/10
PROJECT NUMBER: 60148335-403

FIGURE NUMBER: 1–2

FILENAME: 1–2 RB–Col–Def

1.4.2 Components

The following define the different components of a fish collection system by function.

Guidance refers to the means of guiding fish to the collector entrance, i.e. by funneling all flow to the collector, such as the function of a diversion dam for an in-tributary collector, through the use of exclusion nets in-reservoir, or behaviorally by providing an attractive hydraulic field or other means at-dam.

Collection is the physical arrangement of the collection system that provides collection flow to bring fish into the structure, i.e. a pump-driven floating surface collector.

Dewatering is the means of reducing the fish-laden collection flow to a manageable level for fish handling, enumeration, sorting, bypass, and conveyance, i.e. a v-screen designed to meet NMFS (2008a) criteria.

Bypass/Conveyance is the means of transporting collected fish to the release point in the downstream river system, i.e. a flume, pipe, truck transport, etc.

Outfall/Release describes the way fish are re-introduced to the downstream river system, i.e. through plunging flow from an outfall pipe.

1.5 Acknowledgements

USACE, Portland District contracted AECOM to prepare this report under Contract No. W9127N-10-D-0002, Task Order No. 003. Biological consulting services were provided by BioAnalysts through a subcontract to AECOM.

We would like to acknowledge USACE, Portland District staff members: Liza Roy, P.E., Technical Lead; Dave Griffith, Project Biologist; and Chris Budai, Project Manager for their valuable assistance and input.

2.0 Design Requirements

2.1 Fish Passage Development

NMFS (2008a) has published criteria and guidelines for the design of fish collection and passage facilities. In that document, they present the typical design development phases as reconnaissance study, conceptual alternatives study, feasibility study, preliminary design, and detailed design. While this somewhat linear succession of phases may hold true for design of facilities for which there are precedents and a clear path, the design of many fish facilities, especially those in challenging settings like the Willamette Project, may be better envisioned in a process flowchart in which there are intermediate decision points at which the risk of proceeding is assessed. At each of these decision points, the primary question asked is, “Do we have enough information to proceed?” If not, the best decision may be to regroup and acquire the missing information. In the case of a fish collection facility, there may still be enough unknown after a design is developed that the prudent next step is to build a prototype or test facility to assess performance rather than making the investment in a permanent “production” facility. This process is illustrated in Figure 2-1. In the process described in the figure, the reconnaissance, conceptual alternatives, and feasibility study phases are collapsed under preparation and conceptual design study (Alternative Study). The preliminary and detailed design phases are collapsed under either prototype or production system design (Design Documentation Report [DDR] and Plans and Specifications).

A summary of completed or in-progress project development schedules are presented in Table 2-1. The generic schedule listed was created based on the authors’ best judgment in the context of an accelerated schedule and is not based on a specific project. The generic time frame is founded on the assumption that the majority of the biological information needed for design work is in hand or will be completed shortly. Experience with duration of development for similar projects, summarized in Table 2-1, show this schedule to be optimistic. The prototype development and retest cycle is particularly tight as it is driven by the fish passage cycle. Any delay in this portion of the process would set back the overall schedule approximately one year. Appropriate phases of project development should be defined on a site-specific and as-needed basis. Figure 2-2 presents the generic fish collection facility development schedule in Gantt chart form and includes the process elements in Figure 2-1. The schedule allows for two annual cycles of prototype development monitoring and evaluation.

Table 2-1 Comparison of Fish Passage Development Schedules

Phase	* Project/Phase Duration (years)					
	Generic	Upper Baker Floating Surface Collector (FSC)	Swift FSC	Round Butte SWW	Rocky Reach Corner Collector	Bonneville 2nd Powerhouse Corner Collector
Preparation and Conceptual Design[$]	1	3	7	8.5	1	2
Prototype Studies	2	0	0	0	4	3
Production Design	1.5	3	1.75	1.5	2	2
Production Permitting/Bidding/Construction	2	2	3[#]	2.5	2	3
Start-up and Evaluation	0.5	0.5	n/a	0.5	0.5	2
Total	7	8.5	n/a	13	9.5	12

* ENSR/AECOM, et. al. 2007. Surface Bypass Program Comprehensive Review Report. Contract W9127N-06-D-0004, T.O. 001 and various personal communications.
[$] Adequate biological information already available to select strategy.
[#] Facility is not completed. Duration presented as stated in Settlement Agreement and License Terms with FERC.

The following sections of this chapter define the information that should be collected to provide both the biological and physical basis of design described in the preparation area of the flow chart. Subsequent chapters will address the development of design criteria where applicable from agency standards, such as the NMFS (2008a) document and from the precedents established by other facility designs.

2.2 Biological Goals

A fundamental step in determining the scale, location, and required collection capability of a fish collection system is establishing clear biological goals based on sound scientific principles and criteria. With respect to fish passage and collection systems, these are often expressed in terms of life-stage specific collection efficiencies or survival probabilities. Various Biological Opinions, Relicensing Settlement Agreements, and Habitat Conservation Plans (HCP) typically establish these early in the process before fish collection facilities are designed.

Although passage facilities are generally built to achieve design criteria established by the resource agencies (NMFS 2008a), final facility designs and performance standards are sometimes based on a compromise between collection efficiency and survival by life-stage, cost, site-specific limitations, and ability to achieve identified goals (USDOI 2004, Tacoma Power 2000). Clearly documenting each of these factors becomes critical in designing a passage facility.

In the Pacific Northwest prescriptions for juvenile fish collector/bypass have primarily targeted the smolt stage (e.g., Federal Columbia River Power System [FCRPS] BiOp, and Chelan County PUD HCP). More specifically, population level performance standards for smolts often exceed 90% in terms of dam or dam and reservoir passage survival. In some cases, performance standards are expressed in terms of the joint probability of collection and survival, e.g., Lewis River Settlement agreement (Pacificorp and Cowlitz PUD 2004). Ultimately, monitoring and evaluation studies determine to what extent the standards or goals are being met post-construction.

As we understand it, biological goals are still being established for storage reservoirs in the Willamette Basin. These will likely differ from run-of-river Projects in certain respects. At many reservoirs fry and early parr are the most abundant life stage entering the project, e.g., Lookout Point Reservoir. In contrast to smolts, these are smaller and poorer swimmers and experience higher rates of natural mortality. Unfortunately, the magnitude of mortality is often uncertain, i.e., estimates of reservoir survival are generally absent and may be difficult, if not impractical to obtain. At some storage reservoirs, resource managers have not yet determined whether reservoir rearing for fry-smolt stages is beneficial or detrimental in terms of contributing to recruitment of returning adults. Furthermore, each reservoir has unique conditions that affect productivity and predation risks to salmonids. All of these issues make it difficult to prescribe meaningful survival and collection goals for these life stages. Even so, engineering teams designing passage systems need some guidance from fishery agencies with respect to identifying the minimum acceptable collection capability at the project.

Figure 2-1 Fish Passage Development Process Model

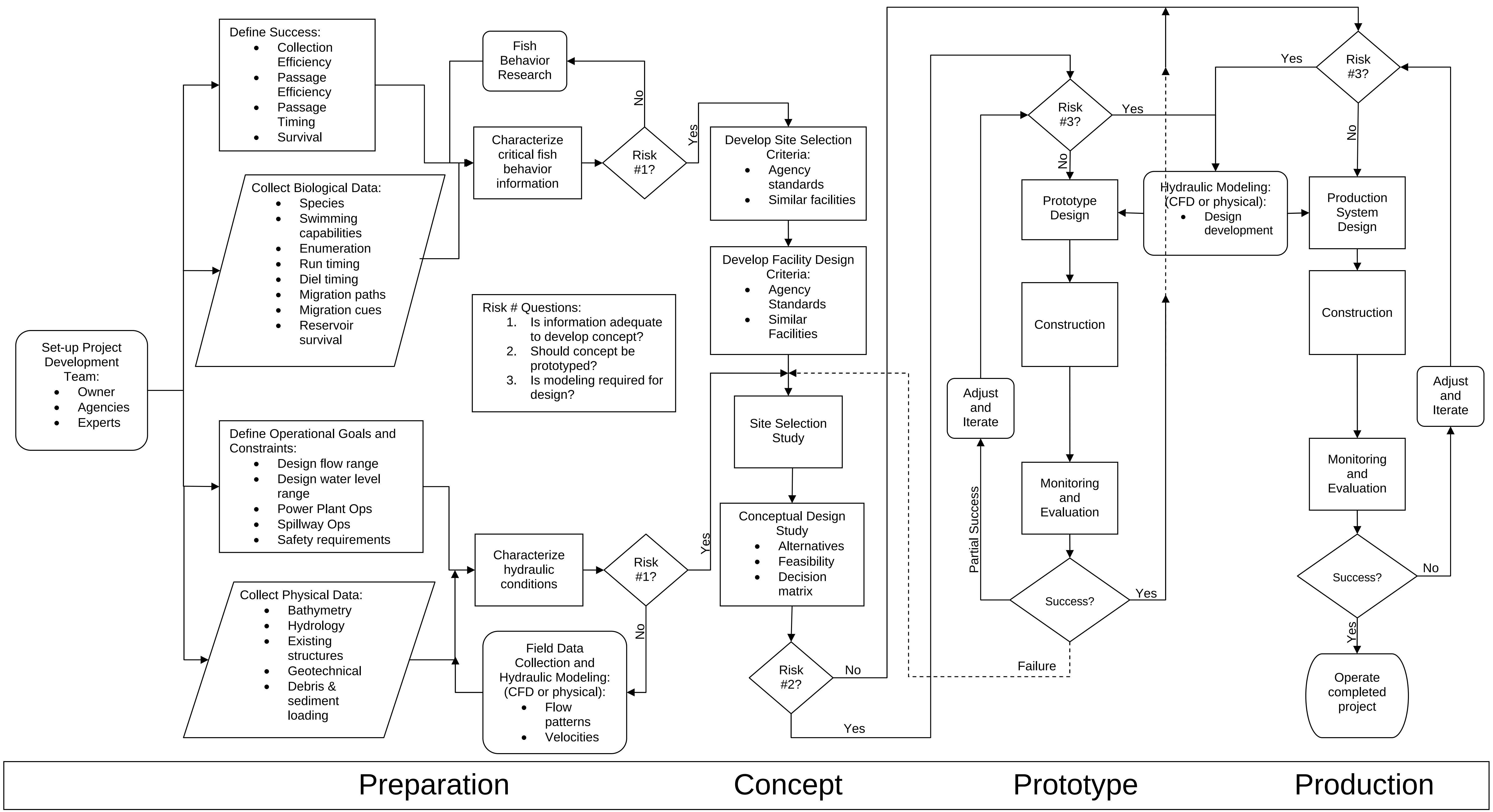
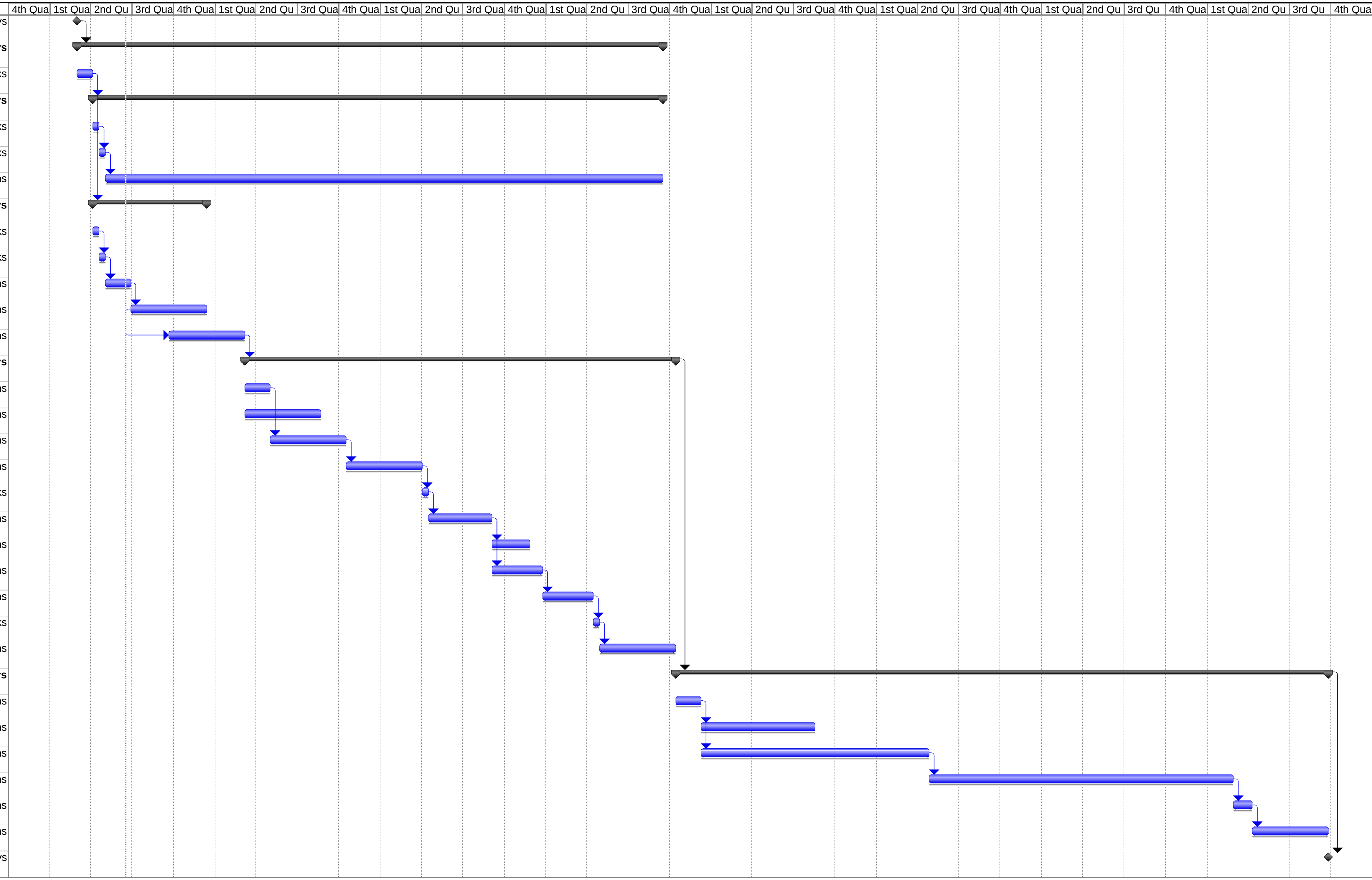


Figure 2-2 Generic Fish Passage Development Schedule.mpp

ID	Task Name	Duration
1	Initiate Project	0 days
2	**PREPARATION**	**925 days**
3	Establish Team	5 wks
4	**Biological Track**	**900 days**
5	Set Biological Success	2 wks
6	Assemble Available Biological Data	2 wks
7	Fisheries Research	44 mons
8	**Physical Track**	**180 days**
9	Define Ops Goals and Constraints	2 wks
10	Assemble Available Physical Data	2 wks
11	Collect Bathy, Current, etc. Data	2 mons
12	Screening Level Hydraulic Modeling	6 mons
13	ALTERNATIVES STUDY	6 mons
14	**PROTOTOYPE**	**680 days**
15	Site/Concept Specific Physical Field Studies	2 mons
16	Hydraulic Model Studies	6 mons
17	DDR/Plans & Specifications	6 mons
18	Bid/Construct	6 mons
19	Facility Start-up	2 wks
20	Monitor and Evaluate	5 mons
21	Hydraulic Model Studies	3 mons
22	DDR/Plans & Specifications	4 mons
23	Bid/Construct	4 mons
24	Facility Start-up	2 wks
25	Monitor and Evaluate	6 mons
26	**PRODUCTION**	**1030 days**
27	Site/Concept Specific Physical Field Studies	2 mons
28	Hydraulic Model Studies	9 mons
29	DDR/Plans & Specifications	18 mons
30	Bid/Construct	24 mons
31	Facility Start-up	1.5 mons
32	Monitor and Evaluate	6 mons
33	Operate Completed Project	0 days



Task — Milestone — Rolled Up Task — Rolled Up Progress — External Tasks — Group By Summary

Progress — Summary — Rolled Up Milestone — Split — Project Summary — Deadline

2.3 Biological Information

The following list presents the types of site-specific information needed from Research, Monitoring, and Evaluation (RM&E) activities, which should be conducted as early as possible, prior to or during the conceptual and preliminary design process, and definitely prior to commencing final design. All listed information may not be required and will depend on the focus of the downstream passage, i.e. at in-tributary, head-of-reservoir, in-reservoir, at-dam locations. The information types are listed here in order of general relative importance:

- Species: Identify species expected to encounter and enter collector (include target species, predatory species, resident species and others).
- Fish Size: Identify the life stages and size range of fish expected to enter the collector. This is important to determine sorting needs and swimming capability.
- Abundance: Estimate the numbers of fish the collector and/or handling facility should be able accommodate on days of peak migration (e.g., 1,000, 10,000, 100,000) including abundance of non-target species.
- Timing: Determine the migration timing (seasonal) and frequency distribution of target species. Passage timing should consider when fish naturally arrive in the reservoir, as well as when they pass. Note, the latter may be an operations-driven behavior.
- Migratory Behavior: For the target species, identify migratory routes or areas where fish tend to congregate.
- Reservoir Survival: Acquire estimates or indices of reservoir survival for critical life stages of target species.
- Daily Cycles: Describe any diel movement or migration activity through the reservoir or past the dam.

2.4 Physical Information

The following list presents the types of site-specific physical information, which should be acquired prior to or during conceptual design and definitely before beginning preliminary design. All listed information may not be required and will depend on the focus of the downstream passage system, i.e. at in-tributary, head-of-reservoir, in-reservoir, at-dam locations. The information types are listed here in order of general relative importance:

- Bathymetry and Topography Mapping: Coverage should include the entire reservoir and upstream into the tributaries beyond the influence of reservoir operations, plus some distance of the tailrace below the dam. The latter extent should be determined during site visits and upon reconnaissance level investigation of existing maps. This information is required for site selection and should also include locations of access roads, easements, and utilities, as well as property and project limits boundaries.
- Hydrology: The project hydrologic analysis must include flow exceedence based on mean daily flows during the (expected) fish migration period/s so the design conditions for facility operation may be defined.
- Hydraulic Setting: Flow patterns in the reservoir and project tailrace during critical project operations expected during fish passage should be defined to aid in facility site selection. These flow patterns may be highly influential on the success of fish collection. The influence of the fish passage facilities on project flow patterns and in-facility flow fields should be defined during

design. Computational fluid dynamics (CFD) and/or physical hydraulic modeling may be required. AECOM (2009b) is a good reference on the applicability of and selection of type and scaling requirements for modeling in different geographic zones of a hydroelectric project.

- Water quality and temperature: Stratification of the reservoir may cause confounding currents, block fish access to a collector, or raise the need to supply fish handling facility water from below the thermocline. Temperature data would be required to identify stratification. Density driven currents may require hydrodynamic modeling of the forebay flow patterns.
- Existing Structures: Complete as-built drawings of all existing structures and an understanding of their operations and limitations, as described in Section 2.5, are critical to understanding of how they may be modified to accommodate new fish passage facilities.
- Debris and Sediment Loading: Debris type, quantity, and timing plus sediment budget must be defined to plan facility location, type and develop design details.
- Geologic and Geotechnical Mapping: Overall geologic characterization of the area is important to ensure active or potential land slide areas be taken in consideration during site selection. While possibly not necessary at the conceptual design stage, detailed information in the geotechnical properties of any area that may be employed as a foundation is critical to design.

2.5 Project Operations

Operation of the existing project to meet its objectives must be clearly defined, including both constraints and flexibility, prior to commencing conceptual design of fish collection facilities. This is of particular relevance for the Willamette Projects as flood control and flood passage are the primary roles of these facilities.

- Design Flows: The typical power generation flows, power plant hydraulic capacity, and minimum instream flow and ramping rate requirements will all inform the process of selecting an appropriate fish collection attraction flow and scheme.
- Water Level Ranges: The range of the operating pool and annual timing and rate of reservoir drafting and filling must be considered in conjunction with fish run timing to select the location and type of fish collector.
- Power Plant Operations: Annual and daily plant operation patterns must be taken into consideration, i.e. is this plant operated for peaking power and subject to daily operating extremes?
- Flood Control Operations: Dam specific safety requirements such as notice of and preparation for flood passage must also be considered.
- Regulating Outlet Operations: Capacity of the regulating outlets to meet project operations objectives must be considered.
- Regulating Outlet/Spill Operations: Preferred release patterns to control erosion and/or total dissolved gas production should be taken into consideration.
- Temperature and Water Quality Control Operations: Annual cycles of operations of all outflows to meet downstream water quality constraints, under both typical and extreme conditions should be considered.

3.0 Reference Projects

3.1 Project Profiles

The following sections summarize profiles of fish collection systems which have been selected as appropriate examples of fish collection and passage designs that may be adapted to the Willamette Project dams or that demonstrate relevant lessons learned. Also presented are several specialized features from selected projects which may be applicable to the Willamette Project dams, but, for which a full detailed project system profile is not necessary. A map displaying all the project sites is show in Figure 3-1. The projects are grouped by the geographic location of the fish collection systems within the project, i.e. in-tributary, in-reservoir, and at dam. The detailed project profiles are included in the Appendix A. Each profile includes:

- A project location map and site map, plus plan and profile schematics of the collection and bypass system;
- A synopsis describing the project function and relevant features;
- A brief statement of the history of development of the system including duration required for design, construction, and testing, as available;
- Construction and operations and maintenance costs, as available;
- A description of the baseline information used for project development;
- The fisheries criteria employed in design;
- The collector location and purpose;
- A table of physical information describing the system by component and citing reference sources from Chapter 6. Components described include:
  - Guidance/Exclusion
  - Collection
  - Dewatering (if applicable)
  - Handling and sorting
  - Bypass or conveyance
  - Outfall or release
- Project operations information;
- A table of biological information about the project citing reference sources from Chapter 6. Information includes:
  - Target species
  - Life stages and size
  - Abundance
  - Collection period

- – Site selection rationale
- – Sorting and handling requirements
- – Facility performance requirements and results
- Site specific concerns and issues.

The literature used for developing each project profile is cited in Appendix A. The project descriptions presented below are meant to be a summary of the more detailed work presented in the appendix.

3.2 In-Tributary Systems

As described in the project profiles in the Appendix A, in-tributary systems are located upstream of the backwater influence of reservoir pools in the free-flowing portion of the river. Water and fish are diverted by a concrete dam or inflatable weir into an in-stream collection facility or into a power canal or other off-channel structure. The system may screen all or portions of the river flow passing the diversion point. Juvenile and adult fish, primarily salmonids, are screened from the water through the use of floor, drum or v-screens. Modern day screens are built to achieve NMFS (2008a) screening criteria for juvenile salmonids. The screens require some type of cleaning system to remove debris and to prevent hydraulic "hot spots" that result in increased water velocities through the screen that can impinge fish on the screen's surface. For the profiled facilities, collected fish are either diverted to a transport system where they are hauled by truck and released somewhere downstream or for purely exclusion-type facilities, diverted directly back to the river through a conveyance structure such as a pipe or flume. The outlet of the conveyance system is situated such that environmental conditions at the release site do not provide habitat for predators that may consume large numbers of bypassed fish.

3.2.1 Leaburg Diversion – Eugene Water and Electric Board

This existing system consists of a three wedge-wire v-screen array deployed to prevent downstream migrating juvenile salmon from entering the power canal. Fish are returned to the McKenzie River via a 440 ft transport flume which drops approximately 20 feet. The project is equipped with 3 roller gates to divert flow towards the power canal and maintain flow levels in the river downstream of the diversion. Fish ladders are provided on both sides of the spillway to allow upstream passage. The site layout can be seen in Figure 3-2 at the end of this chapter. The system can screen a maximum of 2,500 cfs. Screen approach velocities at 2,500 cfs are between 0.53 (total screen area) and 0.67 feet/sec (cleaned area only). The fry approach velocity criterion at the time of the design of the facility was 0.5 fps which has since been lowered to 0.4 fps based on biological testing. Screens are cleaned with a rotary backwash system yet debris continues to be a problem at this facility.

<u>Relevant Feature(s)</u>: This existing v-screen system provides a good example of the impacts debris can have on project operations and the rotary backwash system used for screen cleaning. This system also provides an example of a potential off-channel in-tributary collection system.

<u>Biological Performance</u>: Initial fry survival through the facility was poor, but after extensive evaluations and modifications, fry survival has been significantly improved. Total survival for smolts passing through the entire system was estimated at 99.5%. Fry survival rates were greater than 99% for most tests; with the majority of mortality (1%) the result of handling required to conduct the test. The Leaburg diversions screens were a special exception during settlement discussions with NMFS.

3.2.2 Cowlitz Riverine Collector Concept – Tacoma Power

This is a conceptual design of a collector located in the tailrace downstream of Cowlitz Falls Dam. This concept was one element of an alternatives study that looked at numerous locations in the Cowlitz system to improve downstream passage. This location was the only area in the network of Cowlitz dams that was suited for an in-tributary system. The concept includes an inflatable dam used to divert flow and fish to an in-stream high velocity inclined floor screen. The fish are guided up the screen and into a bypass flume which routes them to a sorting and truck loading facility. Flow through the floor screen is controlled by four gates located downstream of the screen. A site map, plan and profile views of this design can be seen in Figures 3-3 through 3-5. The purpose of the system is to collect downstream migrants for truck transport below two more dams to the lower river. This concept was rejected during the alternative study process due to concerns about the unprecedented size (10,500 cfs) of the high velocity floor screen, which is still considered an experimental technology. V-screens were considered but a v-screen facility of this size is also unprecedented and the required footprint would not fit on the site.

Relevant Feature(s): Provides an example of a system that uses an inflatable dam and inclined floor screen for collecting fish. The inflatable dam design utilizes the largest inflatable rubber dam (full height = 20 feet) available with present technology. Also of note, if tail water levels at the rubber dam might significantly submerge the dam (12 ft for the Cowlitz case), the dam should be water- rather than air-filled due to buoyancy concerns.

Biological Performance: Any flows above 10,500 cfs would have to be passed over the inflatable dam and any fish with that flow would not be collected. For extreme flood events this facility may have to shut down to protect its components. These larger flow events coincide with peak juvenile migration and as such, the overall fish collection efficiency of the facility is decreased. Use of high velocity screens under high debris load conditions poses substantial risk (injury and mortality) to collected fish. High velocity floor screens are probably inappropriate for fry-sized fish.

3.2.3 Cougar In-Tributary Concept – USACE, Portland District

This is a conceptual design of a collector located in a tributary to the Cougar Dam reservoir. The concept includes an inflatable rubber dam used to divert fish and flow to an in-stream v-screen system from which fish are carried in a transport pipe to holding ponds. The facility includes a trash rack in front of the v-screen to minimize impact caused by large debris. The facility was sized to handle 1,210 cfs (1,170 cfs through the screens and 40 cfs through the fish ladder) which corresponds to the 10% exceedance flow for the tributary. The required water level through the v-screens is maintained by a concrete ogee spillway installed at the end of the v-screen channel. Discharge through the bypass pipe is controlled with a tilting flume and adjustable weir downstream of the v-screen. This design also includes a fish ladder to facilitate passage of adults upstream above the inflatable dam. A site map, plan and profile views of this design can be found in Figures 3-6 through 3-8. This concept was one of three that survived the alternative study (USACE 2000) but none were recommended for implementation and none have been designed or constructed. Additional research into reservoir hydraulics and fish behavior was recommended before selection of a downstream passage alternative. Concerns of inability to capture fish above 1,210 cfs and concerns for not allowing reservoir rearing were expressed regarding this concept.

Relevant Feature(s): Provides an example of a system that uses an inflatable dam and a v-screen for collecting fish. The design called for a concrete ogee spillway at the end of the v-screen system to maintain the water level through the screen area and an adjustable flume/weir combination to control bypass flow. Also addressed in this design is the need for upstream passage. This issue was solved by incorporating a proven ladder design into the facility.

Biological Performance: Any flows above 1,210 cfs would have to be passed over the inflatable dam and any fish with that flow would not be collected. For extreme flood events this facility may have to shut down to protect its components. These larger flow events coincide with peak juvenile migration and as such, the overall fish collection efficiency of the facility is decreased. Reservoir rearing by juvenile Chinook was deemed to be important and was not possible under this alternative. Designers express concern of potential debris and sediment load on screens.

3.2.4 Wapato Irrigation Diversion – Yakama Indian Nation

This existing system utilizes 15 rotary drum screens to prevent downstream migrating juvenile salmon from entering an irrigation diversion canal. All fish excluded by the screens pass through a flow control structure and are returned to the Yakima River via a transport pipe. The system includes two intermediate bypass pipes to limit fish exposure along drum screens. The drum screens require ongoing maintenance and regular replacement of seals to ensure they remain fish tight. Ability to dewater the screens greatly increases the ease of which inspections, maintenance, and replacement can occur. A plan view of the facility can be found in Figure 3-9.

Relevant Feature(s): The facility provides an example of a system that uses self-cleaning rotary drum screens and could be applicable to an in-tributary off-channel collection system.

Biological Performance: Approximately 98% of all fish encountering screens were successfully bypassed back to the river. Average descaling rates for Chinook and steelhead juveniles were 2.4% and 1.4%, respectively.

3.2.5 Upper Swift Juvenile Collector Concept – PacifiCorp

This is a conceptual design of a system using a ten foot inflatable dam to divert fish and flow to an in-stream v-screen array to capture migrating juvenile salmon for truck transport to a release point below Merwin Dam. The facility consists of two v-screens located on both sides of the rubber dam (total of four v-screens). Each v-screen is capable of passing 1,675 cfs for a total of 6,700 cfs (10% exceedance flow for this location). The design approach velocity for the screens was 0.4 ft/s. Water level through the screens is controlled by two tainter gates for each v-screen located just downstream of the screens (total of eight tainter gates). Each v-screen has an adjustable control gate to control the actual bypass discharge. The fish laden flow from all four v-screens is combined and directed to a bypass secondary dewatering screen which reduces the amount of water sent through the transport pipe with the juveniles to the sampling and sorting facility. Fish ladders are provided on both sides of the in-stream collector to allow upstream passage. This concept was eliminated as an alternative due to the impact that debris and water levels during large flood flows (~80,000 cfs) would have on the structure. A site map, and plan/profile views of the facility are presented in Figures 3-10 and 3-11.

Relevant Feature(s): This facility provides an example of the use of a rubber dam to divert river flow to v-screens located in the stream channel.

Biological Performance: Any flows above 6,700 cfs would have to be passed over the inflatable dam and any fish with that flow would not be collected. For extreme flood events this facility may have to shut down to protect its components. These larger flow events coincide with peak juvenile migration and as such, the overall fish collection efficiency of the facility is decreased. Reservoir rearing by juvenile Chinook and coho was deemed to be important and was not possible under this alternative. Use of dewatering screens under high debris load conditions poses substantial risk (injury and mortality) to collected fish.

3.2.6 Willamette Falls Hydroelectric Project – Portland General Electric

This existing project employs an inflatable rubber dam along the apex of a natural water fall feature to control passage of fish through the falls and direct them away from areas which have shallow landing depths and historical high mortality rates. The flow control structure is comprised of three 70-ft wide sections each fitted with an inflatable rubber bladder that can be independently raised or lowered. The maximum height of the rubber dams is 9 feet and the target maximum flow rate for the structure is 15,000 cfs. A site map of the project is presented in Figure 3-12. The facility also utilizes a louvered trash rack across the entrance of an off-channel power plant to divert downstream migrating juvenile fish towards two bypass routes (Figure 3-13). One route is via an Eicher screen in a penstock; the other makes use of an adjustable floor weir in a high flow bypass. The louvered trash rack runs along the front of the powerhouse intakes and allows the 12 units to pull the required flow rate through the louvers but creates a small flow field on the forebay side of the louvers and as such does not entrain many fish. The louvers stop at unit 13 and allow for fish laden flow to be drawn into the penstock. In the Unit 13 penstock is the Eicher screen (similar to an inclined floor screen) which fully excludes fish from continuing down the penstock and directs them towards a bypass route in the roof of the penstock. The Eicher screen is periodically rotated about its centerline to allow for any accumulated debris to be backflushed. This bypass route includes an adjustable weir which controls the discharge rate of the bypass. A schematic of this bypass can be seen in Figure 3-14. The bypass can be diverted directly to the tailrace or combined with the other bypass discharge. The other bypass (North Bypass) is located adjacent to the unit 13 penstock and has a guidewall to assist in directing fish towards it. The North Bypass makes use of an adjustable floor weir to control the bypass discharge (500 cfs). This is an example of a high flow bypass. The layout of the powerhouse, nearly parallel to the river bank, and the high flow through the bypass (400-500 cfs) play a large role in the success of the bypass system.

Relevant Feature(s): The operational experience with an inflatable dam is relevant to an application for in-tributary collection as most conceptual designs include one. The application of louvers to guide fish, the high velocity (Eicher) screen, and the high flow bypass are features that could be applied to facilities at any of the geographic locations being considered.

Biological Performance: Mean fish guidance efficiency of the system for Chinook and steelhead were 97.3% and 100%, respectively. Fish injury rates were estimated at less than 0.5% for both Chinook and steelhead. Survival rates through the North Fish Bypass were estimated in excess of 99% for bypass flows ranging from 250 to 400 cfs. The system has a target smolt (> 60mm) and fry (< 60mm) mortality standard of less than or equal to 0.5 percent and 2%, respectively. Domina (1997) reported an injury rate of 0 to 1.8%, with an average 48-hr mortality of 1.3% for spring Chinook, 2.0% for fall Chinook, and 0.3% for steelhead smolts at the louver-Eicher screen bypass.

3.3 In-Reservoir Systems

In-reservoir juvenile collection systems may be located near the dam or in the reservoir. The collection systems generally utilize exclusionary guide nets to lead fish to the trap or FSC entrance. The guide nets can be fully- (extend from surface to reservoir bottom) or partially-exclusionary wherein the net blocks approximately the upper 40 ft of the water column where the majority of juvenile fish are found. The FSC uses a pumping system (e.g. gulper) to produce the attraction flow needed for fish to find and enter the system. Total attraction flow will likely vary based on site conditions, but the only functional system (Upper Baker) has an attraction flow of 500 cfs.

3.3.1 Upper Baker – Puget Sound Energy

This existing system employs full exclusionary netting and a pumped screen system (500 cfs) on a FSC to collect all downstream migrants in the reservoir for truck transport around Upper and Lower Baker Dams. This facility was designed following many years of testing of a lower flow capacity gulper near the same location. The original gulper employed partial-depth exclusion nets that were then modified to provide full-exclusion to improve performance. The design of the new FSC is being employed, with a few minor improvements, for Lower Baker. A similar concept is undergoing final design for in-reservoir collection at Swift by PacifiCorp. The facility, while designed for 500 cfs, can be tested at 1,000 cfs. If biological performance is improved at the higher flow rate the facility would be modified (screen area added) to meet fry criteria for the increased flow rate. The FSC includes a net transition structure (NTS) installed at the entrance of the v-screen that assists in connecting the exclusionary netting to the structure and also assists in creating an attractive flow field towards the entrance. The nets are protected by a debris boom, however debris has not been a problem at this site. Once the fish have passed through the primary and secondary screens and have been dewatered to a manageable amount of flow (3 cfs), they are deposited in one of four holding ponds until they can be sorted and ferried via a hopper to the dam face and crane transferred to trucks. Figures 3-15, 3-16, and 3-17 display a site map, and plan and profile views of the facility.

Relevant Feature(s): The relevant features include: floating structure to follow forebay fluctuation (50 feet), full exclusionary netting, pumped collection flow and v-screen dewatering.

Biological Performance: The system has a mean coho and sockeye collection efficiency of 81% and 76% for fish released near the head of the reservoir. Transported fish are released into a stress relief pond to allow fish to recover from the transport process before entering the river. This approach is designed to reduce losses associated with predation by fish and birds at the release site. Large numbers of fry have been collected since the facility has been in place, compared to minimal fry collection numbers using the previous gulper.

3.3.2 Cougar In-Reservoir Concept – USACE, Portland District

This is a conceptual design consisting of a partial exclusionary net that would guide juvenile fish to two FSCs with attached collection barges. Each FSC uses a 220 cfs capacity v-screen with flow through the screens driven by pumps. Fish laden bypass flow is controlled by an adjustable weir/flume downstream of the screens. It ensures only 12 cfs passes through to the collection barge. Collected fish would be transferred (every 2-3 days) to a smaller barge with a holding tank that would be propelled to a shore-based truck loading facility. The guide net was designed to only extend 75 feet below the water surface with plans for an adaptive management approach to replace with a longer net if fish are passing under the net once it needs to be replaced. Average design velocities through the net range from 0.005 ft/s for full pool to 0.012 ft/s for minimum pool. A shear boom was planned to be installed across the reservoir upstream of the facility to minimize debris impacts on operations. Running the pumps in reverse was considered as a potential method to clean the screens along with a more traditional water backwash system. This concept was one of three that survived the alternative study (USACE 2000) but none were recommended for implementation and none have been designed or constructed. Additional research into reservoir hydraulics and fish behavior was recommended before selection of a downstream passage alternative. Figure 3-6 displays a site map of the facility and an overview and plan and profile views can be found in Figures 3-18 through 3-20.

Relevant Feature(s): The relevant features include: FSC, pumped v-screen system, and exclusionary netting.

Biological Performance: The facility was rated negatively because 1) fish must be transferred twice as part of collection and transport activities (increases fish stress, injury and mortality), 2) reduced reservoir rearing capacity (decreased fish abundance), and 3) fish may swim under guide nets resulting in lower juvenile collection efficiency.

3.4 At-Dam Systems

Passage facilities located at dams generally take advantage of existing or proposed facilities and structures to collect and/or bypass juvenile salmonids. Water passing through turbines, spillways, water temperature control structures is used as the attraction flow needed to concentrate fish for collection or direct bypass through discharge structures. Stationary or travelling screens can be used to divert the fish into a collection system. Fish can be bypassed through the dam directly or directed to a collection facility for truck transport.

3.4.1 Carmen-Smith Hydroelectric Project – Eugene Water and Electric Board

This concept is undergoing preliminary design and is intended to prevent downstream migrating juvenile salmon from entering a power intake at Trail Bridge Dam. The system includes a full exclusionary double v-screen and bypass system with fish returned to the river below the dam via a transport pipe. A site map is presented in Figure 3-21. Total combined capacity of the screens is 2,000 cfs. The fish laden flow exiting the primary and secondary screens for each v-screen, combine and pass a tertiary screen. This can be seen in the plan view in Figure 3-22. From here, a telescoping weir and tilting flume (Figure 3-23) adjust to the 12 feet of forebay fluctuation and provide a constant bypass flow of 30 cfs to transport the juveniles. The bypass pipe to the outfall spans 3,310 feet, drops approximately 85 feet, and varies in slope from 1.5% to 19.7%. Total travel time down bypass pipe is 4.3 minutes. The waste water from the screens passes through a 16 foot diameter conduit to the powerhouse intake structure. The intake structure is planned to be modified to incorporate the conduit as well as an additional structure. The additional structure will include a trashrack and sluice gate that would allow flow to continue to be drawn into the penstock during construction of the facility and if the v-screen is ever out of operation. Figure 3-24 depicts a plan view of the screens.

Relevant Feature(s): Key design features of interest from this design include: a tilting transport flume and variable weir to adjust to changing reservoir levels as well as power plant discharges being drawn through a large v-screen and a long bypass pipe.

Biological Performance: Expected to effectively bypass all juvenile fish encountering the system. The facility has been designed to achieve fry, smolt and adult survival rates of 98% or higher.

3.4.2 Round Butte Selective Water Withdrawal and Fish Collection Facility – Portland General Electric

This newly constructed facility combines a floating double v-screen fish collection facility (6,000 cfs) attached telescopically to a selective water withdrawal tower for temperature control of power plant discharges. Fish laden flows from each v-screen, after passing the primary and secondary screens, combine and pass through a tertiary screen. After this the water is passed through a large fish separator. Juveniles are then pumped to a handling facility where they are sorted by size and transported to a shore-based truck loading facility to be hauled to the lower river. The selective water tower allows water to be drawn through the v-screens located near the water surface or through a screened intake structure located approximately 190 feet below normal pool elevation. The floating structure has 5 Surface Exclusion Plates (SEPs) located on the sides of the structure which provide the capability to intake an additional 1,000 cfs for the powerhouse. The intakes are fully screened. A site map and plan and profile views of the facility are displayed in Figures 3-25, 3-26, and 3-27.

Relevant Feature(s): The relevant features include: a floating structure attached telescopically to intake tower to follow forebay elevation; a unique v-screen application; the bulk of power generation flow is being used to collect fish; compatibility with temperature control; and use of a pump for fish transfer.

Biological Performance: The temperature control structure is expected to alter reservoir currents to better concentrate fish near the dam. Historical passage studies indicated that fish became "lost" in the reservoir and could not find their way downstream. The system is designed to achieve a 93-96% smolt survival standard and a 75% reservoir survival standard (i.e. 75% of smolts entering the reservoir enter the collection system).

3.4.3 Cougar Dam Abandoned Fish Collection Facility – USACE, Portland District

This abandoned system utilized several intake port fish horns at different elevations on the intake tower. Each horn utilized a butterfly valve to control the flow. The valve was operated only fully open or fully closed. Fish and water entered an operating horn which narrowed to a 3 foot diameter pipe. This pipe led to a 5 foot diameter vertical fish well which discharged continuously into the regulating outlet (R.O.) upstream of the slide gate controlling the R.O. discharge. This meant that fish had to dive to depths to find the bypass route. Water levels in the fish well varied depending on R.O. discharge and fish horn discharge and could result in a long free fall for any entrained fish. The fish horn discharge was dictated by head over the horn with a maximum of 350 cfs at 50 feet of head. A schematic of the system is found in Figure 3-28. The fish horns were removed to construct the temperature control tower

Relevant Feature(s): The facility is an example of a structure with multiple intakes designed to pass flow over a wide range of reservoir elevations. Additionally, the facility provides an example of internal hydraulics that produced unfavorable conditions for good fish survival.

Biological Performance: Researchers reported that wild Chinook mortality from passing through the system ranged from 28-40%. The majority of fish migrated through the regulating outlet. Minimum passage efficiency was estimated at 30%.

3.4.4 Green Peter Abandoned Fish Collection Facility – USACE, Portland District

The abandoned system consisted of a floating collection horn, attraction water pumps, box screen, and transport pipe. The floating fish horn was located in essence in a wet well attached to the face of the dam. The collector was connected to the wet well via slots that allowed for the floating structure to travel up and down to follow the changing reservoir elevations. Two pumps in the wet well provided the hydraulic differential from forebay to the water surface in the wet well that drew flow (200 cfs) in through fish horn. The water from the fish horn travelled over a horizontal perforated plate (box screen) that separated the fish from the majority of the flow. The fish and flow was sent via a flexible hose which was manually attached to one of four 12-inch laterals through the dam. From here a 24-inch pipe ran down the back of the dam and discharged into the tailrace. The outfall pipe included 300 feet of vinyl lined pipe as a deceleration zone before entering a rubber lined chute that discharged into the river. The total head on the outfall pipe was up to approximately 300 feet. An isometric and profile of the facility can be found in Figures 3-29 and 3-30.

Relevant Feature(s): This facility provides an example of a floating collection system that operated over a range of reservoir elevations. Another relevant feature is the high velocity bypass pipe.

Biological Performance: The system was considered successful for Chinook but not for steelhead. Collection efficiency for Chinook and steelhead was less than 84% (range 75-84%) and 57% (range 33-57%), respectively. The target goal for the system was 70% FCE, which was based on professional opinion at the time. Juvenile mortality through the bypass pipes (rusted) was estimated at 30%, with an overall handling mortality of 5% (see Appendix A). From the 1960's into the 1980's a substantial decrease in Chinook survival in the reservoir was observed. This appeared to be associated with increased predator abundance, including the introduction of largemouth bass.

3.4.5 Fall Creek Abandoned Fish Collection Facility – USACE, Portland District

The system consisted of three sizes of fish horns grouped at three different elevations located on the dam embankment (Figures 3-31 and 3-32). The horns led to a transport pipe that passed through the dam and separated fish from the water to be used in the fish ladder by using a horizontal perforated plate. The fish were discharged into the tailrace near the regulating outlet outfall. Maximum collection flow was 280 cfs at full pool. Fish collection efficiency for the facility was considered low due to poor location of the fish horns and a passage route that included a sharp right-angle turn into a concrete wall at the exit. This system is still used to provide water for the adult fish trap as well as downstream temperature control purposes. Operations have been modified to limit downstream fish passage via this route.

Relevant Feature(s): This facility is an example of poor fish conveyance and a hazardous (high mortality) passage route.

Biological Performance: More than 94% of fish passing through the system were injured. Recoveries of marked Chinook released upstream of the facility never exceeded 16%.

3.4.6 Howard Hanson Design – USACE, Seattle District

This design includes an intake tower consisting of five collectors each made up of a fish horn and an inclined floor screen also known as a modular inclined screen (MIS). The tower was designed such that the two collectors nearest the varying reservoir water surface operate. The intake tower includes a large trash rack to minimize debris impacts. The fish laden flow is drawn into one of the two operating collectors (600 cfs each) at which point the fish are directed towards the roof of each collector by the inclined screen and into a fish bypass pipe which leads to a vertical fish well. The inclined screens can be rotated about a centerline pivot point to reverse the flow through the screens and backflush any collected debris. Waste water from the collectors is released downstream of the dam. Forebay to fish well water surface differential is maintained less than approximately 3 feet by controlling the discharge out of the well drain. At all times the water in the fish well is above the active fish bypass pipes. A physical model study (1:15 scale) of a preliminary design of the fish well was undertaken to ensure turbulence from the bypass pipes discharging (6.7-9.3 ft/s average bypass velocity) into the well was not a problem. The fish are removed from the fish well via a basket and directed to a holding tank to be diverted to a monitoring facility or directed to a truck transfer station for transport downriver. The basket spans the fish well and is stored at the bottom of the well. The basket is raised when a sufficient number of fish has been collected or a set amount of time has passed. When the basket is redeployed in the fish well, the bottom screen is in the open position allowing it to be lowered below any fish already in the fish well. Drawings of the facility are presented in Figures 3-33 and 3-34.

Relevant Feature(s): The series of vertical fish collectors is the key feature of interest as it collects fish over a wide range of reservoir elevations. Also of interest is the use of Modular Inclined Screens.

Biological Performance: The facility is being designed to achieve a 95% juvenile survival rate and to safely pass both fry and smolts.

3.5 Specialized Features from Selected Projects

The Projects below have specialized features that may have benefits in designing systems for the Willamette Project. As the interest in these facilities is limited to one specific item, full profiles were not developed (i.e. no profiles for these projects in Appendix A).

3.5.1 Bonneville 2nd Powerhouse Corner Collector – USACE, Portland District

This existing system utilizes a modified ice and trash sluice at one corner of the second powerhouse to opportunistically collect fish concentrated by a large eddy near that location (Figure 3-35). The large counter-clockwise eddy forms in the left half of the forebay under most project operating conditions. The eddy focuses fish in this location as well as allows for the downstream migrants to have multiple opportunities to enter this bypass route. The entrance ogee conveys downstream migrating juvenile salmon into a 0.5 mile conveyance channel leading to an outfall downstream of the dam. Incorporating existing flow features into a design to assist in concentrating fish is the feature of note.

3.5.2 Round Butte Abandoned Fish Collection Facility – Portland General Electric

This was a shore-based pumped collection and screening system that did not meet collection goals due to location and adverse thermally-driven currents in the reservoir. The feature of interest is the simple valve-controlled pipe elevator system used in the historic system to transport and release fish below the dam.

Collected fish were held in a live tank until a certain quantity of fish or length of time was met. Once it was time to transport the fish downstream a trap door in the bottom of the live tank was opened and the fish drained into another container of water. This container was directly connected to a 16" pipe that was 2,000 feet long and descended approximately 300 feet down to the tailrace near the powerhouse outlets. Discharge from the pipe was controlled by a valve located near the outlet and initially was closed. Once the fish were added to the full fish transport pipe (water to water transfer), the valve was partially opened to begin draining the water level down in the pipe. As the fish were added to the pipe immediately before the draining started they were located in the upper portion of the water column and in no danger of passing through a partially opened valve (high mortality risk). Once the water level was drained down to an acceptable head on the valve for fish passage, the valve was opened completely and the remaining water and fish drained into the tailrace. The valve would then be closed and the pipe filled with water to start the process over.

This is a very unique and simple method to deal with a bypass around a high head dam. Cycle times would be a major consideration in the use of a method similar to this but could be solved by either increasing the capacity of the bypass pipe or adding additional pipes to ensure cycle times were not an issue.

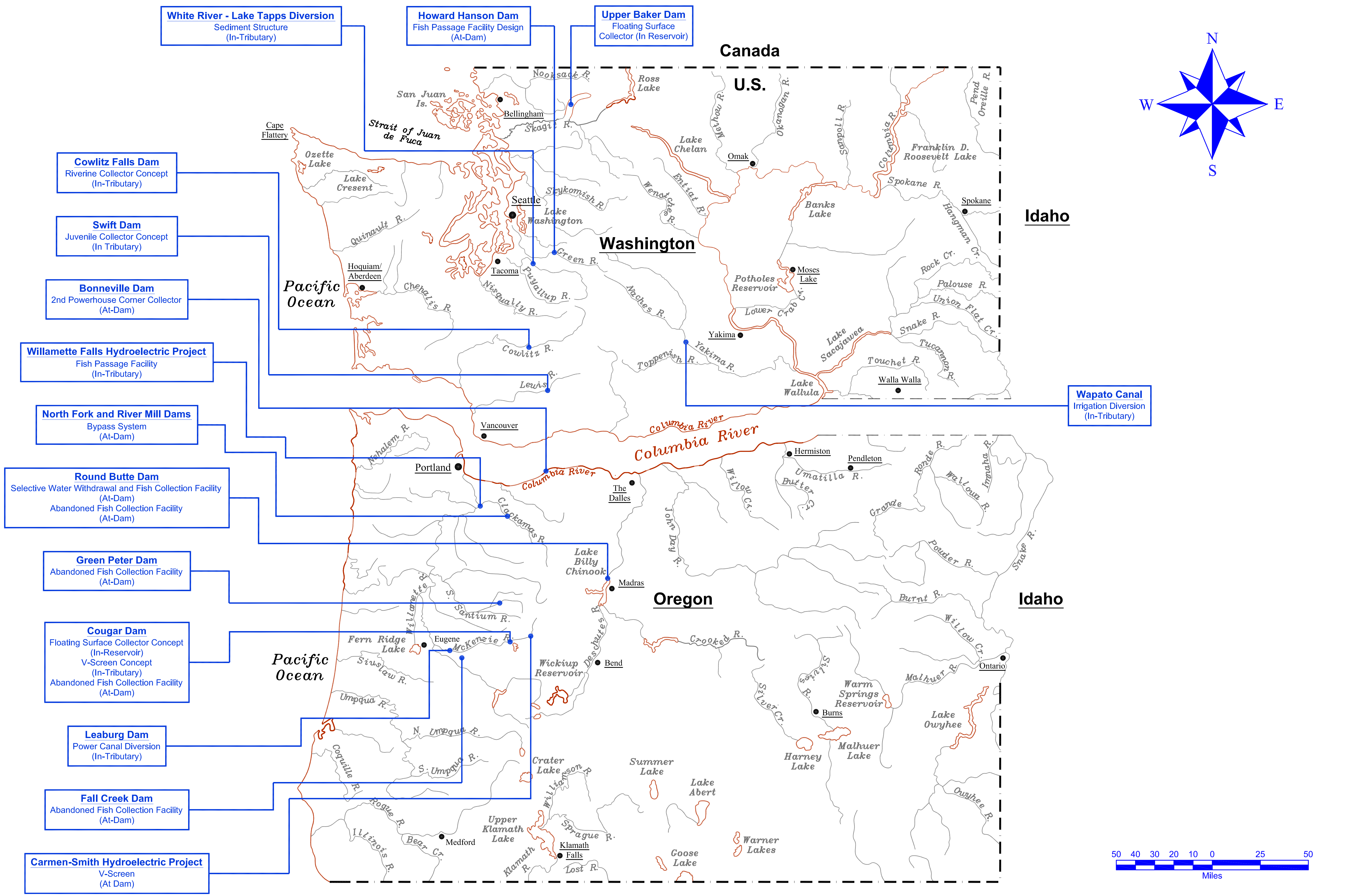
3.5.3 North Fork and River Mill Bypass System – Portland General Electric

The existing North Fork system utilizes the existing exit of the adult ladder with a pumped attraction flow of 240 cfs (40 cfs continuing down the ladder and 200 cfs returning to the reservoir) to collect juvenile migrants. The collected juvenile fish travel about 1-1/2 miles down the ladder to a separator, where they are diverted into a holding tank, identified and counted. Fish are then released into an 18-inch pipe that carries them about five miles (elevation drop of ~300 ft) to an outfall into the Clackamas River below

River Mill Dam. This lengthy fish transport pipe is the feature of interest. The pipeline follows the existing topography along the route. It includes both exposed and buried sections and the slope varies from -4.5% to 6% with a short segment leading to the outfall at 63%. Pipe material also varies as some portions of the pipeline are in areas prone to landslides. Replacement pipe has consisted of either PVC or HDPE connected to the original steel. Current discharge through the pipe is 3 to 4 cfs. Flow in the pipeline is intended to be open channel flow but in reality there are portions that are pressurized. Juvenile injury and mortality rates through the bypass are approximately 2% (NOAA 2003). A plan to add 1.5 miles of pipe to bypass the ladder portion of the route and directly guide fish into the pipeline at the entrance is at 50% design. Once the new pipeline is added flows will be increased to 7cfs. A new pumped floating fish collector facility is being developed for the forebay at North Fork and a fixed turbine flow driven collector is being developed at River Mill.

3.5.4 White River: Lake Tapps Diversion – Cascade Water Alliance

This existing system consists of a diversion from the White River to Lake Tapps. The diversion includes a v-screen facility to screen off all fish from the diversion. The feature of interest is the use of settling basins and rock chutes to deal with high sediment load in the system. The basins and chutes are located upstream of the v-screen to minimize sediment impacts on the screening facility. The rock chutes consist of an angled weir across the diversion channel and are meant to divert the large diameter bed load near the invert out of the diversion channel. The sediment basins are used to slow the velocity of the flow and facilitate the deposition of sediment entrained in the flow. The basins periodically need to be dredged to maintain effectiveness. Similar structures might be necessary to deal with sediment load found in the tributaries above dams for an in-tributary facility. Figure 3-36 presents an overview of the system.



DESIGNED BY: KM
DRAWN BY: KM
CHECKED BY: IW
APPROVED BY: CS

REVISIONS		
NO:	DESCRIPTION:	DATE:	BY:

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PROJECT SITES

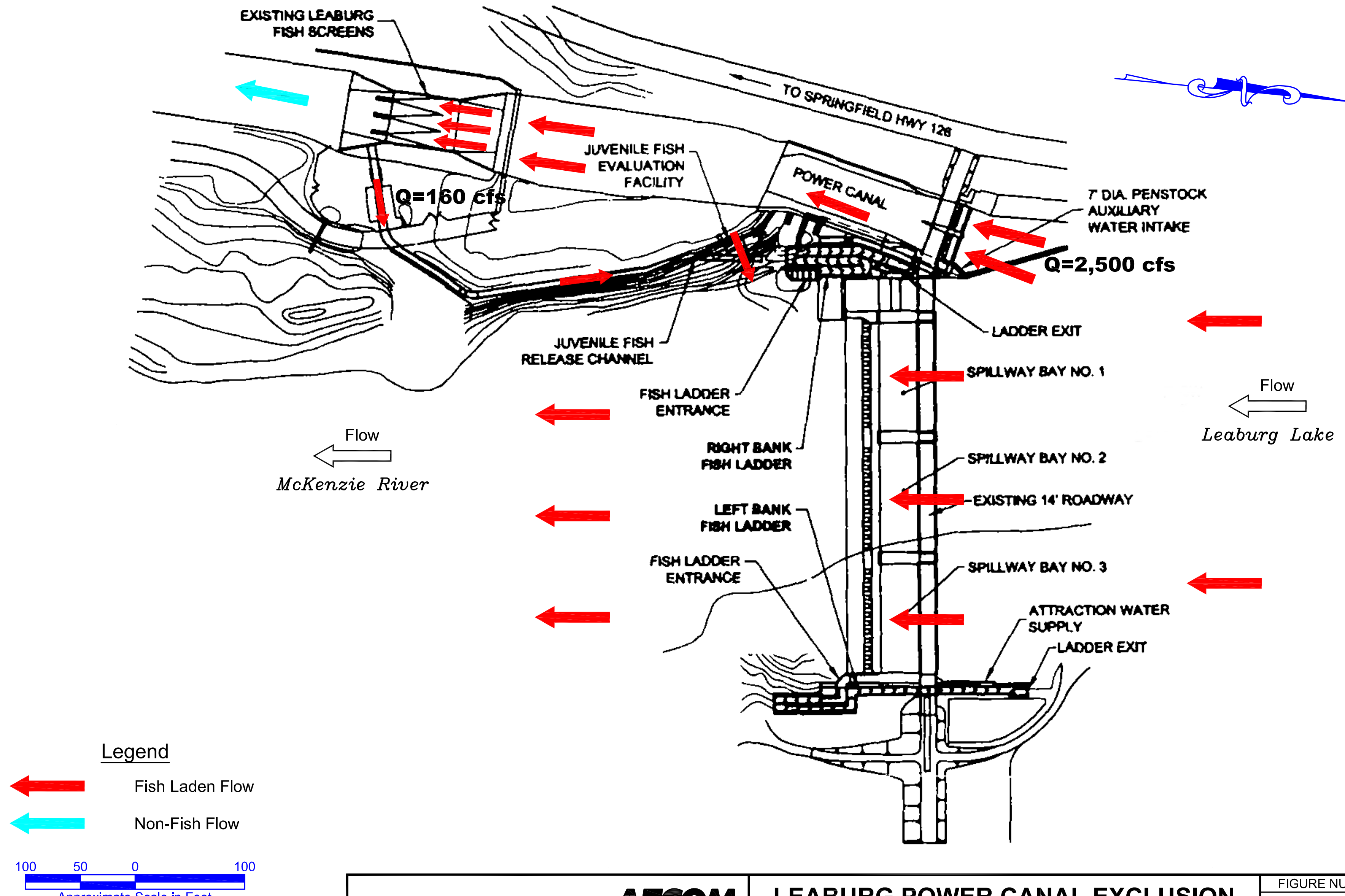
Willamette Downstream Fish Passage
Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

PROJECT NUMBER: 60148335-403
DATE: 06/03/10
SCALE: 1' = 50'

FIGURE NUMBER: 3-1

FILENAME: All-Proj-Sites

FILENAME: Leaburg Plan



Source: FERC 2496, Article 418,
"Leaburg Left Bank Fish Ladder"
Hydraulic Evaluation Report
August 17, 2005

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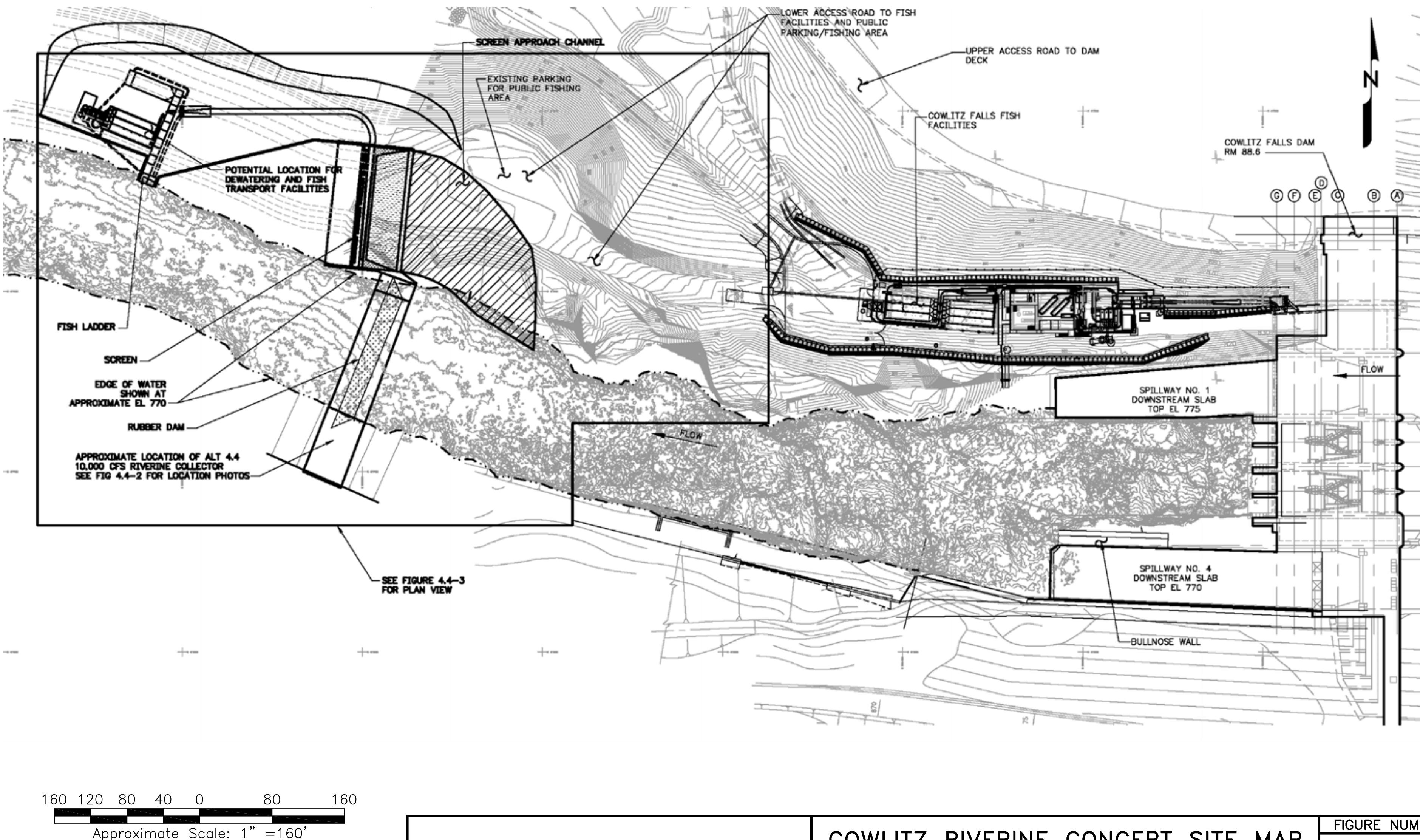
LEABURG POWER CANAL EXCLUSION PLAN VIEW

Willamette Downstream Fish Passage Design Requirements
U.S. Army Corps of Engineers - Portland District
Portland, Oregon

FIGURE NUMBER:	DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
3–2	EWEB/KM	06/08/10	60148335-403	IW

FILENAME: 03–Cowlitz



Source: R2 Resource Consultants, Inc. Figure 4.4–1, 04/27/09

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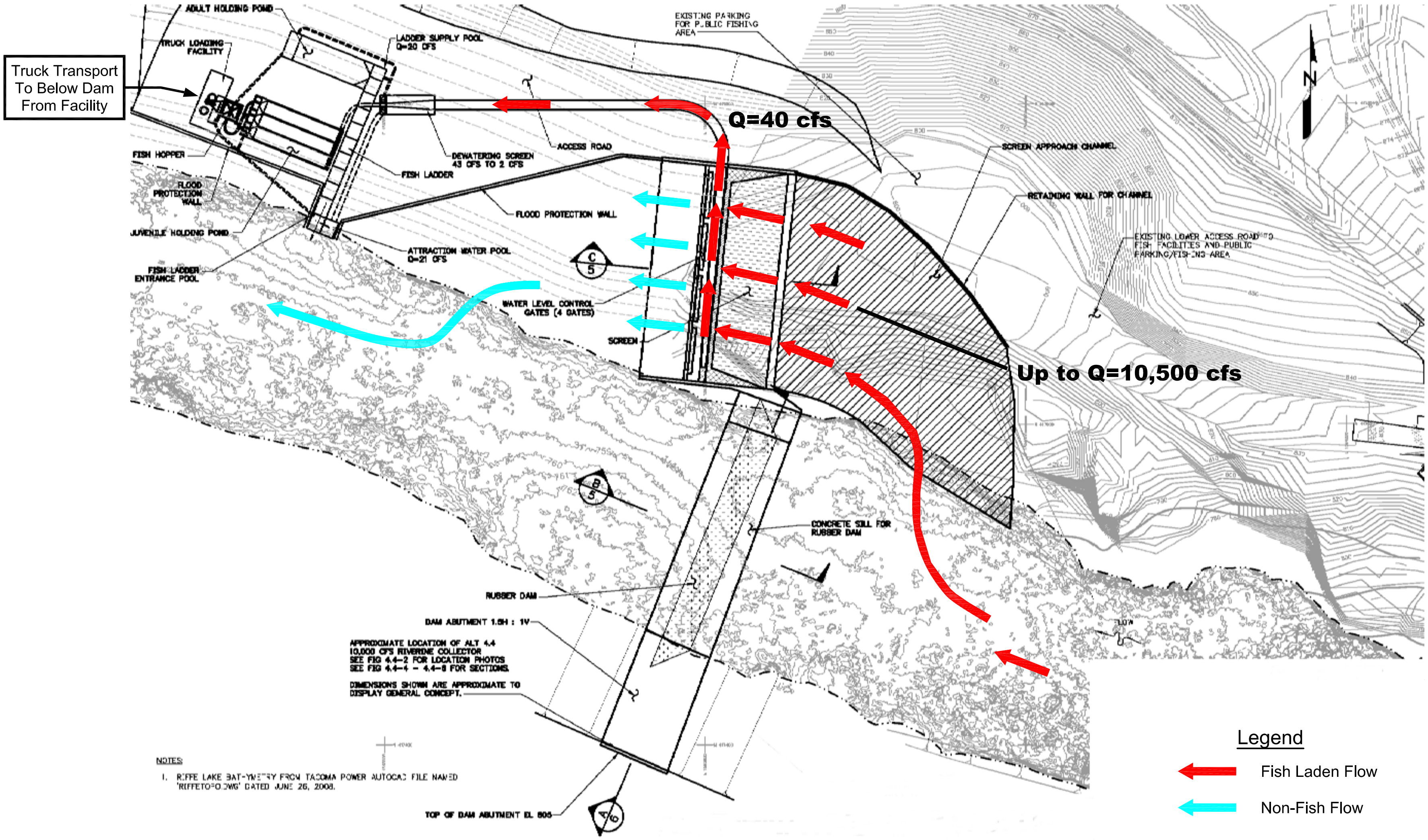
COWLITZ RIVERINE CONCEPT SITE MAP

Willamette Downstream Fish Passage Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

FIGURE NUMBER:	DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
3–3	KM	06/07/10	60148335–403	IW

FILENAME: 04—Cowlitz



100 75 50 25 0 50 100

Approximate Scale: 1" = 100'

Source: R2 Resource Consultants, Inc.
Figure 4.4-3, 04/27/09

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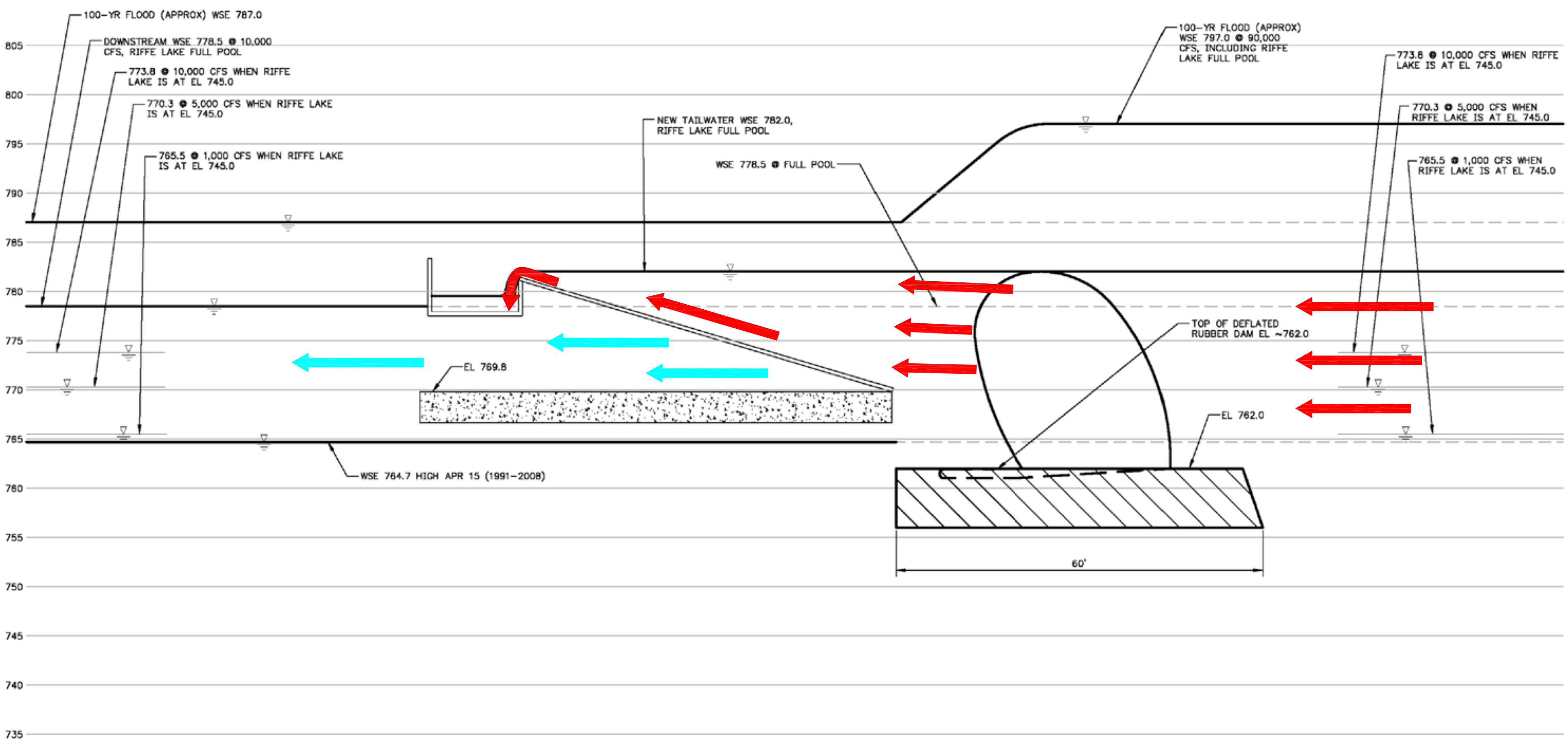
COWLITZ RIVERINE CONCEPT PLAN VIEW

Willamette Downstream Fish Passage
Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

FIGURE NUMBER:	DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
3-4	KM	06/10/10	60148335-403	IW

FILENAME: 05—Cowlitz



Not to Scale

Legend

Fish Laden Flow

Non-Fish Flow

Source: R2 Resource Consultants, Inc.
Figure 4.4—4, 04/27/09

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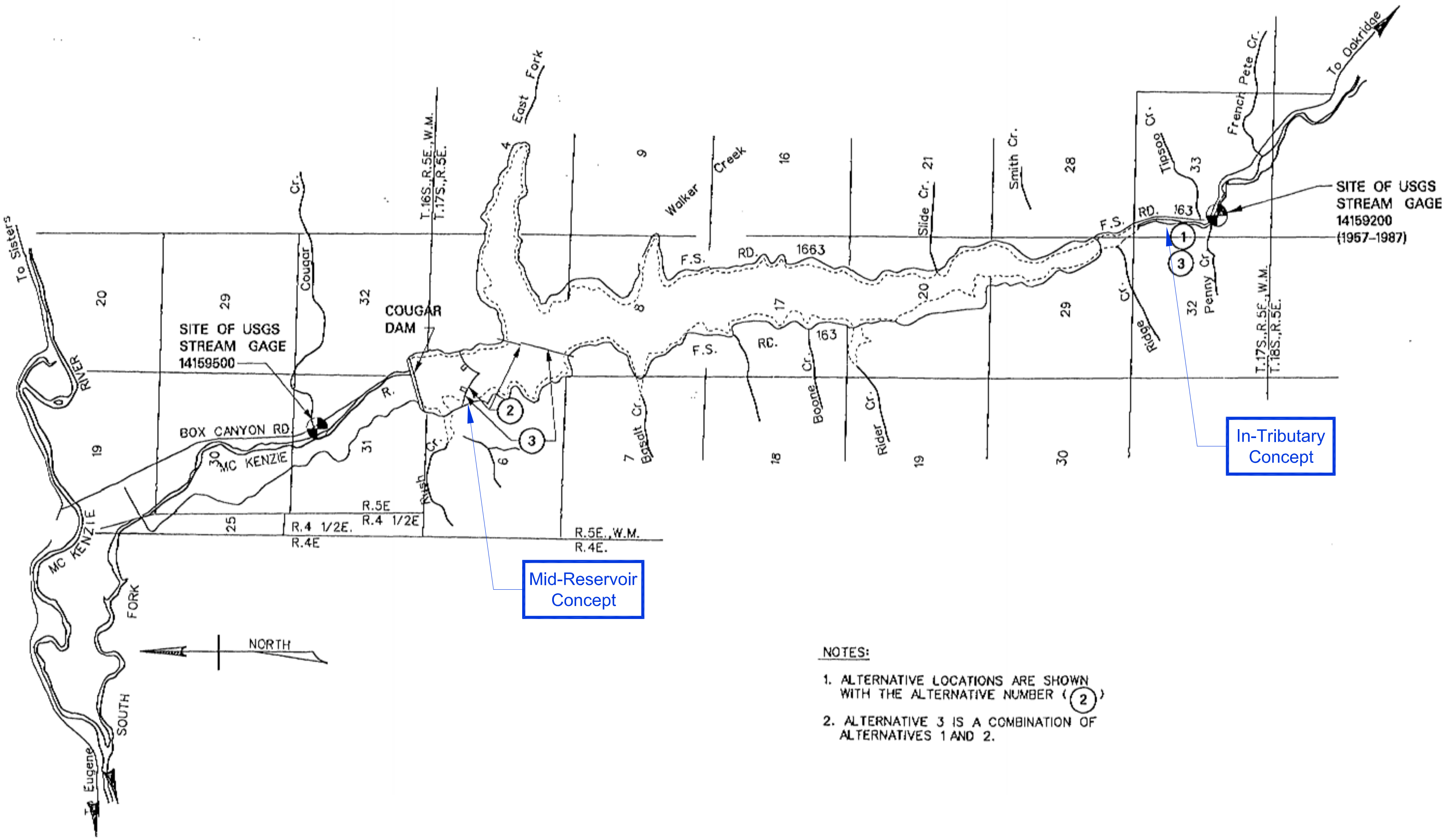
COWLITZ RIVERINE CONCEPT PROFILE VIEW

Willamette Downstream Fish Passage
Design Requirements
U.S. Army Corps of Engineers — Portland District
Portland, Oregon

FIGURE NUMBER:
3—5

DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
RC/KM	05/31/10	60148335—403	IW

FILENAME: 06–Cougar



NOTES:

1. ALTERNATIVE LOCATIONS ARE SHOWN WITH THE ALTERNATIVE NUMBER (2)
2. ALTERNATIVE 3 IS A COMBINATION OF ALTERNATIVES 1 AND 2.

6,000 | 4,000 | 2,000 | 0 | 3,000 | 6,000

Aproximate Scale: 1" = 3,000'

Source: CH2MHILL/Montgomery Watson Joint Venture
Plate 6, May 2000

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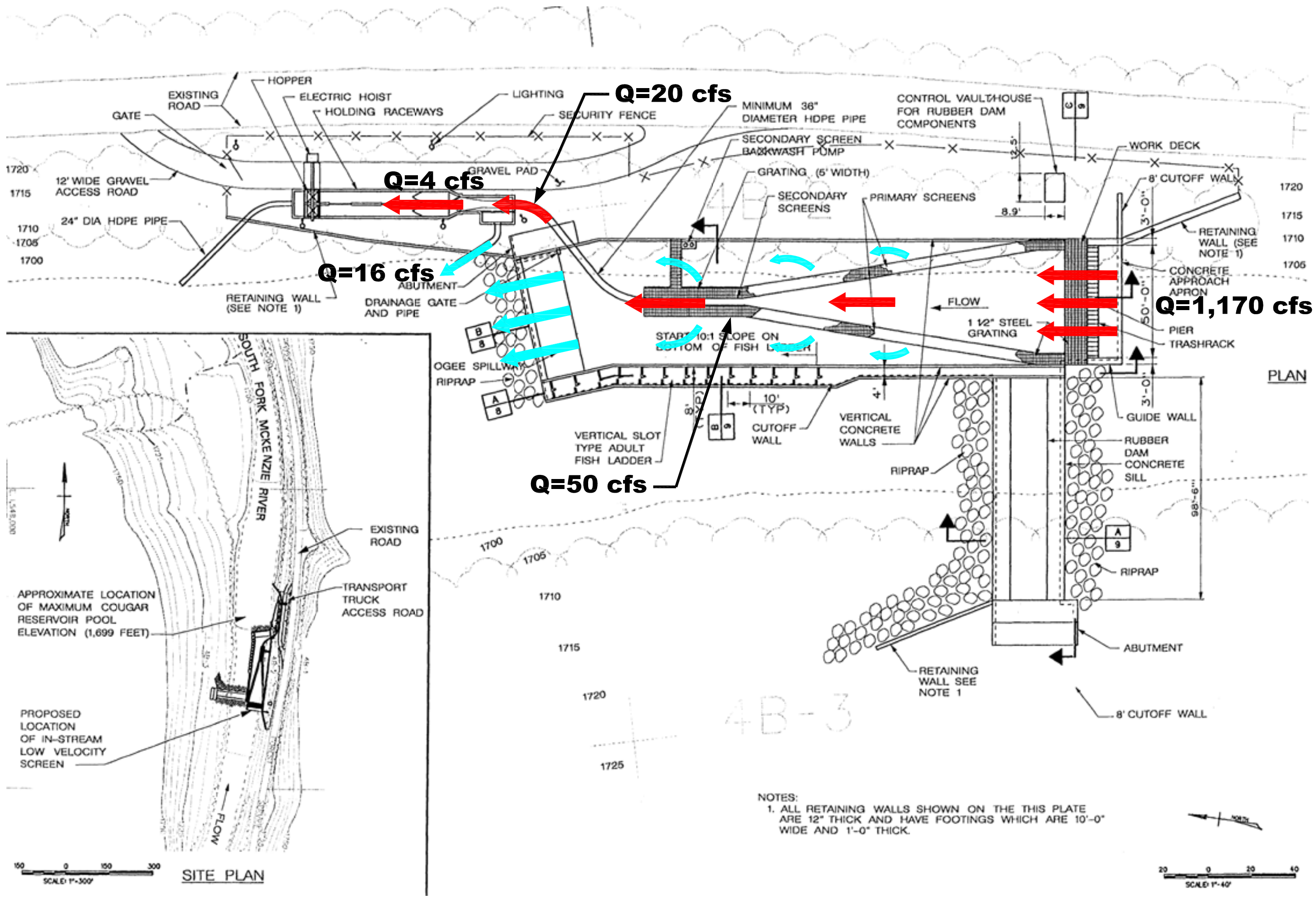
COUGAR DAM SITE PLAN

Willamette Downstream Fish Passage
Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

FIGURE NUMBER:	DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
3–6	KM	05/31/10	60148335–403	IW

FILENAME: 07–Cougar



Legend

Fish Laden Flow

Non-Fish Flow

125 100 75 50 25 0 125

Aproximate Scale: 1" = 125'

Source: CH2MHILL/Montgomery Watson Joint Venture Plate 7, May 2000

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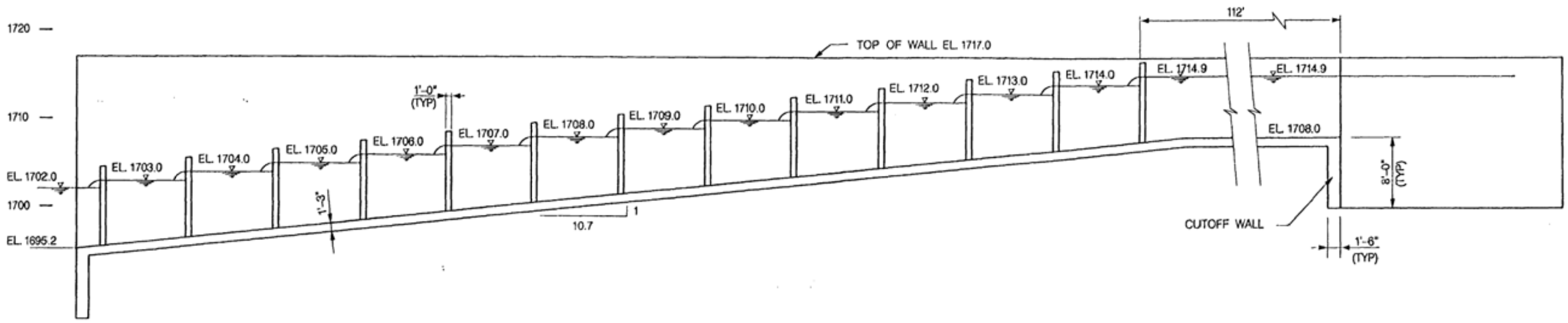
COUGAR DAM IN–TRIBUTARY PLAN

Willamette Downstream Fish Passage
Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

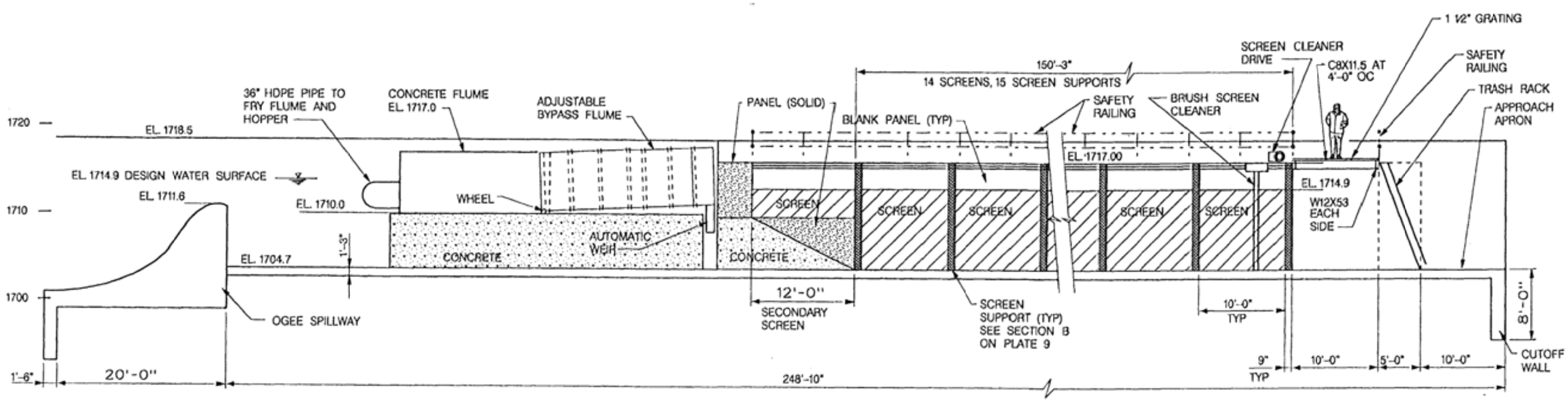
FIGURE NUMBER:	
3–7	

DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
KM	06/09/10	60148335–403	IW

FILENAME: 08–Cougar



SECTION A/7
NTS



SECTION B/7
NTS

Not to Scale

AECOM	COUGAR DAM IN-TRIBUTARY PROFILE		FIGURE NUMBER:
ENVIRONMENT 9521 WILLOWS ROAD NE REDMOND, WASHINGTON 98052 PHONE: (425) 881-7700 FAX: (425) 883-4473 WEB: HTTP://WWW.AECOM.COM	Willamette Downstream Fish Passage Design Requirements U.S. Army Corps of Engineers – Portland District Portland, Oregon		3–8
DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
KM	05/31/10	60148335–403	IW

Source: CH2MHILL/Montgomery Watson Joint Venture
Plate 6, May 2000

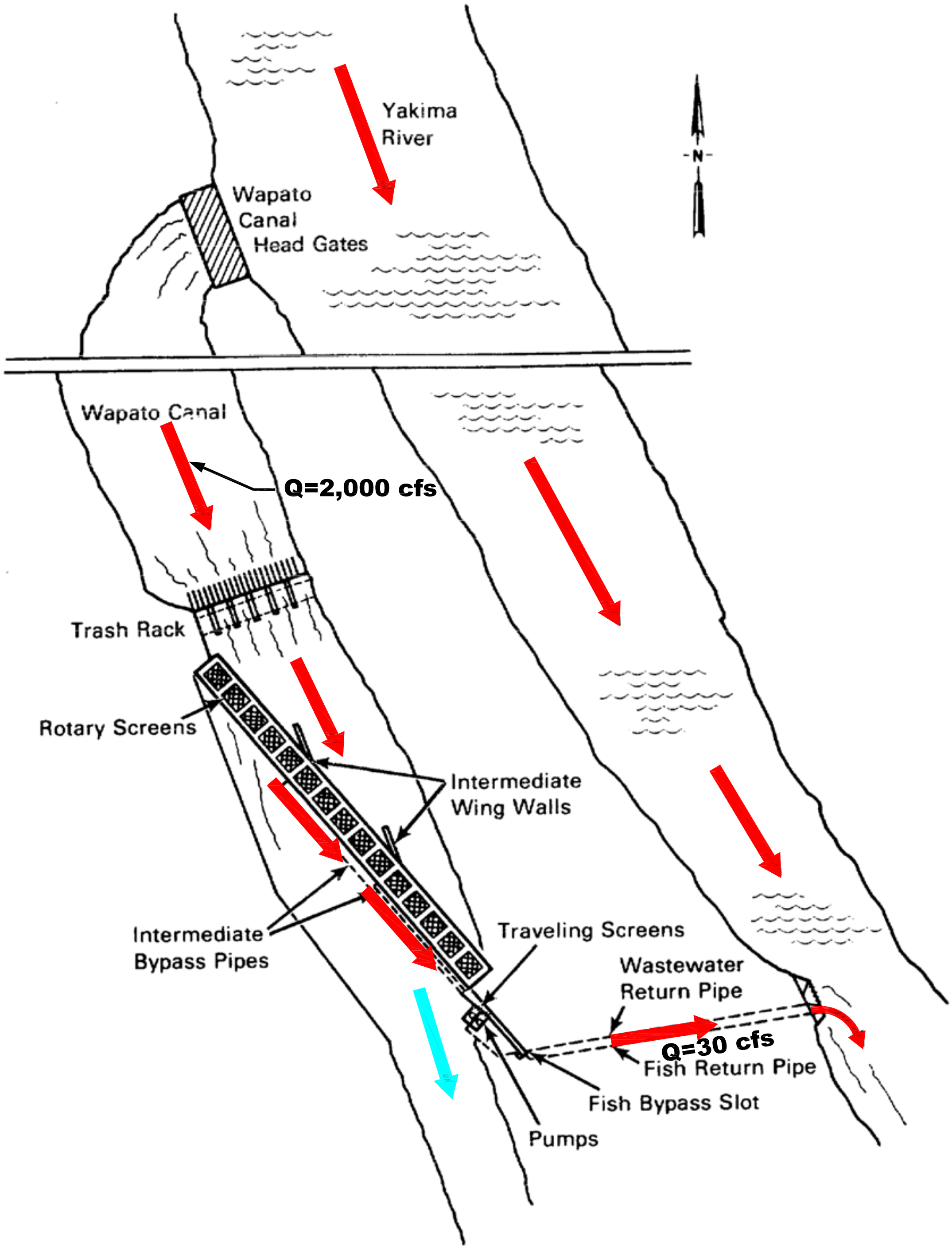


FIGURE 4. Flow Control Structure and Fish Bypass System in the Wapato Canal Fish Screening Facility

Legend

Fish Laden Flow

Non-Fish Flow

Source: A Fisheries Evaluation of the Richland and Wapato Fish Screening Facilities, (Annual Report), by Pacific Northwest Laboratory, 1987.

Not to Scale

FILENAME: 09-Wapato

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WAPATO CANAL FISH SCREENING FACILITY

Willamette Downstream Fish Passage Design Requirements
U.S. Army Corps of Engineers – Portland District
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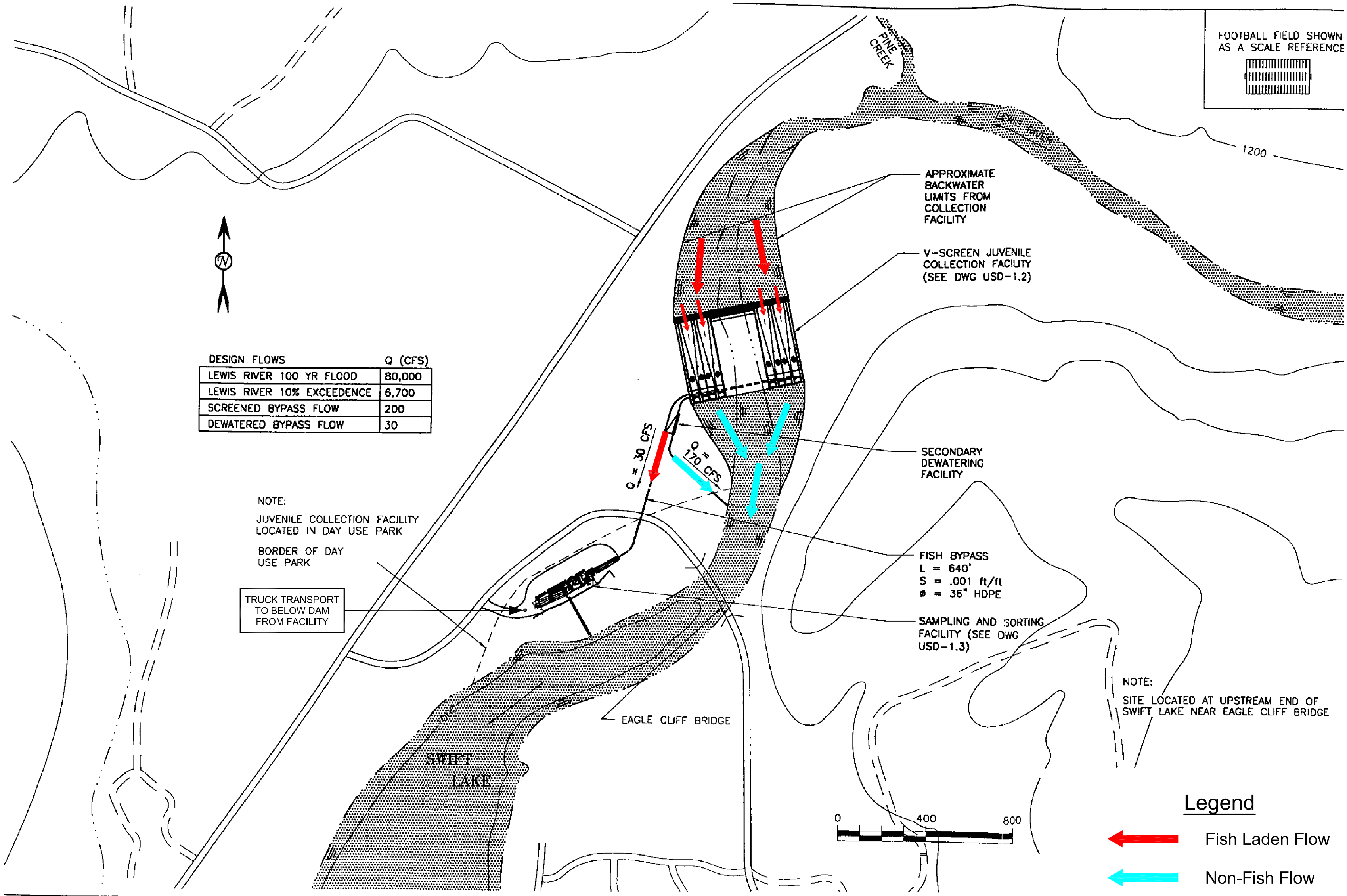
FIGURE NUMBER:
3-9

DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
KM	06/08/10	60148335-403	IW

FILENAME: 10–Swift Plan



DESIGN FLOWS	Q (CFS)
LEWIS RIVER 100 YR FLOOD	80,000
LEWIS RIVER 10% EXCEEDENCE	6,700
SCREENED BYPASS FLOW	200
DEWATERED BYPASS FLOW	30

700 0 350 700

Aproximate Scale: 1" = 700'

Source: PacificCorp/HARZA Engineering "Upper Swift Juvenile Collection Plan" Lewis River Hydro Project, July 2001

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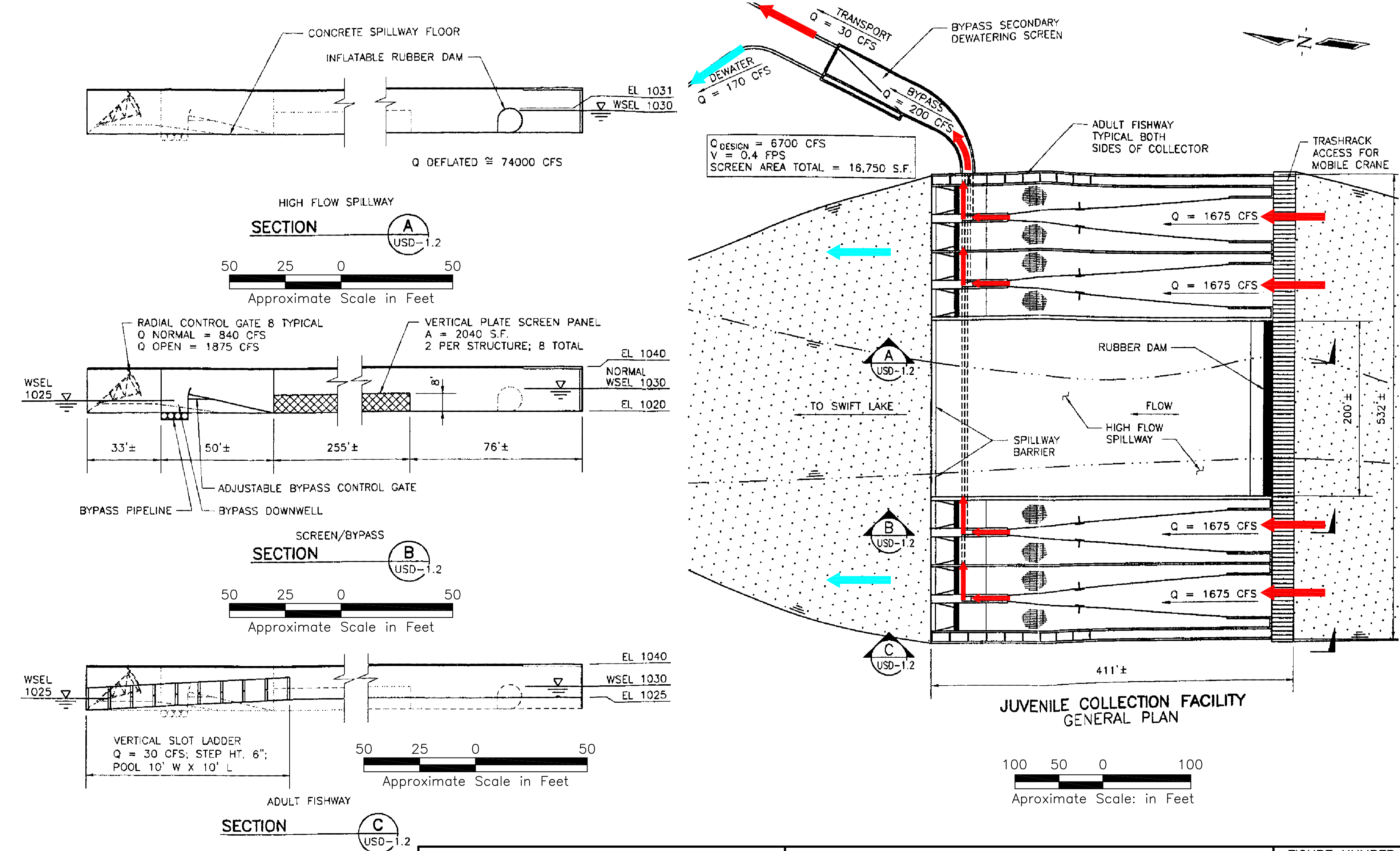
SWIFT SITE MAP

Willamette Downstream Fish Passage
Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

FIGURE NUMBER:			
3–10			
DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
PC/HARZA/KM	06/10/10	60148335–403	IW

FILENAME: 11–Swift Plan and Sections



Legend

Fish Laden Flow

Non-Fish Flow

Source: PacificCorp/HARZA Engineering
"Upper Swift Enlarged Plan and Sections"
Lewis River Hydro Project, July 2001

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SWIFT ENLARGED PLAN AND SECTIONS

Willamette Downstream Fish Passage
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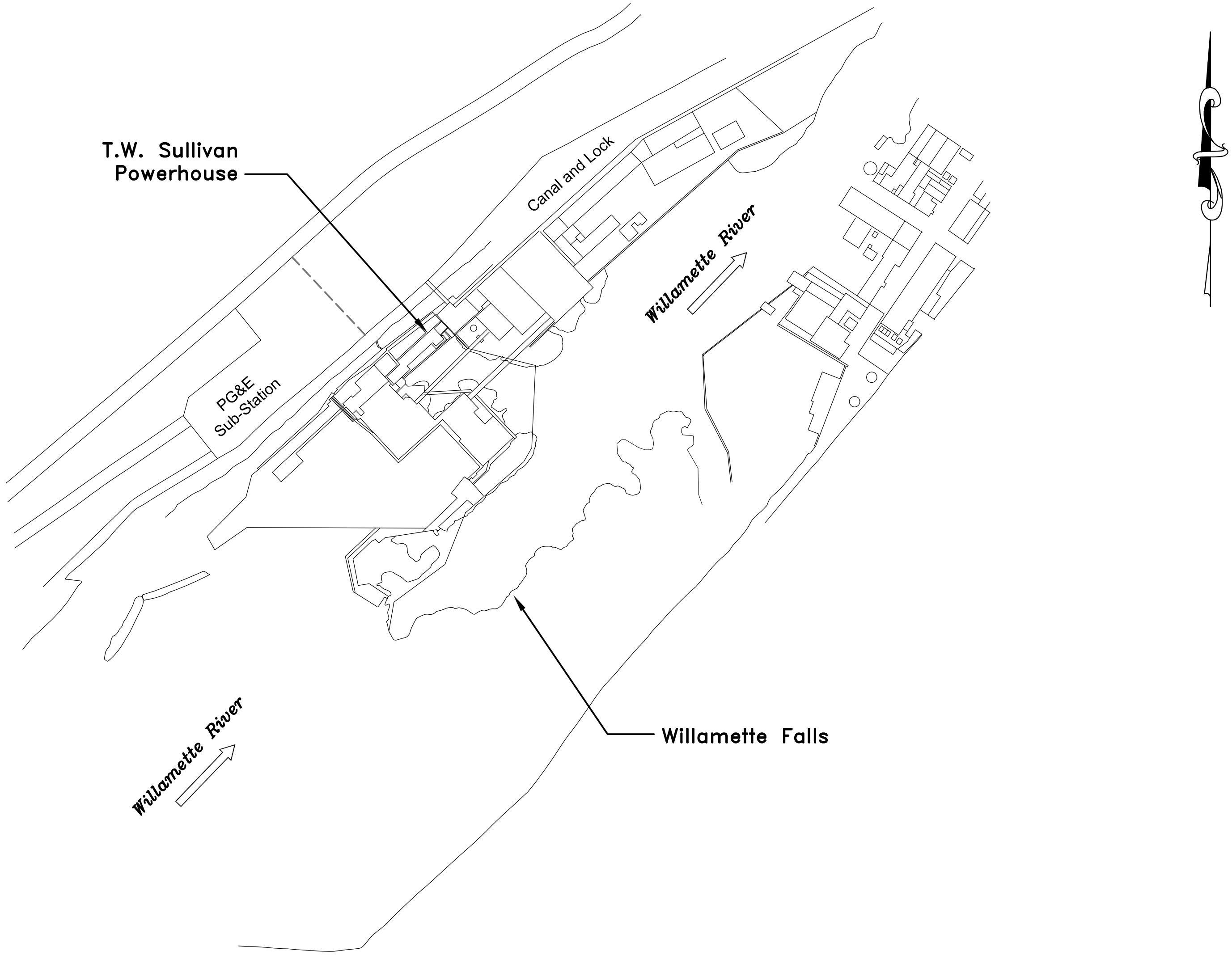
Portland, Oregon

FIGURE NUMBER:	DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
3–11	PC/HARZA/KM	06/07/10	60148335–403	IW

FILENAME: 12–Willamette Falls



Not to Scale

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WILLAMETTE FALLS SITE LOCATION

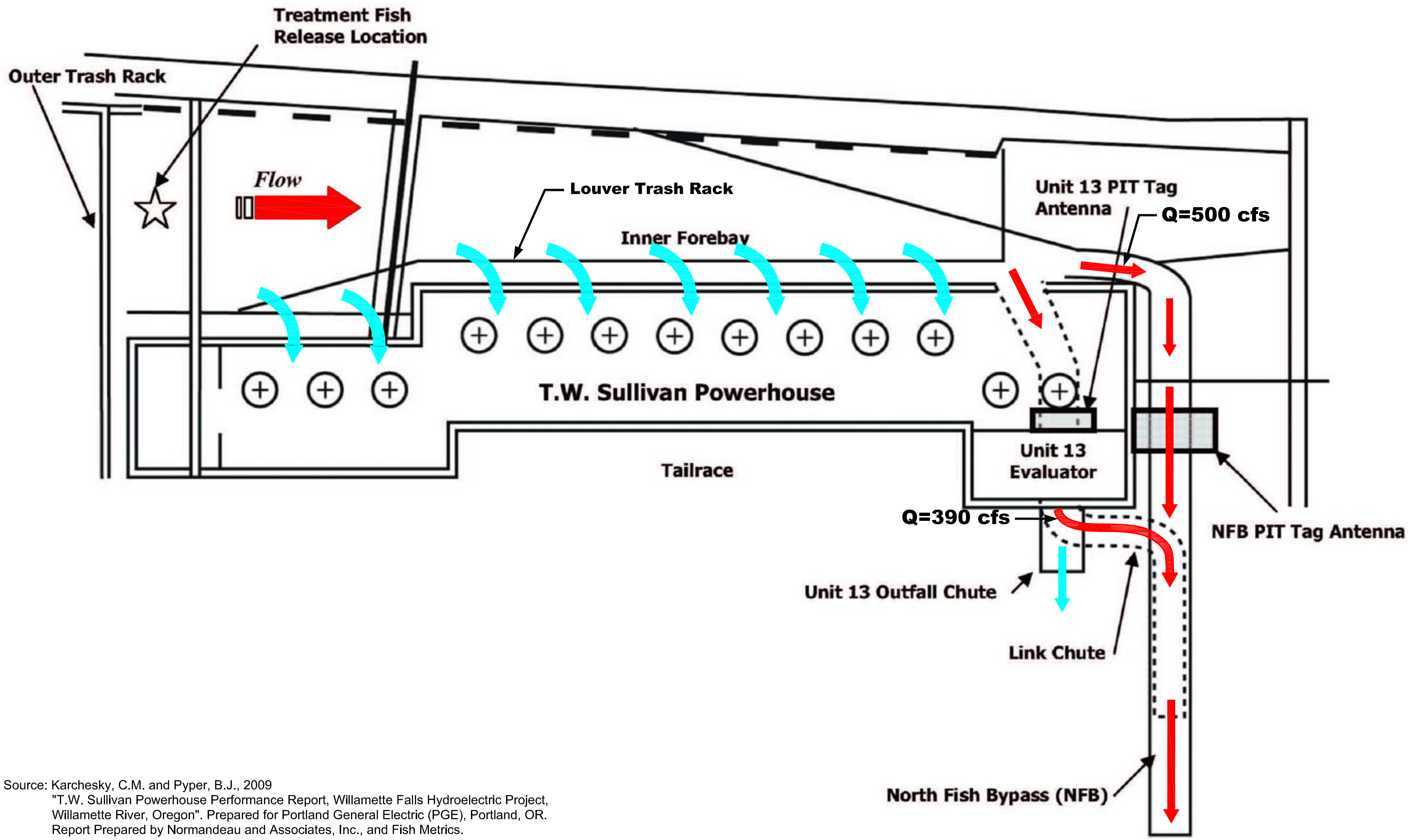
Willamette Downstream Fish Passage
Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

FIGURE NUMBER: 3–12

DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
KM	06/03/10	60148335–403	IW

Source: Karchesky, C.M. and Pyper, B.J. 2009. "T.W. Sullivan Powerhouse Performance Report, Willamette Falls Hydroelectric Project, Willamette River, Oregon". Prepared for Portland General Electric (PGE). Portland, OR. Report Prepared by Normandeau and Associates, Inc., and Fish Metrics.

FILENAME: 13-Willamette Falls



Source: Karchesky, C.M. and Pyper, B.J., 2009
"T.W. Sullivan Powerhouse Performance Report, Willamette Falls Hydroelectric Project, Willamette River, Oregon". Prepared for Portland General Electric (PGE), Portland, OR. Report Prepared by Normandeau and Associates, Inc., and Fish Metrics.

Legend

- Fish Laden Flow
- Non-Fish Flow

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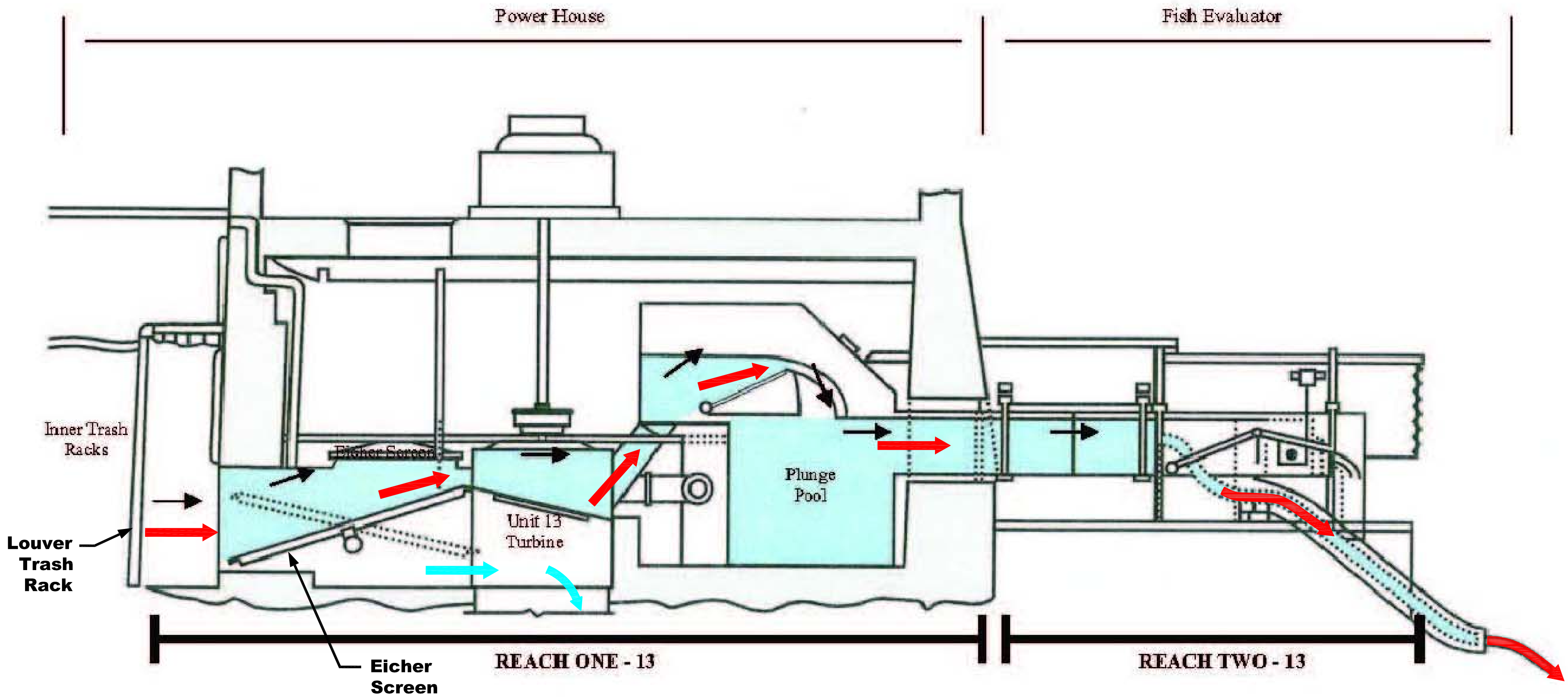
WILLAMETTE FALLS - T.W. SULLIVAN FOREBAY AND BYPASS FACILITIES
Willamette Downstream Fish Passage Design Requirements
U.S Army Corps of Engineers - Portland District
Portland, Oregon

FIGURE NUMBER: 3-13

DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
KM	06/08/10	60148335-403	IW

FILENAME: 14-Willamette Falls



Source: Karchesky, C.M. and Pyper, B.J., 2009
"T.W. Sullivan Powerhouse Performance Report, Willamette Falls Hydroelectric Project, Willamette River, Oregon". Prepared for Portland General Electric (PGE), Portland, OR. Report Prepared by Normandeau and Associates, Inc., and Fish Metrics.

Legend

Fish Laden Flow

Non-Fish Flow

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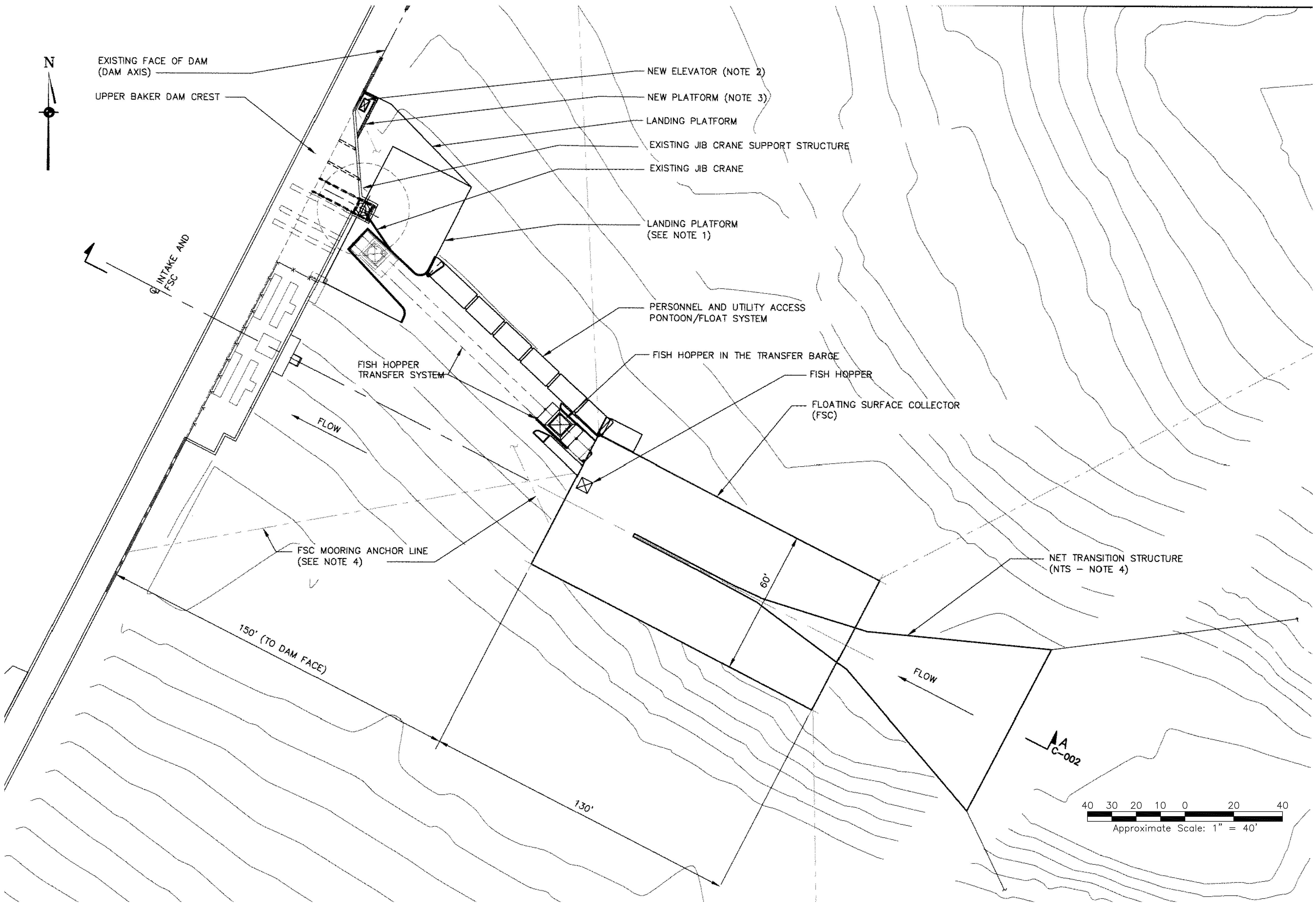
WILLAMETTE FALLS-T.W. SULLIVAN UNIT 13 FISH BYPASS CROSS-SECTION

Willamette Downstream Fish Passage Design Requirements
U.S. Army Corps of Engineers - Portland District
Portland, Oregon

FIGURE NUMBER: 3-14

DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
KM	06/03/10	60148335-403	IW



Source: Washington Group International,
Puget Sound Energy,
Upper Baker "Overall Site Plan"
Drawing #: C-001 April 7, 2006

REVISIONS			
NO:	DESCRIPTION:	DATE:	BY:

DESIGNED BY: IW
DRAWN BY: KM
CHECKED BY: IW
APPROVED BY: CS

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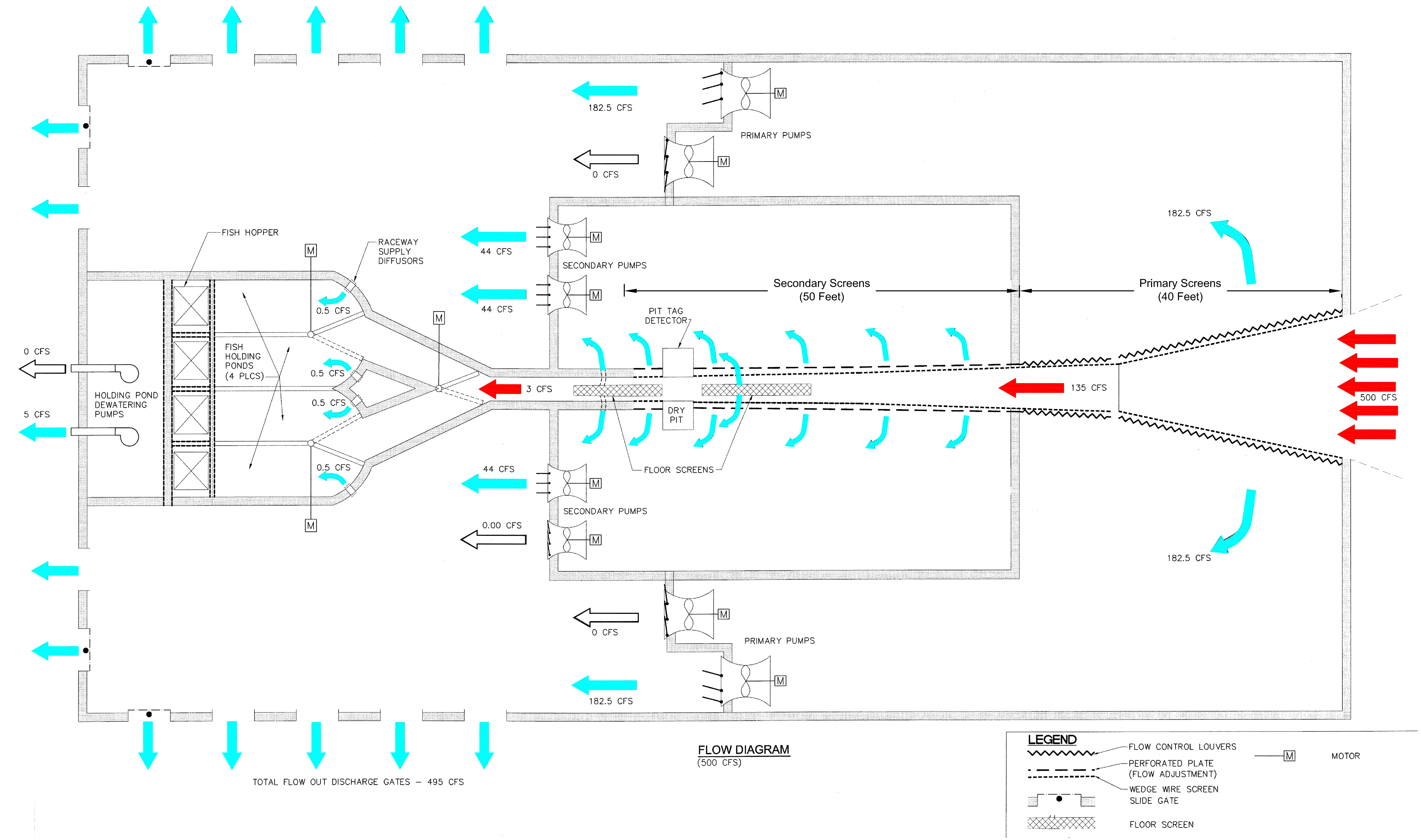
UPPER BAKER FLOATING SURFACE COLLECTOR – OVERALL SITE PLAN
Willamette Downstream Fish Passage
Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

SCALE:	DATE:	PROJECT NUMBER:
1" = 40'	05/31/10	60148335-403

FIGURE NUMBER:
3–15

FILENAME:
Upr–Bkr–Site Map



Source: Puget Sound Energy, Washington Group, Internatonal
Drawing No. GA-013.dwg "Screened Water Flow Diagram"
February 9, 2007

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APPROVED BY: CS

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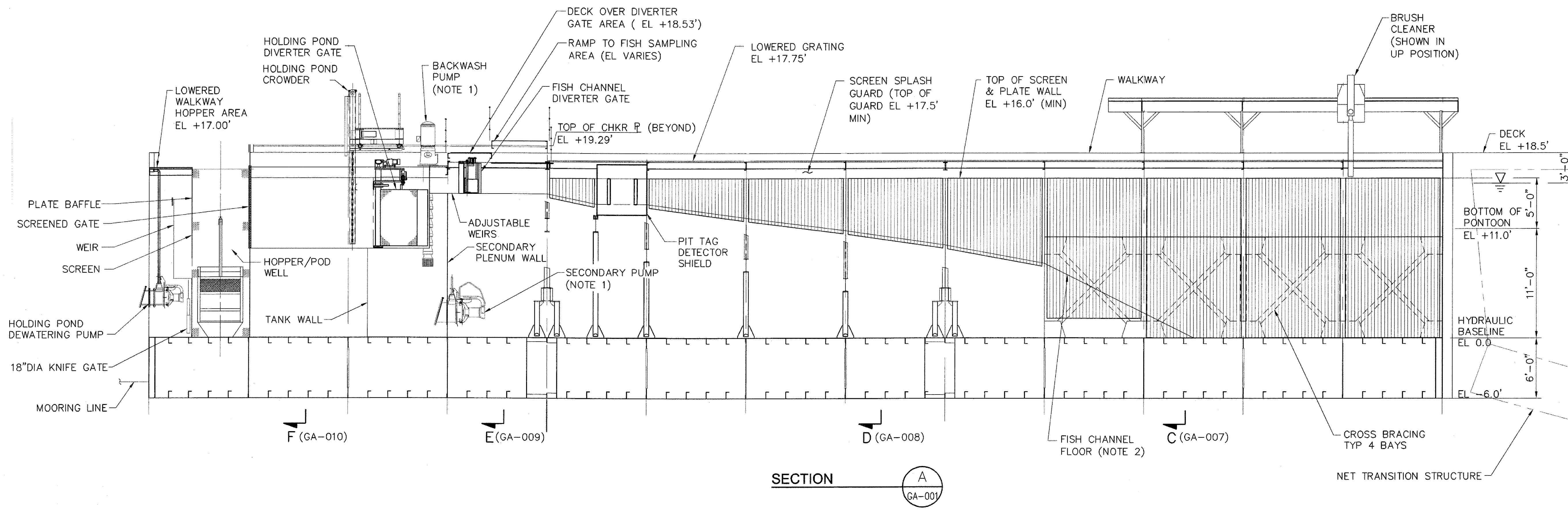
UPPER BAKER FLOATING SURFACE COLLECTOR - PLAN VIEW

Willamette Downstream Fish Passage Design Requirements
U.S. Army Corps of Engineers - Portland District
Portland, Oregon

PROJECT NUMBER: 60148335-403
DATE: 06/03/10
SCALE: Not to Scale

FIGURE NUMBER:
3–16

FILENAME:
Up-Baker-Pln



Source: Puget Sound Energy, Washington Group, Internatonal Drawing No. GA-014.dwg "General Arrangement, Hydraulic Data", February 9, 2007

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DRAWN BY: KM
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APPROVED BY: CS

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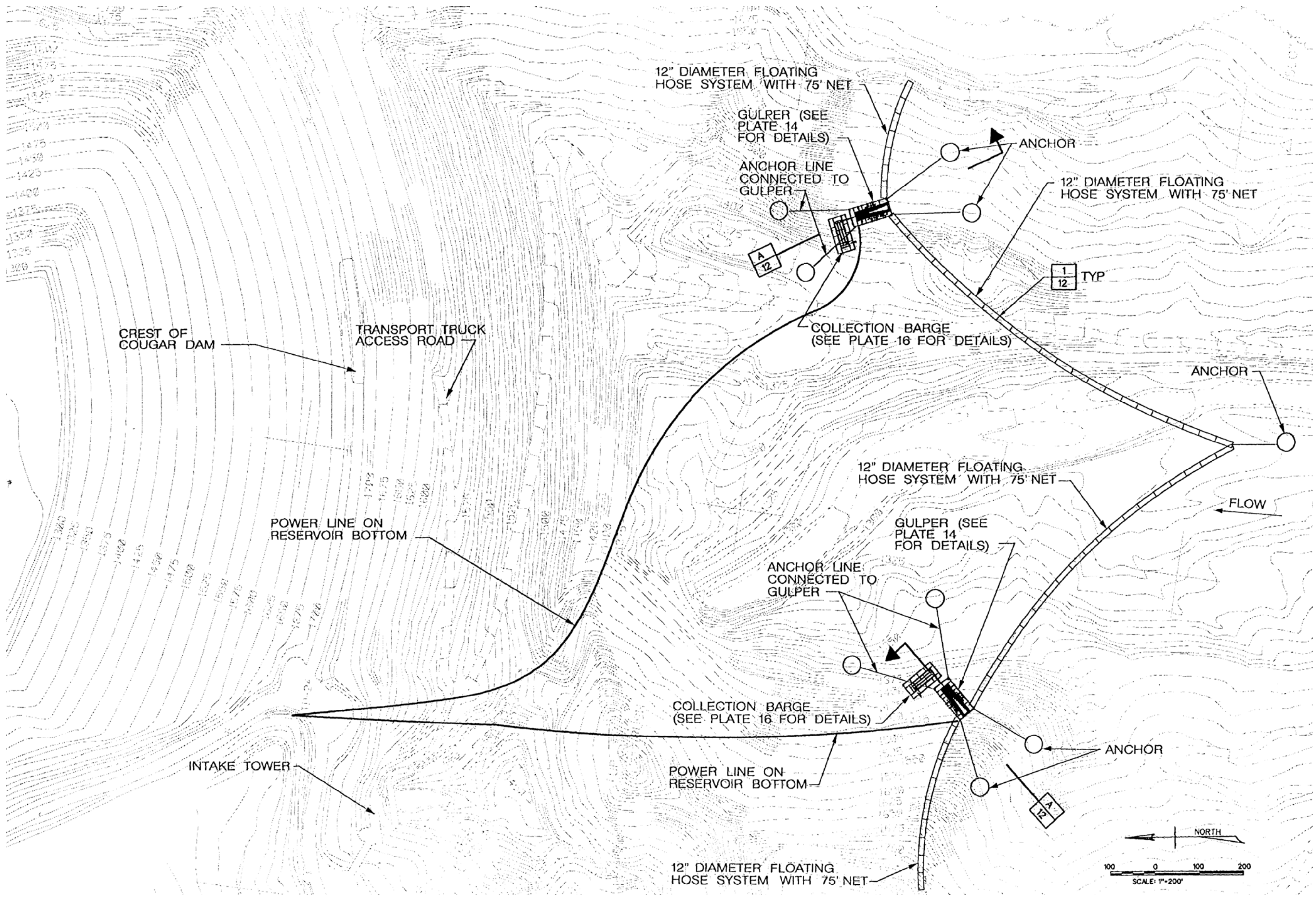
UPPER BAKER FLOATING SURFACE COLLECTOR – ELEVATION VIEW

Willamette Downstream Fish Passage
Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

SCALE:	DATE:	PROJECT NUMBER:
Not to Scale	05/31/10	60148335-403

FIGURE NUMBER:
3-17

FILENAME:
Up-Baker-Pro



Source: CH2MHILL/Montgomery Watson Joint Venture
Drawing Name: Plot-All.dgn May 2000

DESIGNED BY:	DRAWN BY:	CHECKED BY:	APPROVED BY:
IW	KM	IW	CS

REVISIONS		
NO:	DESCRIPTION:	DATE:	BY:

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COUGAR IN-RESERVOIR PLAN VIEW

Willamette Downstream Fish Passage
Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

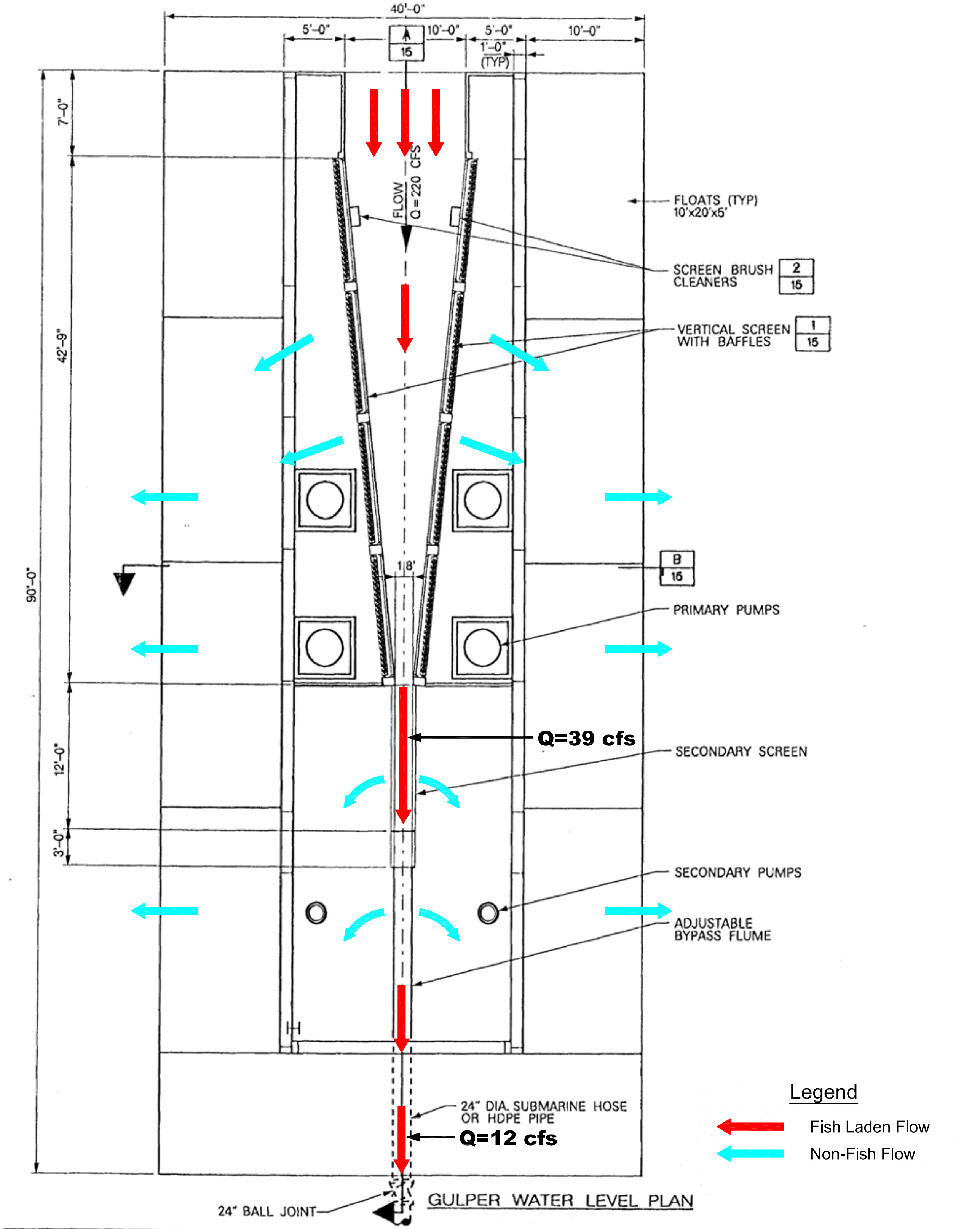
SCALE:	DATE:	PROJECT NUMBER:
Not to Scale	05/31/10	60148335-403

FIGURE NUMBER:

3–18

FILENAME:

Cougar–Lg–Pln



Source: CH2MHILL/Montgomery Watson Joint Venture
Drawing Name: Plate-14.dgn May 2000

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COUGAR RESERVOIR GULPER PLAN VIEW

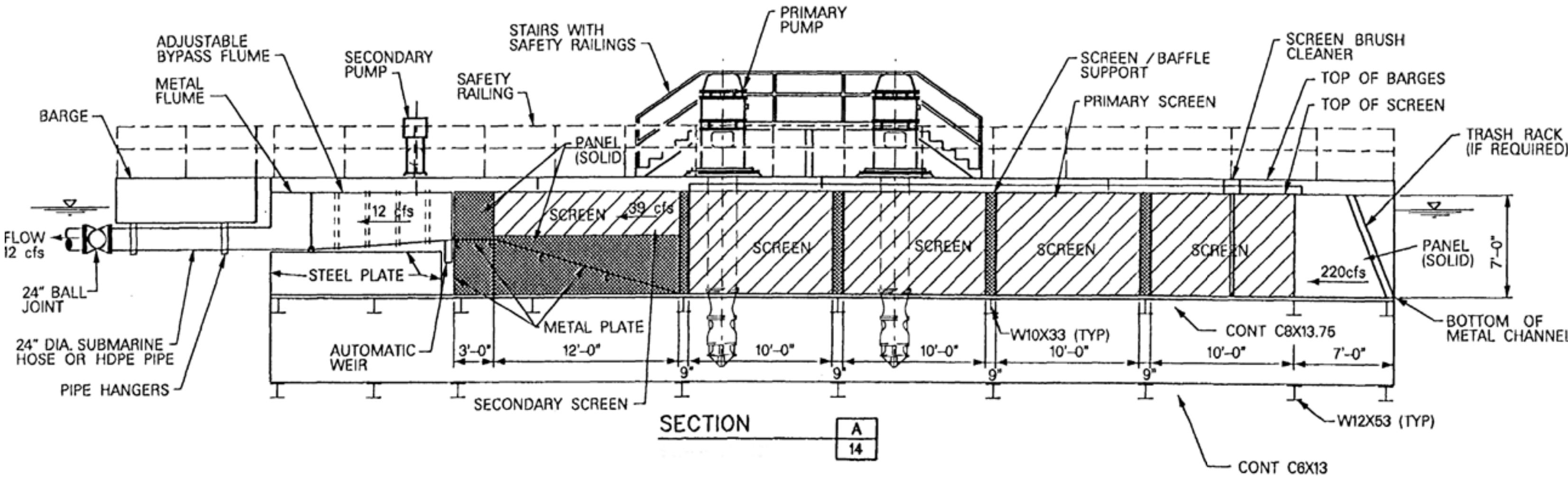
Willamette Downstream Fish Passage Design Requirements
U.S. Army Corps of Engineers - Portland District
Portland, Oregon

FIGURE NUMBER: 3–19

DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
KM	06/08/10	60148335-403	IW

FILENAME: 19-Cougar-Glp-Pln

FILENAME: 20-Cougar-Glp-Sec



12 9 6 3 0 6 12

Approximate Scale: 1" = 12'

Source: CH2MHILL/Montgomery Watson Joint Venture
Drawing Name: Plate-15.dgn May 2000

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COUGAR RESERVOIR GULPER SECTION VIEW

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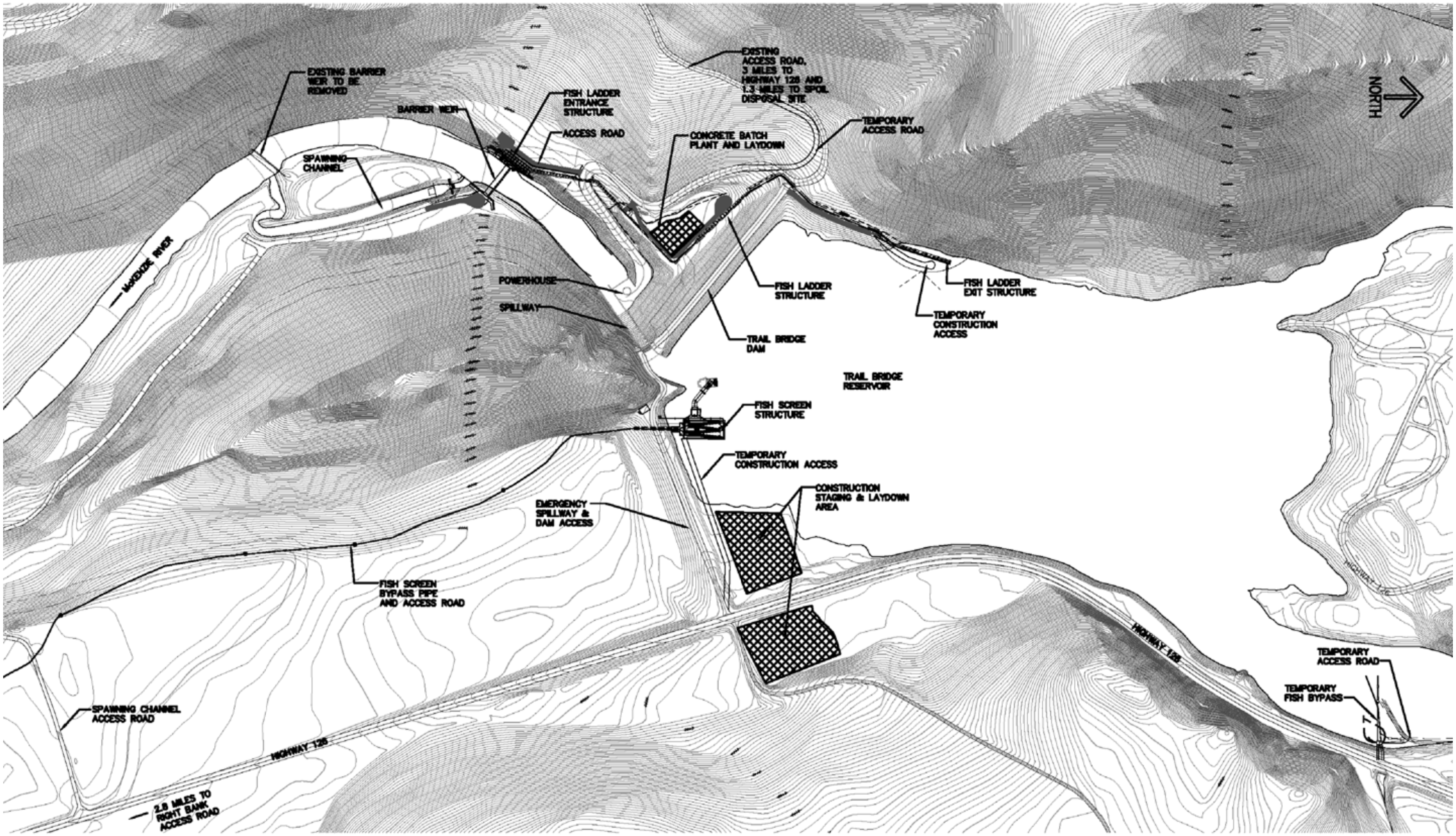
Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

FIGURE NUMBER:
3-20

DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
KM	05/31/10	60148335-403	IW

FILENAME: 21-CS-Site Map



500 300 100 400 200 0 250 500

Approximate Scale: 1" = 500'

Source: Eugene Water and Electric Board
Figure C-9, July 17, 2007

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CARMEN-SMITH HYDROELECTRIC PROJECT
TRAIL BRIDGE DAM VICINITY MAP

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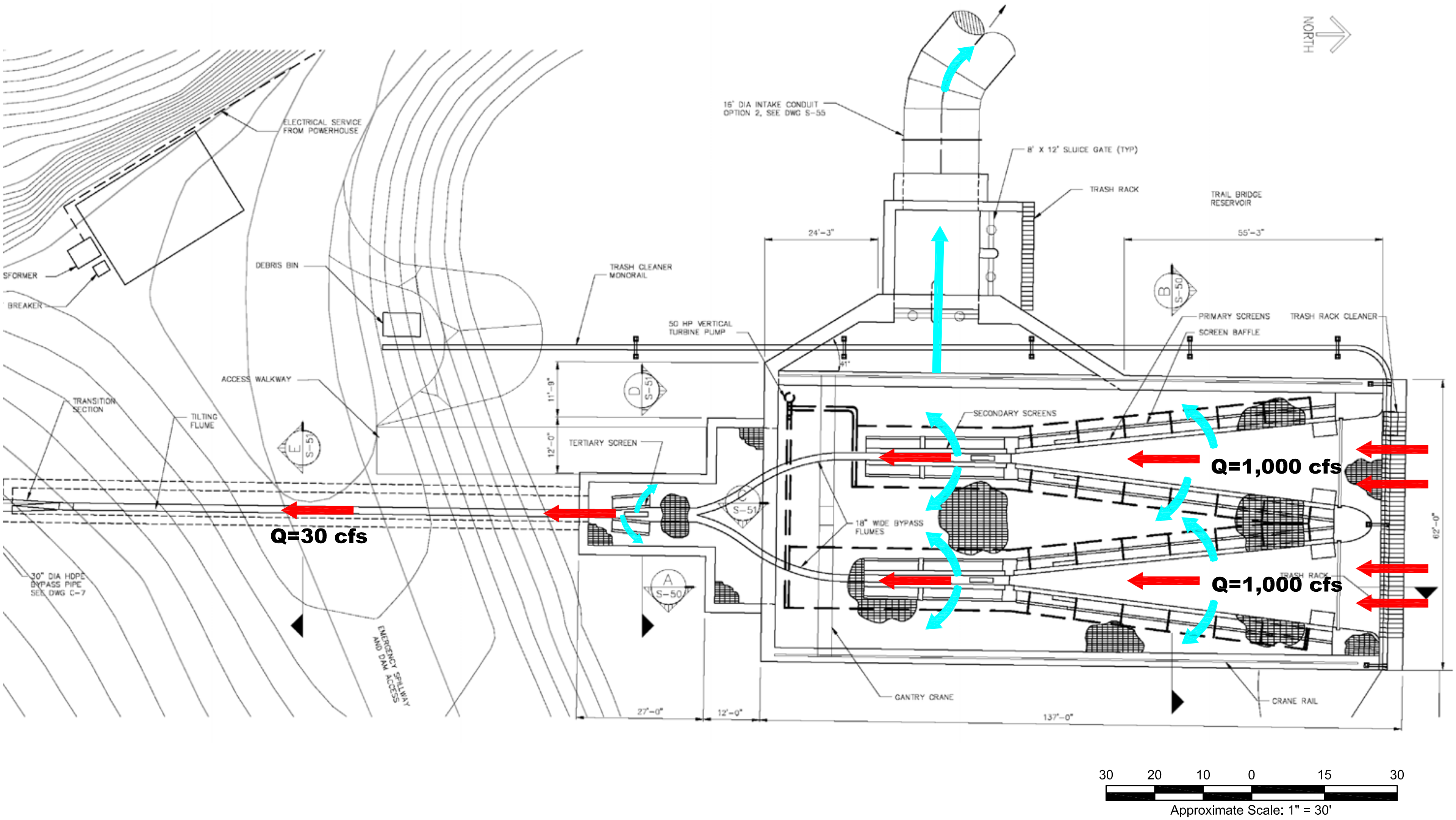
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

FIGURE NUMBER:
3-21

DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
KM	05/31/10	60148335-403	IW

FILENAME: 22-CS-FS-Plan



Legend

Fish Laden Flow

Non-Fish Flow

Source: Eugene Water and Electric Board Figure S-29, July 17, 2007

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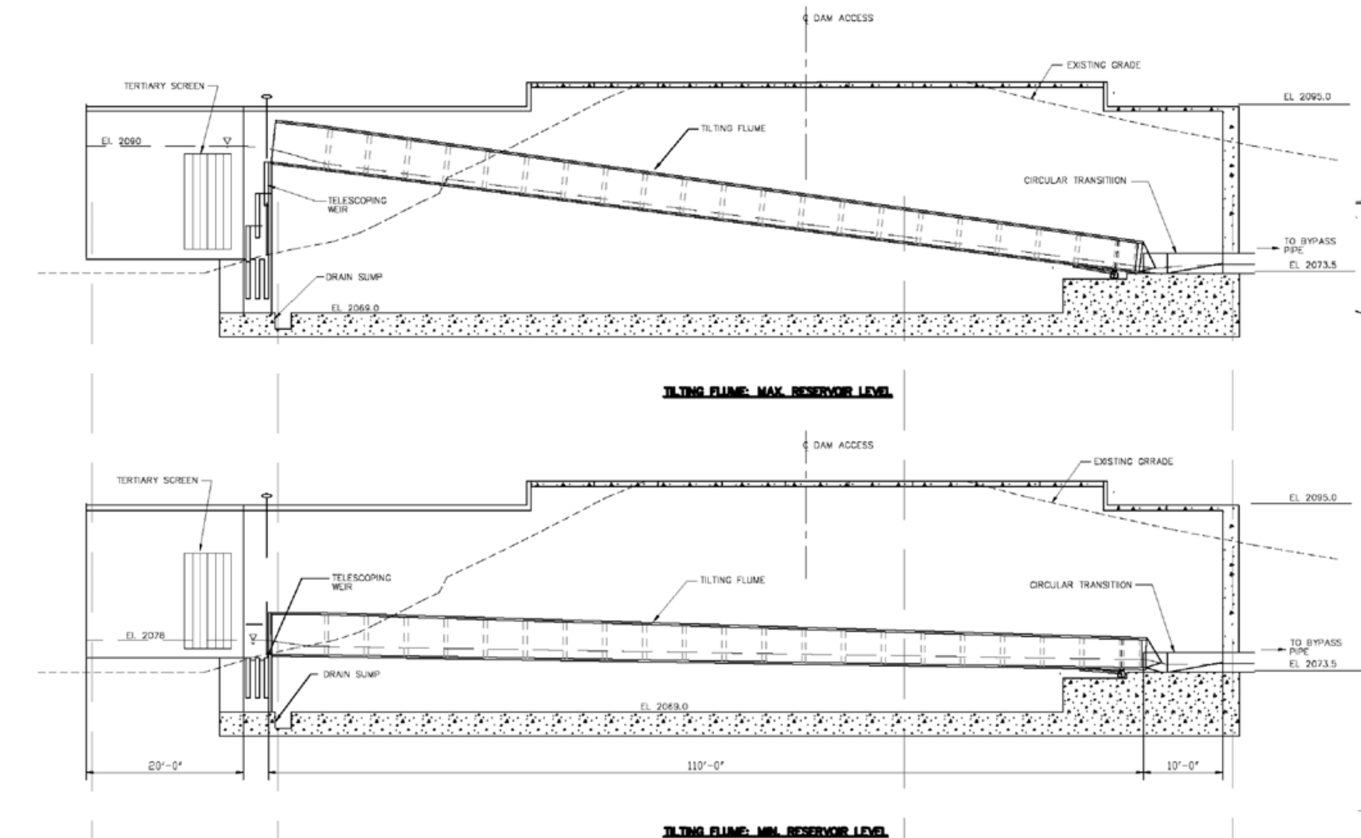
CARMEN-SMITH HYDROELECTRIC PROJECT
TRAIL BRIDGE DAM FISH PASSAGE - PLAN VIEW

Willamette Downstream Fish Passage Design Requirements
U.S. Army Corps of Engineers - Portland District
Portland, Oregon

FIGURE NUMBER:
3-22

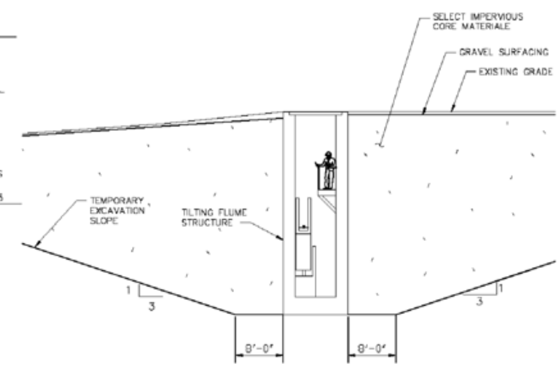
DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
KM	06/08/10	60148335-403	IW

FILENAME: 23-CS-Tilt-Flume

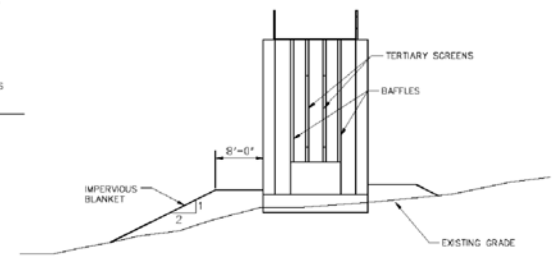


MAX RES. LEVEL	d=14.2 FT V=4.7 FT/S	d=2.3 FT V=8.4 FT/S	d=0.79 FT V=25.3 FT/S
MIN RES. LEVEL	d=2.3 FT V=9.0 FT/S	d=2.3 FT V=8.6 FT/S	d=1.8 FT V=11.3 FT/S

SECTION C S-40
1" = 15'



SECTION E S-40
1" = 20'



SECTION D S-40
1" = 20'

Not to Scale

Source: Eugene Water and Electric Board
Figure S-51, July 3, 2007

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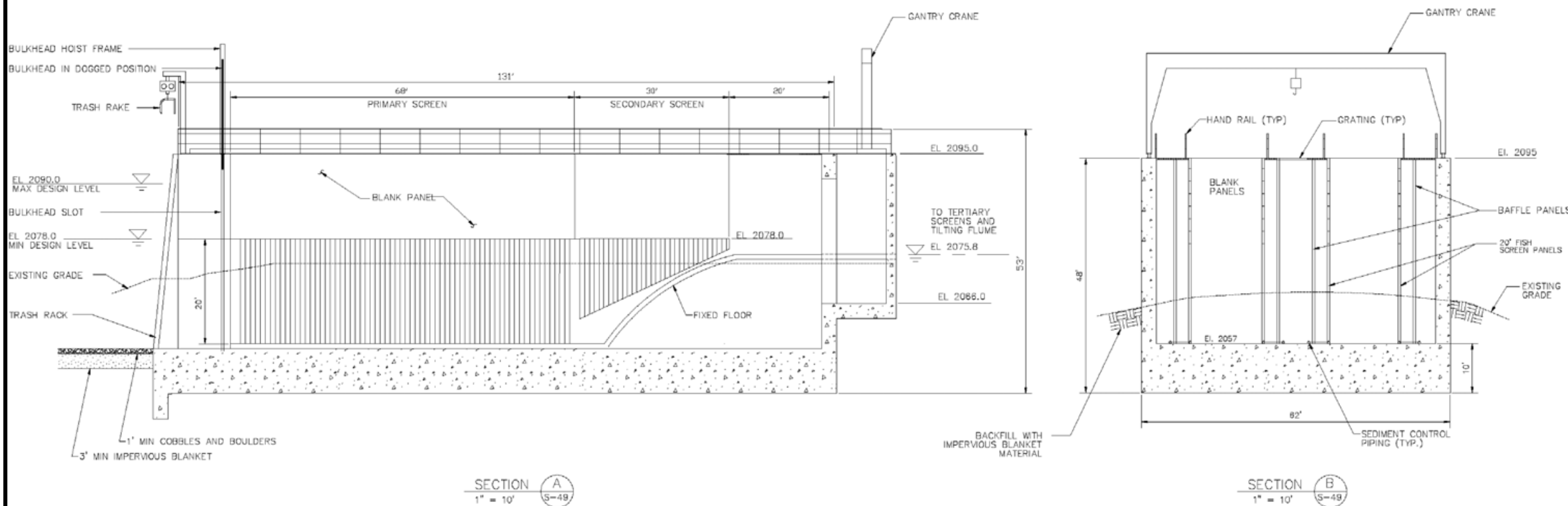
CARMEN-SMITH HYDROELECTRIC PROJECT
TRAIL BRIDGE DAM TILTING FLUME DETAIL
Willamette Downstream Fish Passage
Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

FIGURE NUMBER:	DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
3-23	KM	05/31/10	60148335-403	IW

FILENAME: 24-CS-FP-Sec



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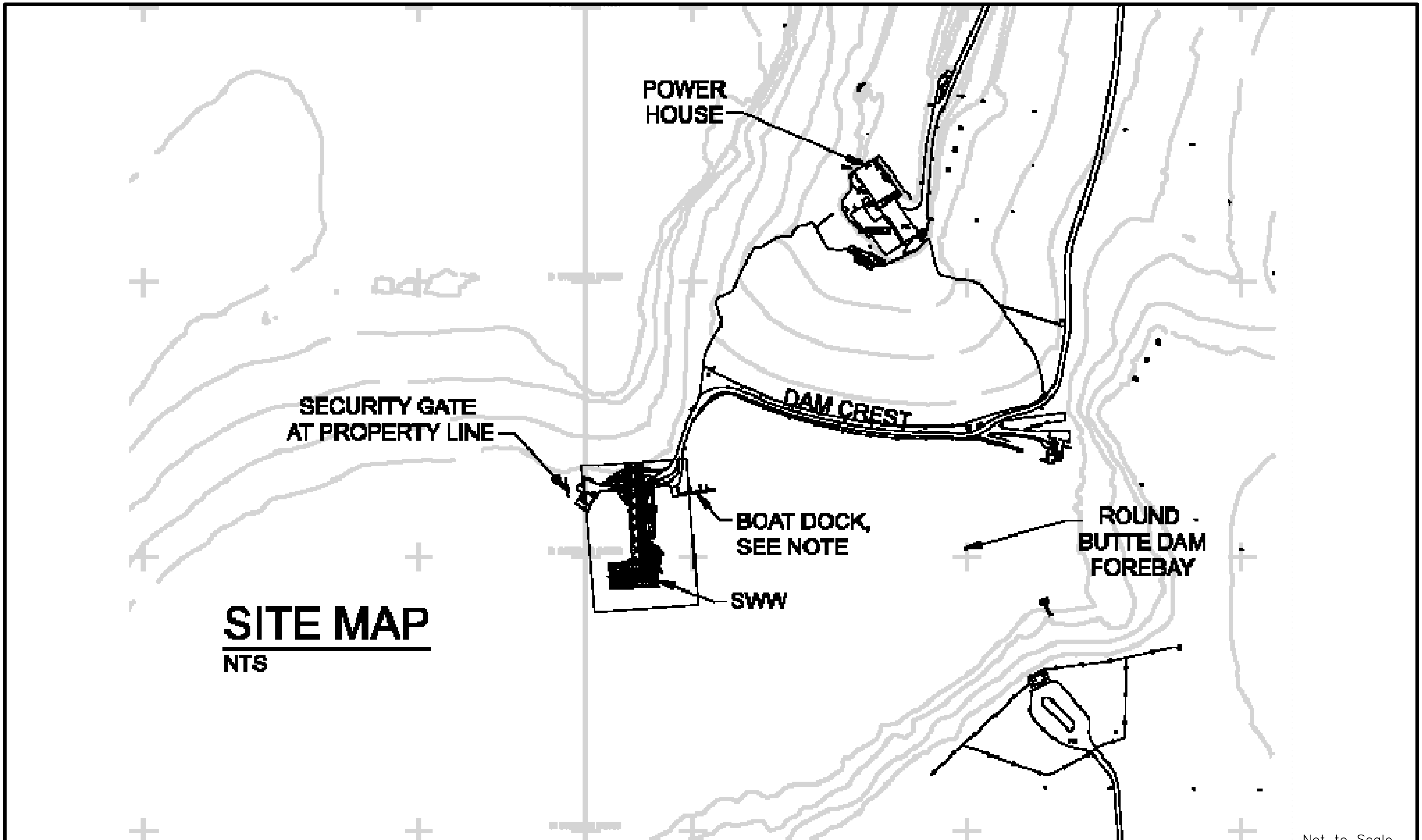
CARMEN-SMITH HYDROELECTRIC PROJECT
TRAIL BRIDGE DAM FISH PASSAGE SECTION

Willamette Downstream Fish Passage
Design Requirements
U.S. Army Corps of Engineers - Portland District
Portland, Oregon

FIGURE NUMBER:	DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
3-24	KM	05/31/10	60148335-403	IW

Source: Eugene Water and Electric Board
Figure S-50, July 31, 2007

FILENAME: 25-RB-Site Plan



Not to Scale

Source: CH2MHILL/Portland General Electric, Round Butte Selective Water Withdrawal "SWW – General Vicinity Maps" Drawing: RB-SWW-G-005, May 2007

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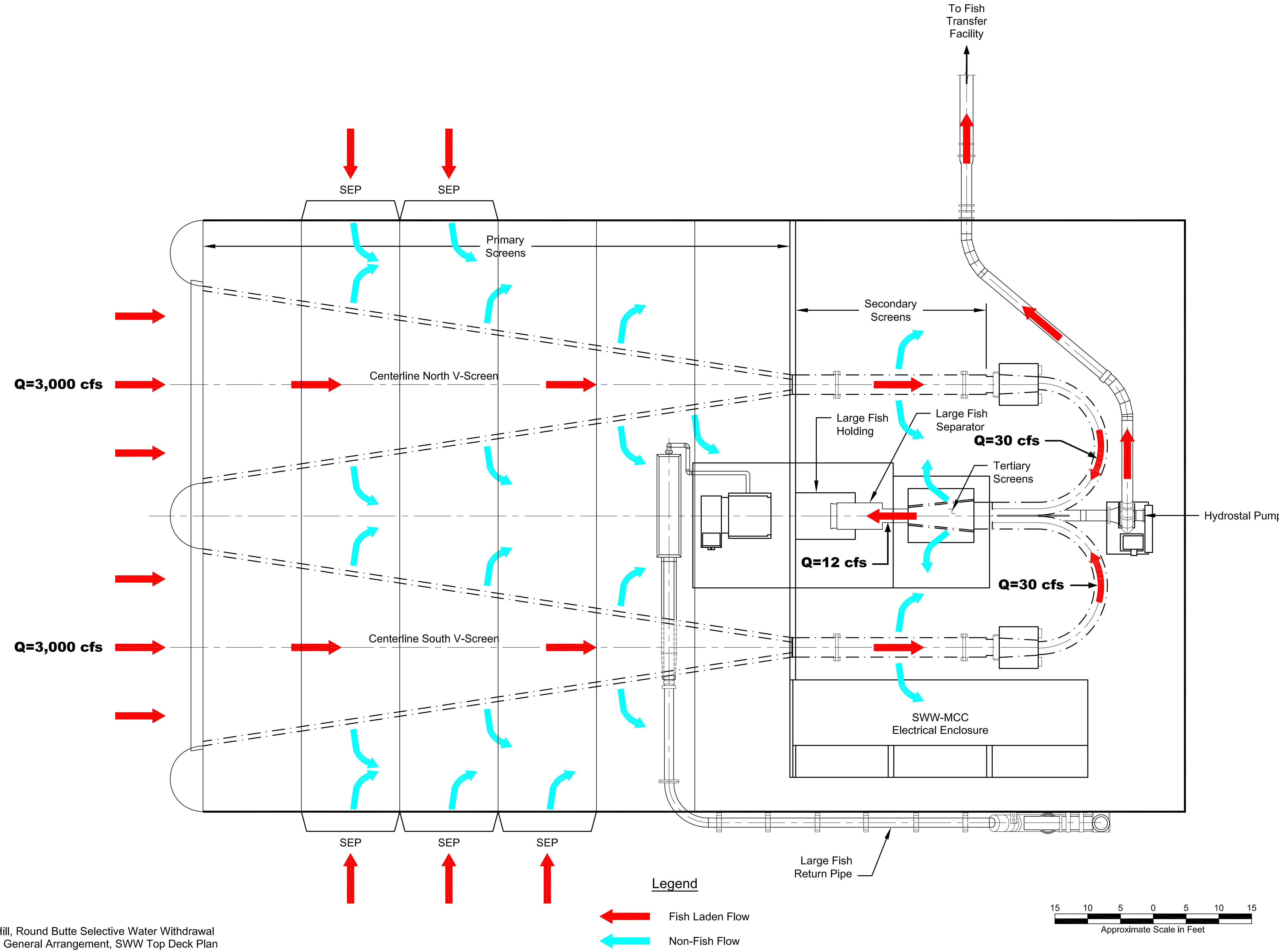
ROUND BUTTE SWW SITE VICINITY MAP

Willamette Downstream Fish Passage
Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

FIGURE NUMBER: 3-25

DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
KM	05/31/10	60148335-403	IW



Source: CH2MHill, Round Butte Selective Water Withdrawal
SWW - General Arrangement, SWW Top Deck Plan
Drawing: RB-SWW-A-006, November 2007

REVISIONS		
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DESIGNED BY: IW
DRAWN BY: KM
CHECKED BY: IW
APPROVED BY: CS

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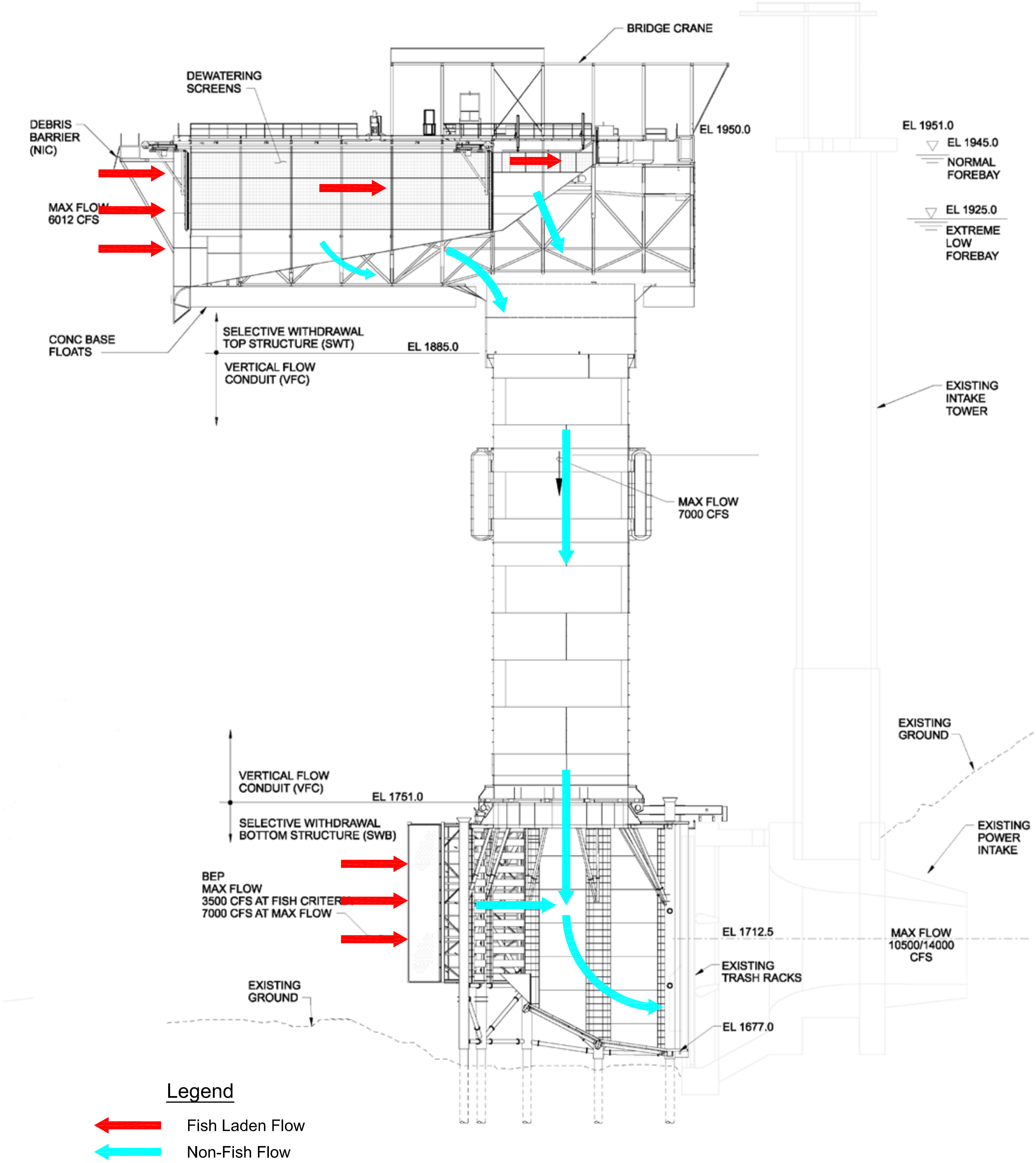
ROUND BUTTE SWW – PLAN VIEW
Willamette Downstream Fish Passage
Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

PROJECT NUMBER: 60148335-403
DATE: 06/08/10
SCALE: 1" = 15'

FIGURE NUMBER:
3–26

FILENAME:
26-RB Up Dek Plan



Source: CH2MHill, Round Butte Selective Water Withdrawal
SWW - General Arrangement, SWW Top Deck Plan
Drawing: RB-SWW-A-005, November 2007

Not to Scale

FILENAME: 27-RB Up Dek Sec

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ROUND BUTTE SWW
SECTION VIEW

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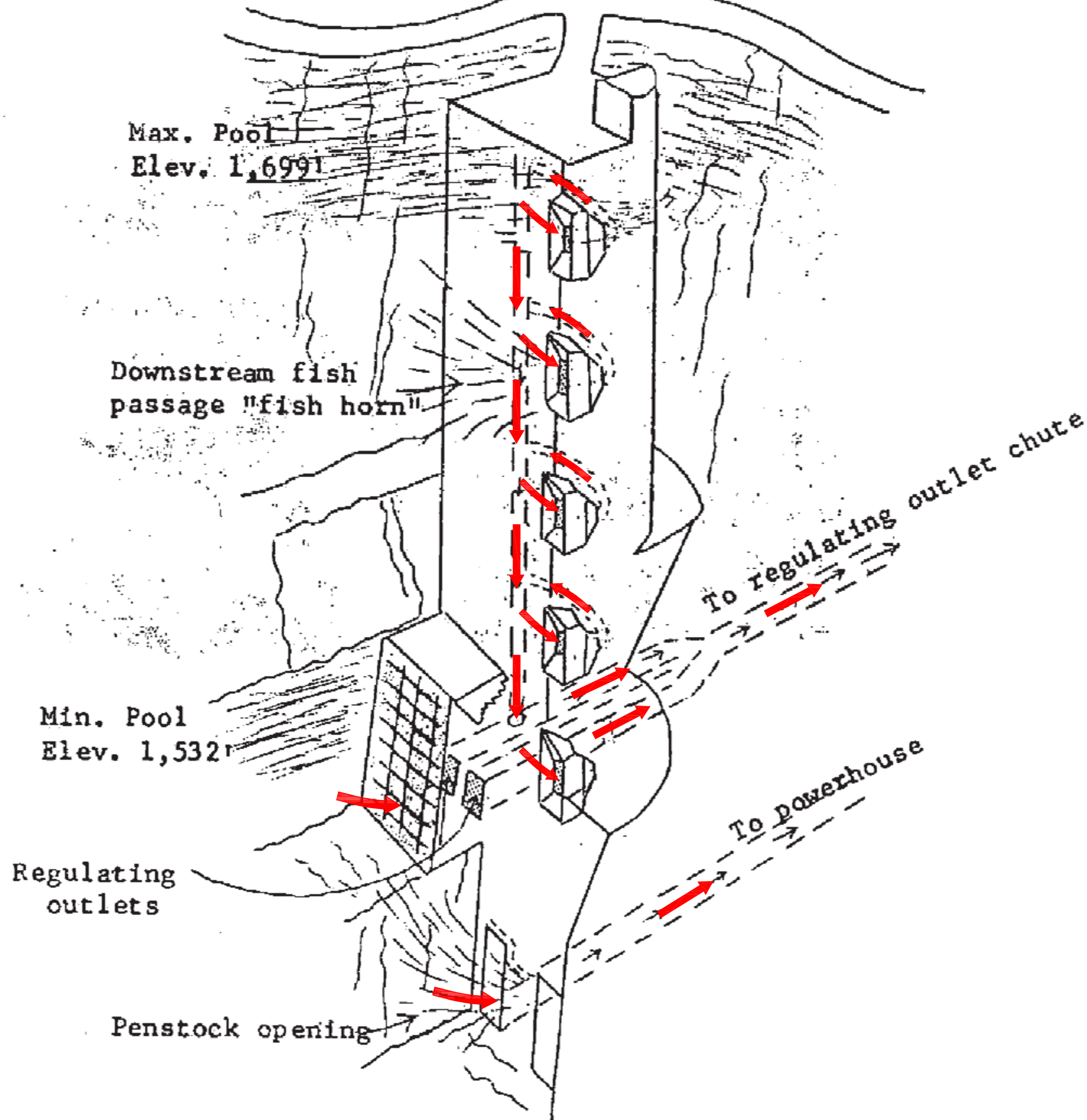
FIGURE NUMBER: 3–27

DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
KM	06/07/10	60148335-403	IW



Source: Ingram, P. and L. Korn. 1969. "Evaluation of fish passage facilities at Cougar Dam on the South Fork McKenzie River in Oregon". Fish Commission of Oregon, Research Division, Portland.

Intake structure located in west abutment and containing downstream-migrant fish passage facilities, regulating outlets, and penstock opening

Legend

Fish Laden Flow

Not to Scale

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DRAWN BY: KM	DATE: 05/31/10	PROJECT NUMBER: 60148335-403	CHECKED BY: IW

FILENAME: 28-Cougar-Iso

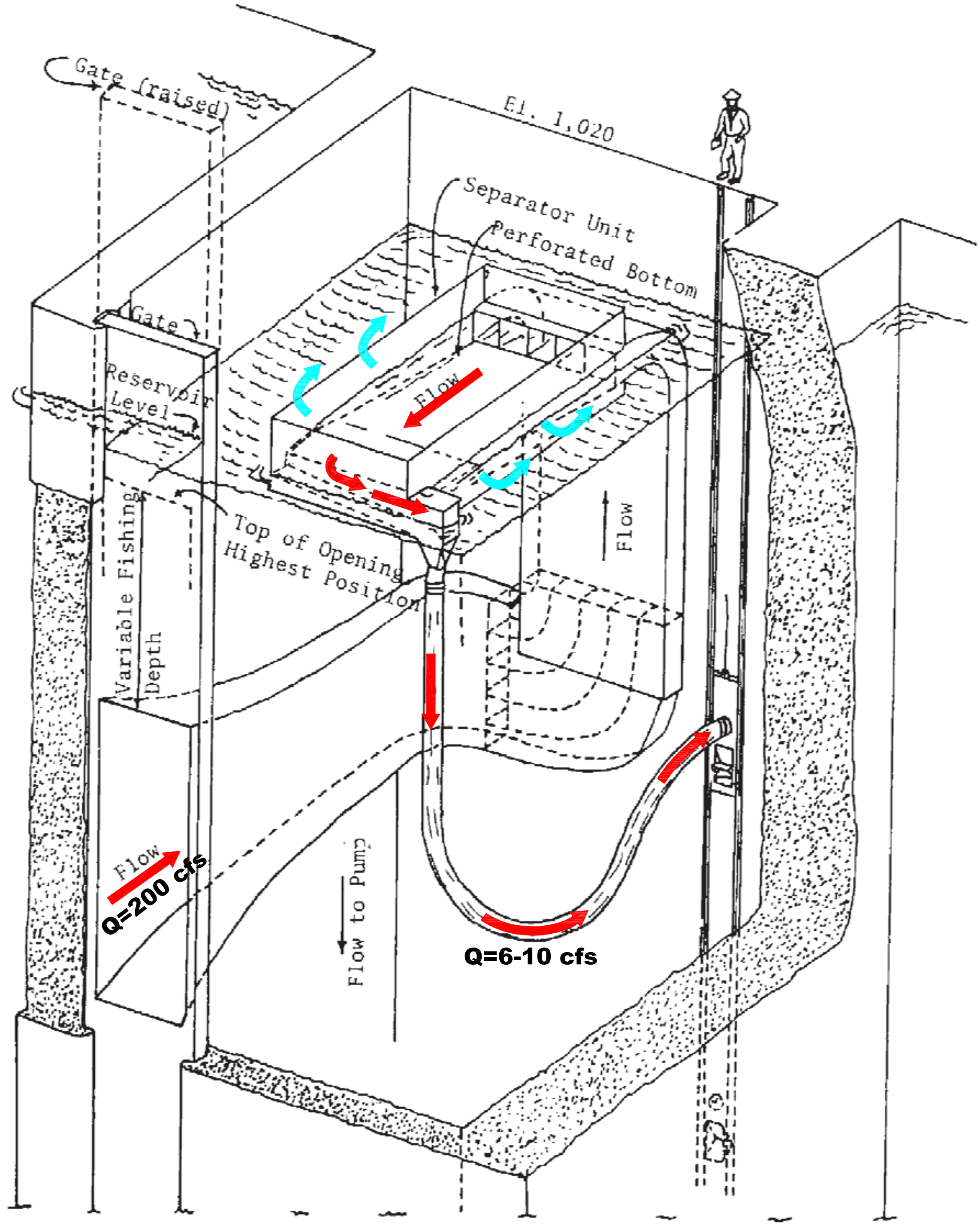

Diagram of Green Peter Downstream-Migrant Collection
Horn and Separator Unit

Source: Wagner, E. and Ingram, P. 1973. "Evalustion of fish facilities and passage at Foster and Green Peter Dams on the South Santium River drainage in Oregon". Fish Commission of Oregon, Portland.

Legend

Fish Laden Flow

Non-Fish Flow

Not to Scale

FILENAME: 29-Gr-P-Iso	GREEN PETER DS FISH COLLECTION ISO			FIGURE NUMBER:
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	DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
	KM	06/08/10	60148335-403	IW

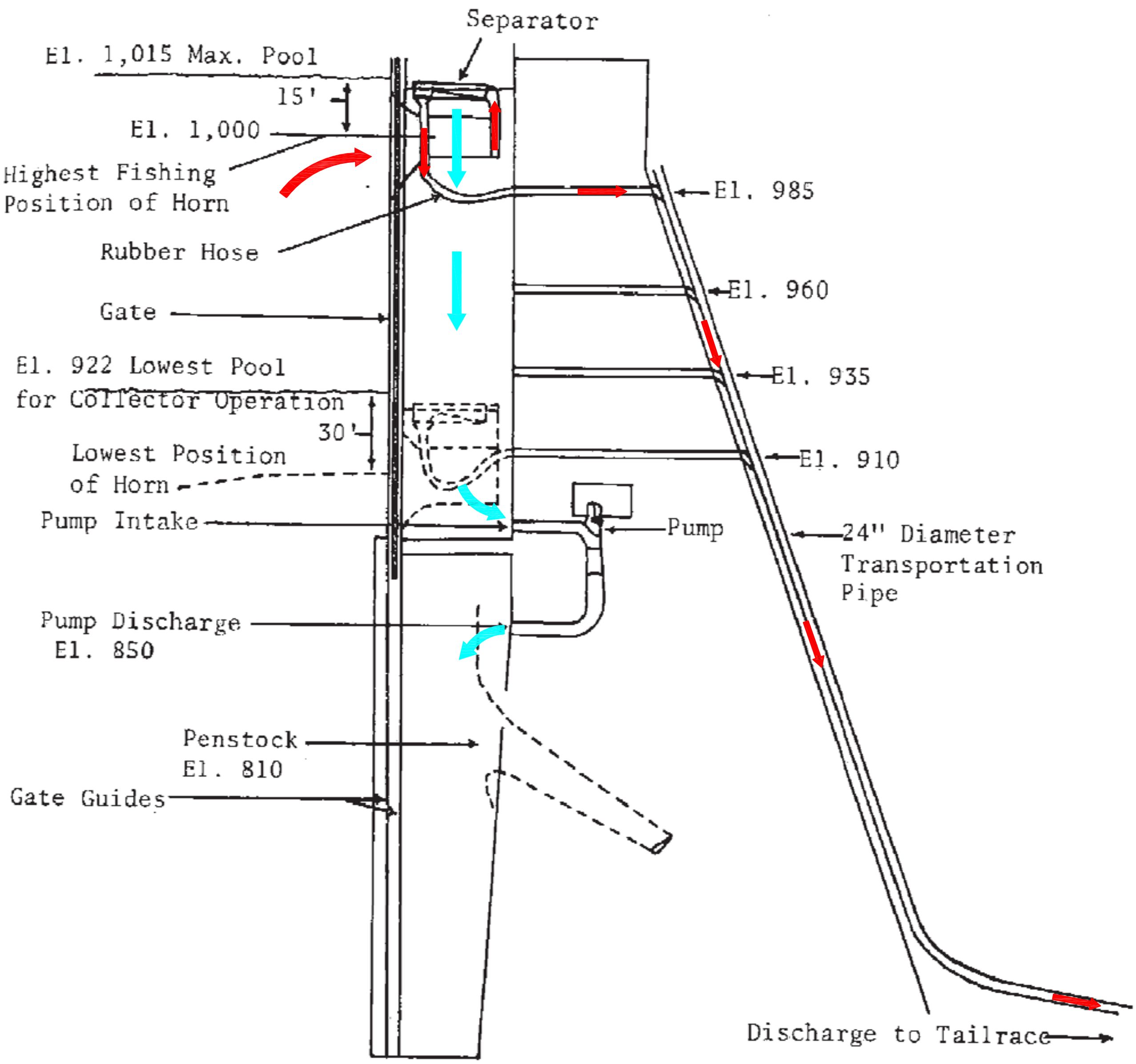

Diagram of Green Peter Downstream-Migrant Collection Facilities

Source: Wagner, E. and Ingram, P. 1973. "Evalustion of fish facilities and passage at Foster and Green Peter Dams on the South Santiam River drainage in Oregon". Fish Commission of Oregon, Portland.

Legend

Fish Laden Flow

Non-Fish Flow

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GREEN PETER DS FISH COLLECTION PROFILE

Willamette Downstream Fish Passage
Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

FIGURE NUMBER:
3-30

DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
KM	05/31/10	60148335-403	IW

FILENAME: 30-Gr-P-Pro

FILENAME: 31-Fal-Crk-Iso

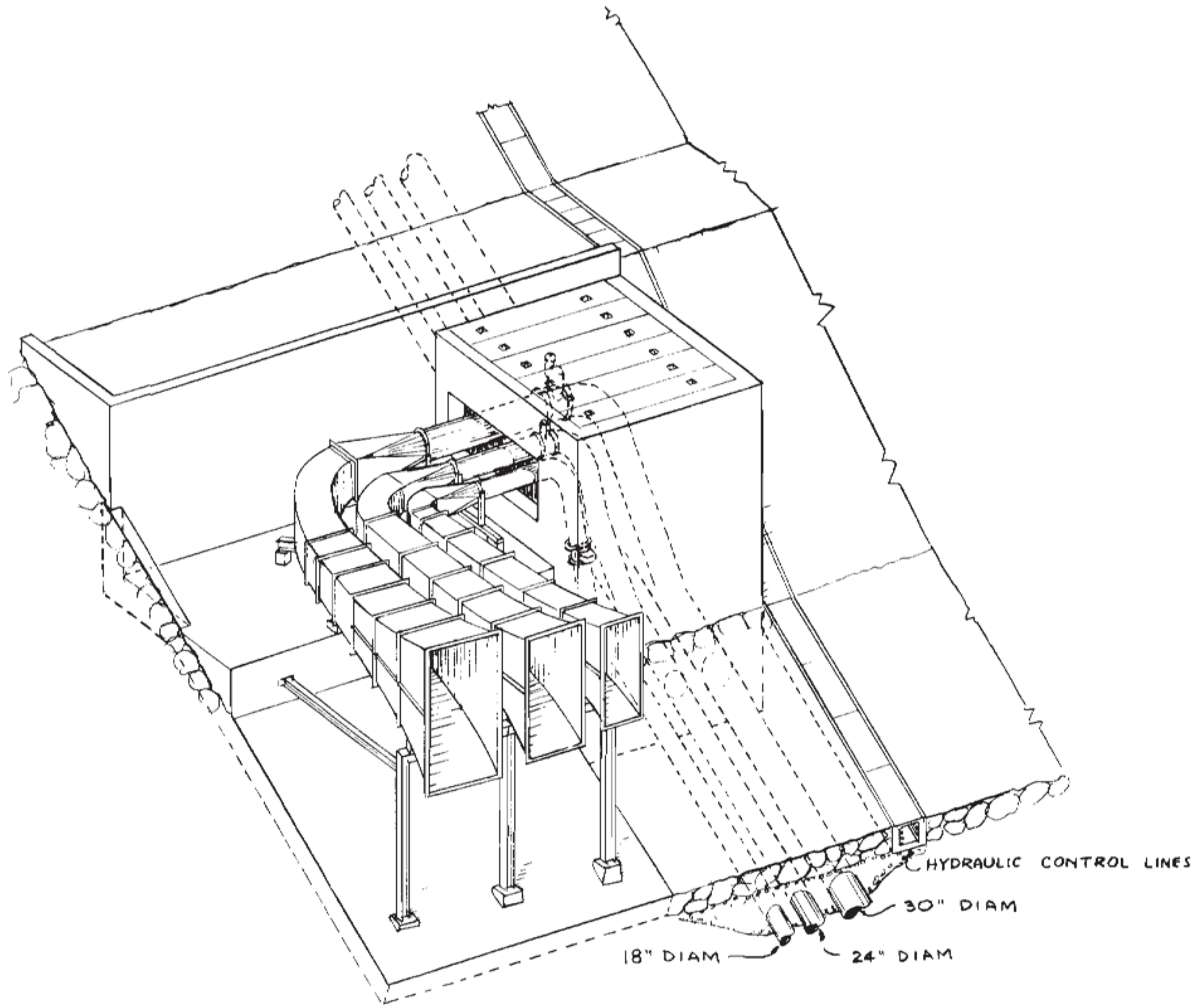

Diagram of One Tier of Fish Horns Showing Transport Pipes For Each Horn Size

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FALL CREEK DAM TYPICAL FISH HORNS AND THEIR RESPECTIVE TRANSPORT PIPES

Willamette Downstream Fish Passage
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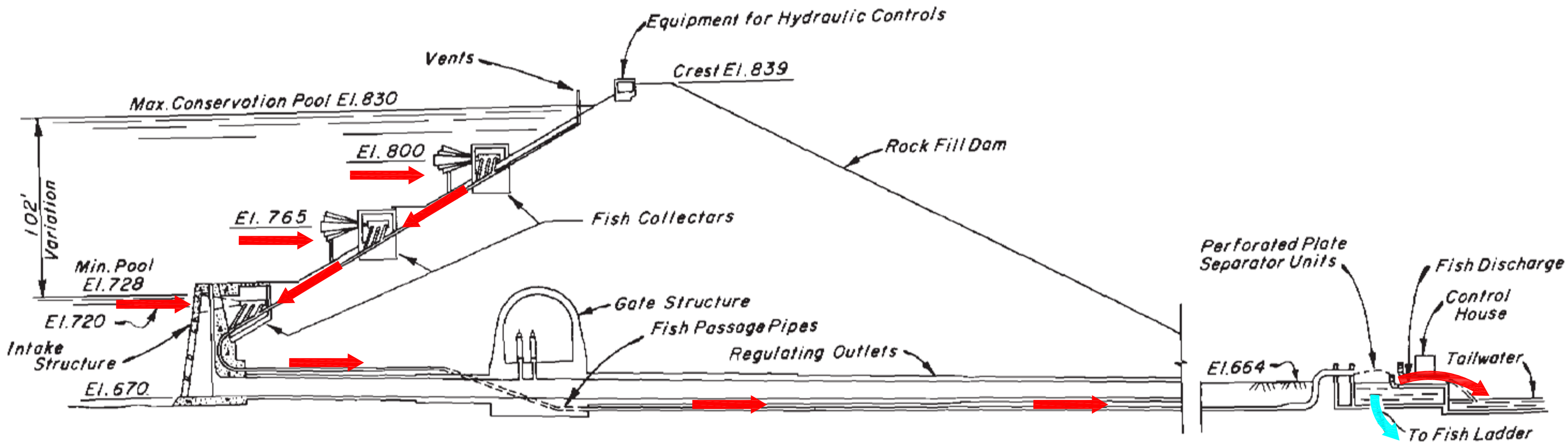
FIGURE NUMBER:	DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
3-31	KM	05/31/10	60148335-403	IW

FILENAME: 32-Fal-Crk-Pro



Cross-sectional View of Fall Creek Dam Showing the Downstream-Migrant Transport System Relative to Other Structures

Not to Scale

Legend

- Fish Laden Flow
- Non-Fish Flow

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FALL CREEK DAM CROSS-SECTIONAL VIEW

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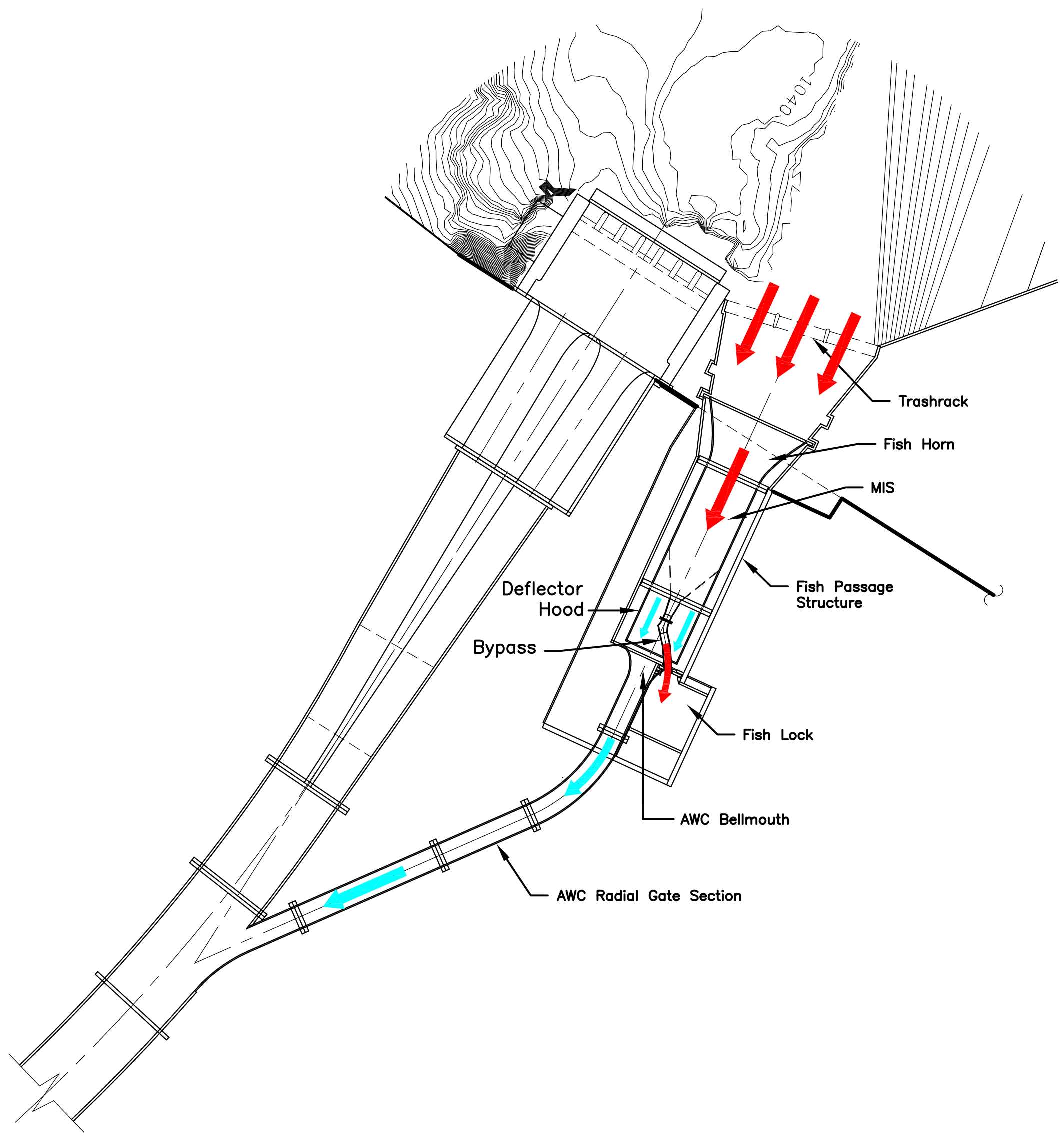
FIGURE NUMBER:
3-32

DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
KM	05/31/10	60148335-403	IW



Legend

Fish Laden Flow

Non–Fish Flow

40 30 20 10 0 20 40

Approximate Scale: 1" = 40'

FILENAME: 33–HH–Dam Pln

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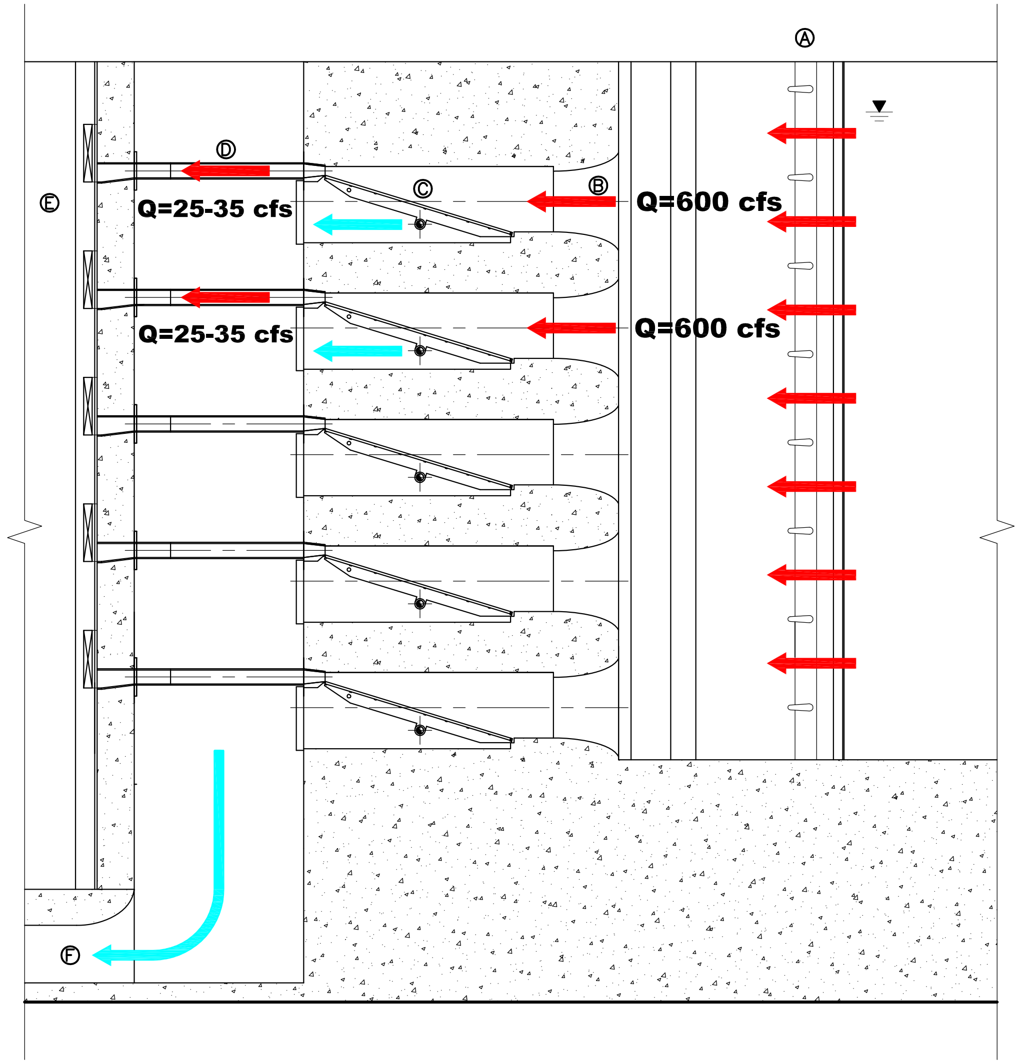
HOWARD HANSON DAM FISH PASSAGE PLAN VIEW

Willamette Downstream Fish Passage Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

FIGURE NUMBER:
3–33

DRAWN BY:	DATE:	PROJECT NUMBER:	CHECKED BY:
KM	05/31/10	60148335–403	IW



Legend

- Ⓐ Trash Rack
- Ⓑ Horn
- Ⓒ MIS Enclosure
- Ⓓ Bypass Conduit
- Ⓔ Fish Well
- Ⓕ Attraction Water Conduit

Legend

- Fish Laden Flow
- Non–Fish Flow

25 20 15 10 5 0 25

Approximate Scale: 1" = 40'

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HOWARD HANSON DAM FISH PASSAGE PROFILE

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Portland, Oregon

FIGURE NUMBER: 3–34

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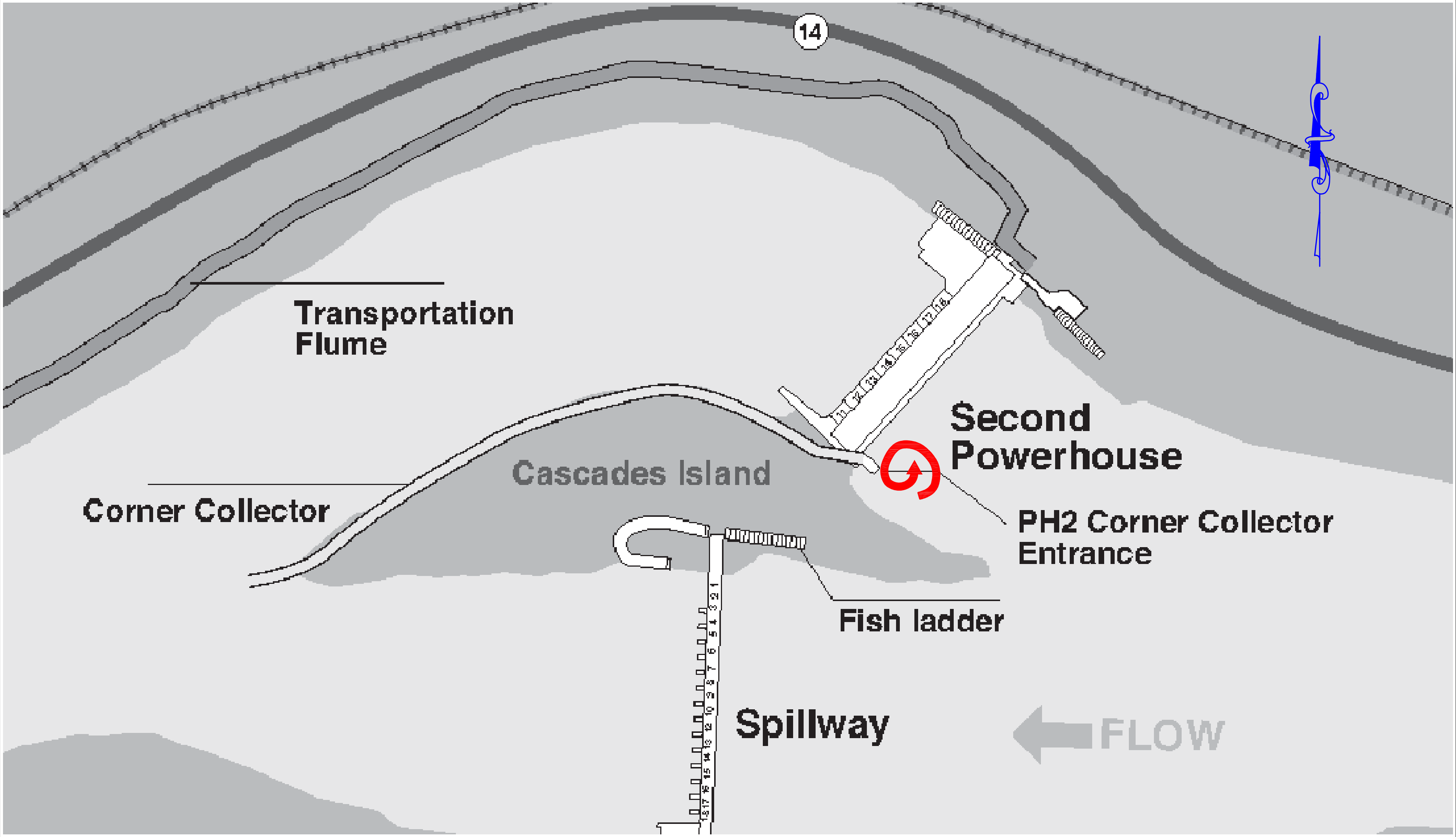
KM	06/08/10	60148335–403	IW

FILENAME: 34–HH–Dam Pro

FILENAME: 35-Bonn-Site



Legend

Fish Laden Flow

Non-Fish Flow

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BONNEVILLE DAM SITE MAP

Willamette Downstream Fish Passage Design Requirements
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Portland, Oregon

FIGURE NUMBER:
3–35

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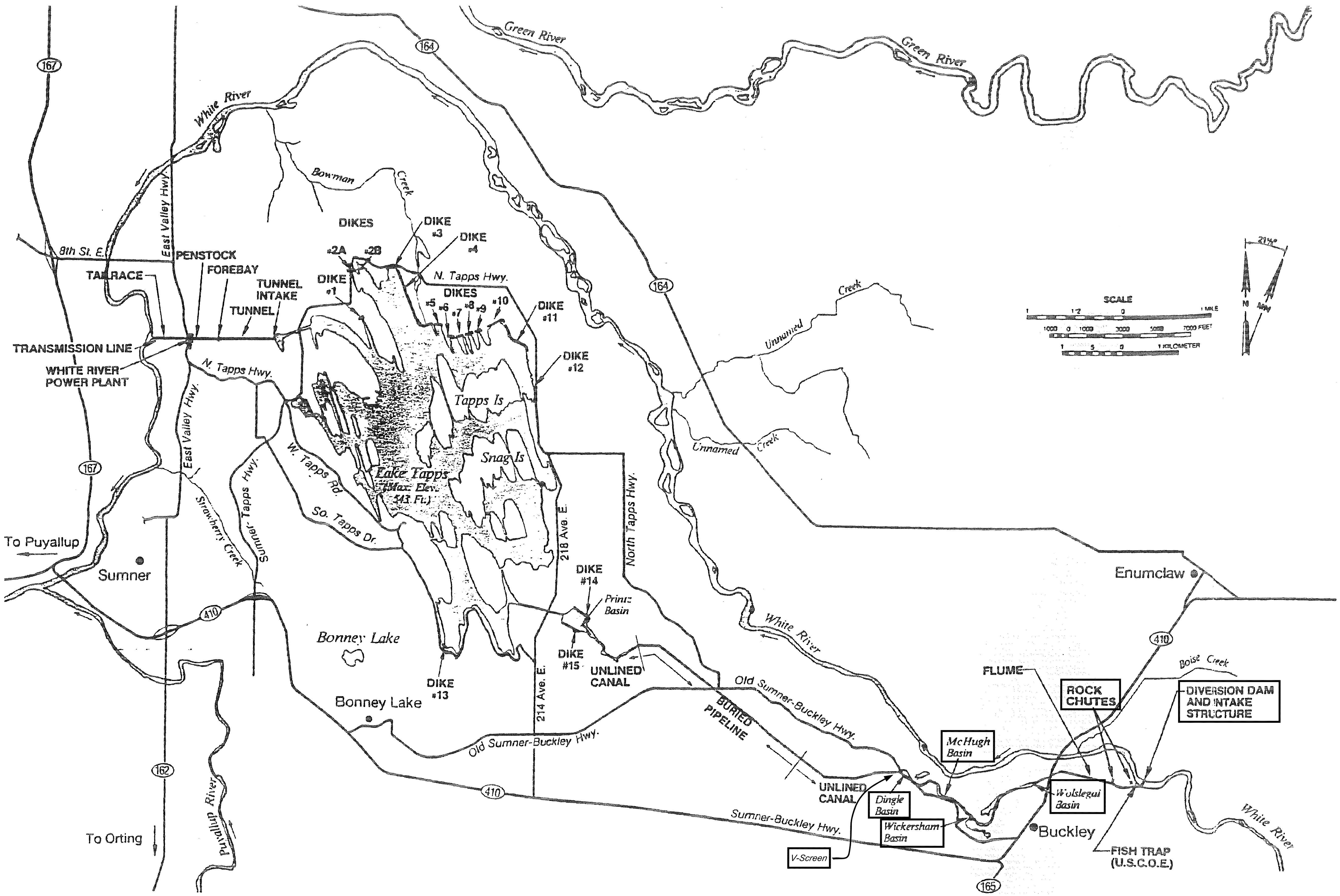
KM	05/31/10	60148335-403	IW



REVISIONS			
NO:	DESCRIPTION:	DATE:	BY:

DESIGNED BY: IW
DRAWN BY: KM
CHECKED BY: IW
APPROVED BY: CS

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WHITE RIVER/LAKE TAPPS DIVERSION – PLAN VIEW

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U.S. Army Corps of Engineers – Portland District
Portland, Oregon

SCALE:	DATE:	PROJECT NUMBER:
Not to Scale	05/31/10	60148335-403

FIGURE NUMBER: 3-36

FILENAME: 36-White River-Pln

4.0 Analysis and Synthesis of Profiled Projects

4.1 Collection Strategies to Meet Biological Objectives

Table 4-1 is organized to focus on key issues pertaining to types of juvenile fish collectors relevant to the Willamette Project that have been designed or constructed. It specifies where certain types of collectors can be deployed. For each class, examples of collectors are referenced from the listing in this report. Also provided is our assessment whether the collector type is predicted to be effective at collecting two juvenile life stages (fry and smolts), and must accommodate upstream passage of anadromous adults or resident fish species. Finally we indicate if the system is functioning, abandoned, or is in the conceptual design stage.

Few collector types relevant to the Willamette Project have actually been constructed and are currently operating. Only five of the 12 combinations of location and technologies are currently in operation, i.e., Leaburg, Wapato, Willamette Falls, Upper Baker, and Round Butte (Appendix A). The other seven are either untested concepts, are in design, or facilities that have been abandoned due to excessive impacts on fish.

For the five functioning collector examples, the functional history varies considerably. Some have been operating for years, while the improved Upper Baker and new Round Butte have been recently activated. The nature and extent of performance evaluations varies as well, but in general they have been rather generic without much detailed behavioral data. In general, these systems have been designed to collect smolts (i.e. active migrants), the life stage used in most evaluations. As a consequence there is a poor understanding as to how efficient these collectors are, or might be, for collecting relatively non-migratory life stages such as fry and parr[1] . Considering these issues, in Table 4-1 we note whether smolts or fry-parr can be effectively collected with each collector type. Inspection of the table clearly shows that only 3 of the 12 collector types have been demonstrated, or are expected, to effectively collect fry. That narrows the pool of proven contenders to two; off-channel v-screens and drum screen systems. If any other systems are considered candidates, reconnaissance studies or prototype tests will be required to make an informed selection. A variety of traps could be useful for implementing these studies, e.g., Merwin, scoop/dipper, or screw traps.

Some collector designs will need to accommodate upstream passage of anadromous adults or resident fish. Basically, any system staged anywhere except at a dam will require such. This could present challenges depending on the particular species mix at the project.

[1] Fry collection efficiency is difficult to assess primarily due to their size, short-migration period, tendency to rear in reservoir environments and susceptibility to predation. The results of mark/ release studies designed to measure fry collection efficiency can be heavily influenced by each of these factors: Thus making interpretation of study results difficult.

Table 4-1 Analysis of Collection Strategies

Location	Collector Type	Biological Performance: Adequate Juvenile Fish Collection Potential		Biological Performance: Adult Resident Fish Passage Required	Example Project	Status
		Fry	Smolt			
In-Tributary	In-stream v-screen	Yes	Yes	Yes	Cougar and Swift	Concepts
	In-stream floor-screen	No	?	Yes	Cowlitz	Concept
	Off-channel v-screen	Yes	Yes	Yes	Leaburg	Existing
	Off-channel drum-screen	Yes	Yes	Yes	Wapato	Existing
	Off-channel louvers	No	Yes	Yes	Willamette Falls Hydroelectric Project	Existing
Head-of Reservoir	Floating Surface Collector	?	Yes	Yes	-	-
Mid-Reservoir	Floating Surface Collector	?	Yes	Yes	Cougar	Concept
Forebay	Floating Surface Collector	?	Yes	No	Upper Baker	Existing
At-Dam	Floating v-screen	?	Yes	No	Round Butte and Carmen-Smith	Existing (under evaluation) and Planned
	Floating box-screen	?	Yes	No	Green-Peter	Abandoned
	Multi-level horns	?	Yes	No	Cougar and Fall Creek	Abandoned
	Multi-level MIS	?	? *	No	Howard Hanson	Planned

4.2 Fish Collection Issues and Solutions Transportable to the Willamette Projects

As discussed in the previous section, the choice of location of a fish collection system, i.e. in-tributary, head-of-reservoir, mid-reservoir, forebay, or at dam, depends on the biologically-driven decision on collection strategy. Once that decision is made, a facility must be designed that will deliver the desired physical performance for fish collection and safe bypass around the reservoir-dam complex to the downstream river. The physical and operational characteristics of dams in the Willamette system provide a unique suite of design challenges to be overcome in delivering the desired performance. The challenges vary with the fish collection system location and may be further broken down by the specific components of the system, i.e. guidance, collection, dewatering, bypass/conveyance, and outfall/release. Table 4-2 presents a matrix of the suite of challenges or issues associated with the various collection locations and components.

Table 4-2 is particularly revealing of the complexity of developing a fish collection design at the various locations:

- In-tributary location designs must primarily deal with the flow, debris, and sediment issues associated with a flashy (highly variable) in-flow hydrograph and secondarily with the need to provide upstream fish passage and distance that fish must be conveyed to reach a release facility, even if release is to be made in the river immediately below the dam.
- Head-of-reservoir facilities must overcome the most design obstacles of any location: hydrograph, upstream fish passage, distance from collection to release location, and range of reservoir elevation change impacts onboth water level and longitudinal location Of the head-of-reservoir.
- Mid-reservoir, forebay, and at-dam locations must all deal with the impacts of range of reservoir water level on guidance, collection and bypass, and the impact of total project head on bypass and release, with the additional complication of upstream fish passage for the mid-reservoir location.

Comparing the level of complexity for the various locations, it can be seen why existing fish collection facilities have been focused on forebay and at-dam locations.

The following paragraphs describe the issues and how they might be overcome in the design of various system components through reference to example projects from Chapter 3. The discussion is undertaken on an issue by issue perspective rather than by a location and component perspective to minimize repetition of applicable solutions and examples that would apply for multiple locations.

Table 4-2 Analysis of Fish Collection Design Issues

Location	Issue/Component #					
	Inflow hydrograph	Need to provide upstream passage	Distance from collection to release location	Range of reservoir elevation change	Head of reservoir longitudinal location change with reservoir elevation change	Total project head
In-tributary	1, 2, 3	1	4			
Head-of-reservoir	1	1	4	1, 2, 4	1, 2, 4	
Mid-reservoir		1	4	1, 2, 4		
Forebay				1, 2, 4		4, 5
At-dam				1, 2, 4		4, 5
Component #	Issue Description					
1	Guidance					
2	Collection					
3	Dewatering					
4	Bypass/Conveyance					
5	Outfall/Release					

4.2.1 Inflow Hydrograph

The impact of the inflow hydrograph on design is an issue for head-of-reservoir guidance/exclusion and in-tributary guidance/exclusion, collection, and dewatering components.

For a head-of-reservoir location, flow fields and discharge rates will be dictated by the tributary inflow hydrograph, rather than reservoir flow releases, as for an at-dam or forebay location. This in turn means that the exclusionary net area needed to remain under approach velocity criteria for passive screens at a head-of-reservoir location is greater than for at an at-dam or forebay location as the Willamette Projects are operated in a manner to absorb peak inflow events and not pass the peak discharges downstream.

We found no examples of existing in-tributary facilities constructed for fish collection and transport. The existing facilities profiled with similarities and component designs that might be used as examples to guide design of an in-tributary collection facility, were all designed for exclusion of fish from water diverted for another purpose, either a hydropower canal intake (Leaburg), a hydropower plant forebay (Sullivan Plant at Willamette Falls), or a diversion canal intake (Wapato). For all of these facilities, a fish bypass was provided to directly return excluded fish to the river below the facility. All of these designs were off-channel facilities, where, while the diversion structure directing flow to the facility was in the river, the exclusion or screening facility was contained in a separate channel, not within the bank-to-bank river channel proper.

Several of the designs profiled were concepts for in-tributary collection systems including Cougar, Cowlitz, and Swift (Appendix A). All of these designs utilized in-stream facilities with the dewatering system located within the bank-to-bank river channel. In each case, the design concept was not considered for implementation because of factors related to the inflow hydrograph, design flow capacity, and the impacts of these on potential biological performance.

4.2.1.1 Guidance

The Inflow hydrograph issue affected the guidance component of collectors at head-of-reservoir and in-tributary locations.

For head-of-reservoir locations, velocities are driven by the tributary flow. If the facility is to be designed for the 5 % exceedance flow per NMFS (2008a), this results in a very large area of netting needed to meet approach velocity criteria (0.2 ft/s but typically applied as 0.1 ft/s to avoid hotspots and minimize hydraulic loading). By definition the head-of-reservoir collector location is near the upstream end of the reservoir. Finding a cross-section at this location that provides the required cross-sectional area may prove to be difficult. If it is simply not possible, two paths for the design of the facility present themselves; 1) request a waiver to allow for the netting to operate out of criteria during large flow events or, 2) to design in the capability for the nets to sink during these large events. The latter option will result in decreased fish capture efficiency.

The inflow hydrograph also presents a debris problem for head-of-reservoir locations. Large flood events carry a high debris load. A log boom can provide protection for the exclusionary nets but requires additional maintenance to clear log build up.

Guidance of fish into an in-tributary collection system could be achieved by using a gate-controlled dam to divert all river flow up to the design value for fish collection into the fish collection structure, where a dewatering facility would screen off the majority of the collection flow, concentrating collected fish in a bypass flow that would be directed to the fish handling facilities. These facilities would depend purely on diversion of flow, rather than any behavioral means, for collecting fish. NMFS (2008a) recommends fish facilities should be designed for the 5 % exceedance flow during the fish migration period. For an in-tributary facility, this would imply that the entire river flow up to the 5 % exceedance level be considered in the design. When flows would exceed the design value for fish collection, the gates would be opened or the inflatable dam lowered to pass increasing flows without increasing upstream water levels and flooding and all fish in the flow not directed to the collection facility are not available for collection. It may be difficult for biological performance goals for the facility to be met if large numbers of fish move downstream at peak flows that exceed the 5 % exceedance design level. In fact, it might not be practical to even design the facility to accommodate the 5 % exceedance flow. It is worth noting that all of the conceptual in-tributary facilities profiled were sized for the 10 % exceedance flow. This is due to the magnitude of 5% exceedance flows and the associated size of facility that would be required. None of the facilities were developed past the conceptual stage and as such NMFS input was never obtained on the sizing issue.

All of the in-tributary conceptual designs profiled utilized inflatable dams rather than gated concrete structures to provide the diversion towards the screens. The advantage of an inflatable dam is that during flood passage, when the dam crest is lowered, very little structure remains in the river providing an unobstructed floodway. There is an advantage to designing an inflatable dam using the maximum head difference possible without causing upstream flooding. Such an approach increases the depth available to provide screen area within the dewatering structure component of the system making larger screen areas and design flows possible. The designers developing the Cowlitz concept determined that the maximum practical inflatable dam height, based on other existing applications, would be 16-20 ft and that if tail water levels at the rubber dam might significantly submerge the dam (by 12 ft for the Cowlitz case) that the dam should be water- rather than air-filled due to buoyancy concerns.

The existing off-channel exclusion facilities profiled utilized both gated concrete diversion dams (Leaburg and Wapato) and a combination of a natural falls feature, fixed elevation concrete dams, and inflatable dams (Sullivan Plant at Willamette Falls) to provide guidance.

Either gated concrete dams or inflatable dams may be applicable for in-tributary guidance for the Willamette Project dams.

4.2.1.2 Dewatering

The in-tributary conceptual designs profiled utilized in-channel facilities and two de-watering technologies: traditional NMFS (2008a) criteria v-screens (Cougar and Swift) and high-velocity inclined floor screens (Cowlitz). The layout of the Swift v-screen arrays is unique with screens at either side of a central inflatable dam. However the Swift arrangement was eliminated due to the impact large flood flows might have on the facility. The Cougar concept utilized a more conventional arrangement locating the screens at one side of the river channel and protecting them with a trash rack. The Cougar concept was eliminated due to concerns over loss of fish collection capability during floods and potential sediment and debris loading on the screens. The Cowlitz concept was eliminated due to concerns over potential biological performance both because, even with high-velocity screens, it was not possible to accommodate the peak flows that may carry large numbers of juvenile fish, plus the size (10,500 cfs) of the high velocity floor screen made it an unprecedented experimental facility.

The existing off-channel exclusion facilities profiled utilized a variety of dewatering devices including v-screens (Leaburg), drum screens (Wapato), and a combination of a louver/trash rack system with a high-velocity inclined floor (Eicher) screen (Sullivan Plant at Willamette Falls). All of these facilities have experienced successful biological exclusion performance. The louver-type exclusion system especially may not be appropriate for fry-sized fish as they are likely to be swept through the louver panel. Decided advantages of an off-channel facility are that: there may be less limitation on the footprint of the facility, allowing a larger design flow; they may be easier to protect from floating debris loading via use of booms and trash racks; and they may be easier to protect from sediment load via intake design, settling basins and rock return chutes (ala White River Diversion).

4.2.1.3 Summary

Many of the same concerns that eliminated the conceptual designs profiled in this report will be the same for the Willamette Project dams: namely will a reasonably-sized facility provide adequate flow capacity to meet biological goals? It seems that the best features applicable to the Willamette Project found in our research for in-tributary concepts include: Inflatable dam guidance, with the head and tailwater limitations listed above, and off-channel v-screens with boom and trash rack protection plus consideration of rock-return channels and sediment basins for sediment protection.

4.2.2 Need to Provide Upstream Fish Passage

The need to provide upstream fish passage for both migrating adult and resident fish is an issue where the guidance/exclusion device divides the river and reservoir environments into sub-sections where fish movement across the boundary is required. This is the case for in-tributary, head-of-reservoir, and mid-reservoir locations. For forebay and at dam locations it is assumed that migrating adult fish will be released upstream from the facility and that there is no need for resident fish to access the limited forebay region downstream from the facility.

Since in-tributary devices utilize fixed location gated-concrete dams (existing Leaburg) or inflatable dams (existing Sullivan Plant at Willamette Falls) within a well defined river channel as guidance devices, conventional fish ladders designed utilizing NMFS (2008a) guidelines have provided successful passage for adult and resident fish.

There are no existing operating precedents that we know of for adult migrant or resident fish passage facilities through the exclusionary nets, which would be used for exclusion and guidance for an in-reservoir system. An adult trap might be employed utilizing pumped attraction flow and located either along a shoreline, or at the FSC to provide passage. Another alternative might be to locate a fish passage gap or gaps in the exclusionary net again near a shoreline or near the FSC, where discharge from the collection water pumping system might be utilized to attract migrating adults to the area. However, such a gap would result in some loss of juvenile fish through the same gap.

4.2.3 Distance from Collection to Release Location

The distance from the in-tributary or in-reservoir collection location to the downstream release facility is a definite issue for the in-tributary, head-of-reservoir, and mid-reservoir locations, where the distances may be on the order of several miles or more.

The only profiled projects dealing with these types of distances were the existing PSE Upper Baker Dam, PGE Round Butte Dam, and PGE North Fork/River Mill Dams and they demonstrate three completely different approaches, all of which might be applicable on the Willamette Projects:

- At Upper Baker, fish are transported via a holding tank from the floating FSC to the shore on a ferry operating along a fixed cableway. The holding tank is then hoisted by crane to the deck of the dam and fish are loaded on trucks to be transported to the downstream release location.
- At the Round Butte facility, fish are pumped via a Hydrostal pump from the floating collection facility to a sorting and fish transfer facility for truck transport to a downstream release location.
- Between the collection location at North Fork Dam and the release location below River Mill Dam, fish are transported in a five mile long 18-inch diameter pipe and released to the river. The pipeline follows the existing topography along the route. It includes both exposed and buried sections and the slope varies from -4.5% to 6% with a short segment leading to the outfall at 63%. Pipe material also varies as some portions of the pipeline are in areas prone to landslides. Replacement pipe has consisted of either PVC or HDPE connected to the original steel. Current discharge through the pipe is 3 to 4 cfs. Flow in the pipeline is intended to be open channel flow but in reality there are portions that are pressurized.

4.2.4 Range of Reservoir Elevation Change

The range of reservoir elevation change for the Willamette Projects (over 100 ft) will present challenges for design of all but the in-tributary alternatives and will affect many different components of the fish collection and passage systems. In order to discuss this issue and present potential solutions in a logical manner, we will discuss them on a component by component basis with comment on the applicability across the range of facility locations.

4.2.4.1 Guidance

The Upper Baker FSC is the only operational precedent for a successful in-reservoir (forebay) system (ENSR/AECOM 2007). It utilizes full exclusionary nets from reservoir surface to bottom to guide fish to the Net Transition Structure (NTS) and FSC entrance. These nets accommodate a 50 ft change in reservoir elevation; include a boat pass section, and the ability to lower the nets below the water surface to reduce drag on the nets during flood passage. The nets are designed with enough area to provide a gross average approach velocity component at design flow of less than 0.1 ft/sec. This value maintains acceptable drag force loading on the nets and prevents fish impingement. A similar exclusion net system is being designed for Lower Baker, as well as for PacifiCorp's Swift Dam and Tacoma Power's Cushman Dam. The collector and net system for all of these projects is located in the project forebay near the dam and utilize net alignment, bathymetric features, and the discharges from the FSC pumping system to maintain approach velocity components below the criterion level of 0.1 ft/sec, positive downstream sweeping velocity components parallel to the nets, and to prevent areas of flow down-welling near the NTS, so all fish are guided by the flow field toward the entrance.

The twin FSC concept developed for Cougar Dam was to be deployed in mid-reservoir and utilized partial (75 ft) depth nets to guide fish to the FSC entrances. The nets were to be lengthened in an adaptive management approach if fish were found to pass under them. This concept was rated negatively in part because of the potential for fish to swim under the nets.

The full exclusionary net system, such as employed for Upper Baker is recommended for consideration for the Willamette Projects as the only operational precedent (ENSR/AECOM 2007). Partial exclusionary nets (depth of 100 ft) utilized for earlier versions of the Baker gulper were abandoned in favor of full-exclusion nets (mesh size ¼”) to meet biological objectives (PSE 2002). Even in the case of an adaptive management approach as suggested for the Cougar concept, the design must accommodate the potential for extension to full-exclusionary nets to meet biological objectives. Design considerations, in addition to those listed under the Baker description above, include:

- Accommodating an even larger reservoir operational range in the net design; This may result in additional operations and maintenance considerations as over 100 ft of net may be draped over the reservoir bottom at low water level, or may billow in the current. The reservoir bottom around the net alignment must be cleared of debris to prevent snagging and ripping of the net. Billowing may be detrimental to fish guidance along the net.
- Providing adequate net area to pass the design river flow at low reservoir elevation will drive site selection for a head-of-reservoir collector.
- Provisions for a debris boom to protect the net from floating debris, depending on the location of the facility and prevailing wind direction, may include booming both sides of net for mid-reservoir and head-of-reservoir sites.

For at-dam systems, there is one concept that has a precedent for providing guidance and that can accommodate a reservoir elevation change that may prove beneficial for the Willamette Projects. The concept is illustrated by the Corner Collector at Bonneville Second Powerhouse and its use of a large eddy in the forebay to assist collecting fish. Eddies are known to concentrate fish. It would be advantageous to make use of any similar flow patterns that may be present at the Willamette Projects.

A behavioral guidance structure (BGS) may be a way to supplement fish concentrating affects of existing flow patterns (Anglea et al 2000). A BGS is a solid structure that is deployed in the top portion of the water column (depth determined by site specific conditions) that creates a hydraulic signature that fish can sense and guides them in a predetermined direction (typically towards a preferred bypass route). BGS alignment should promote surface velocity components parallel to the actual structure.

The incorporation of such features in a design requires hydraulic modeling analysis and understanding of fish movement in the project forebay.

4.2.4.2 Collection

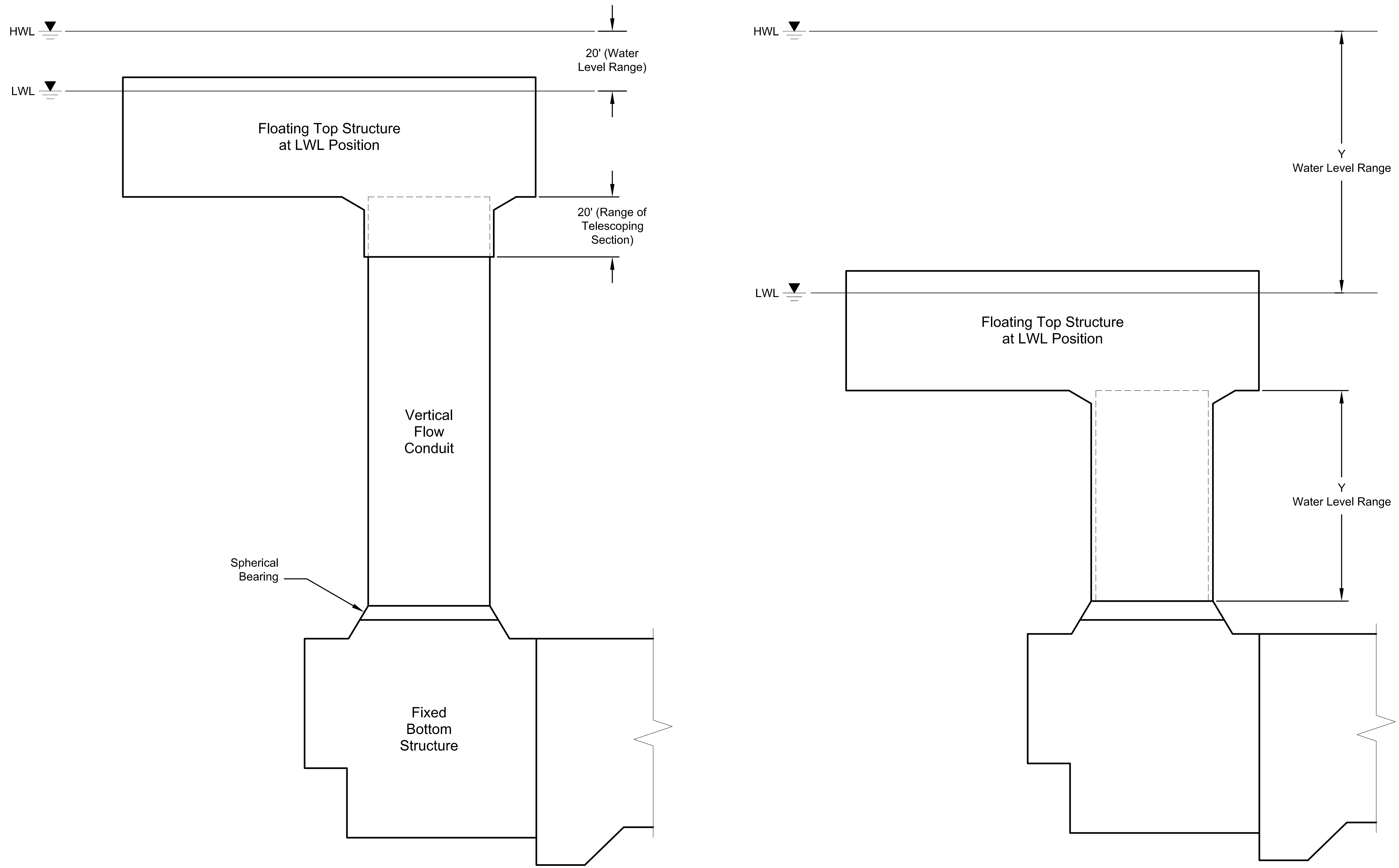
As described under the discussion of guidance systems above, the pumped FSC is the only operational precedent for accommodation of reservoir elevation change by an in-reservoir system.

Accommodation of reservoir elevation change in at-dam collection facilities has employed two approaches:

- Multi-level intakes – The abandoned facilities at Cougar utilized intakes (collection horns) at multiple elevations to follow reservoir elevation. The Fall Creek Facility also employed multiple level horns but is no longer used for fish passage, only for adult trap water supply. The abandonment of both of these facilities for juvenile fish passage was primarily driven by fish mortality in the bypass system downstream from the collectors. The Howard Hanson design also utilizes multiple level intakes, but with much higher flow rates and has associated dewatering challenges.

- Floating collection entrances – Both the abandoned collection system at Green Peter and the newly operational system at Round Butte utilized a collection entrance that is fixed to the dam structures, but floats to follow the reservoir water level, but following two radically different approaches:
  - Green Peter used limited pumped flow of 200 cfs entering a horn which floated inside a wet well where it was screened and the bypass flow routed through flexible pipe that could be attached to bypass piping systems at different elevations. See the profile in the appendix and Section 3.4.4 for more details.
  - Round Butte uses all of the project's dominant power generating flow (approximately 6,000 cfs) to collect fish in a floating dual entrance v-screen structure. The screened power flow passes down a 40 ft diameter vertical flow conduit (VFC) that connects to the existing power intake. The VFC telescopes inside the floating top structure to accommodate a 20 ft normal reservoir elevation (for greater reservoir drawdown, the top structure would be removed and anchored at another location. This same approach could be used for a larger reservoir level variation by telescoping two halves of the VFC, one inside the other, instead of inside the top structure, as shown in Figure 4-1, to accommodate a range of nearly half the reservoir depth. Multiple telescoping sections could be used to accommodate an even greater reservoir range. As described in more detail in the profile and Section 3.4.2, the Round Butte system also has features that can accommodate selective water withdrawal to meet temperature regulation requirements.

All of the approaches described here may have applicability for the Willamette Projects depending on the biological performance objectives, the magnitude of collection flows targeted, and whether temperature control of releases must be accommodated in the facility. While the project is quite costly as a whole, many of the features of the Round Butte facility: large collection flow, conventional v-screen dewatering, incorporation of temperature control, and the ability, with some modification of the collector to power intake (or regulating outlet) connection concept, to follow a range of reservoir level variation approaching half or more of the full reservoir depth may be adaptable to Willamette Projects (see Appendix A – Round Butte Selective Withdrawal Facility).



Profile
(NTS)

REVISIONS			
NO:	DESCRIPTION:	DATE:	BY:

DESIGNED BY: CS
DRAWN BY: CS/KM
CHECKED BY: IW
APPROVED BY: CS

AECOM
ENVIRONMENT
9521 WILLOWS ROAD NE
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MODIFICATION OF ROUND BUTTE VFC CONNECTION TO ACCOMODATE LARGER RESERVOIR LEVEL VARIATION
Willamette Downstream Fish Passage Design Requirements
U.S. Army Corps of Engineers – Portland District
Portland, Oregon

SCALE: Not to Scale
DATE: 07/08/10
PROJECT NUMBER: 60148335-403

FIGURE NUMBER: 4-1

FILENAME: 4-1 RB-VFC-Mod

4.2.4.3 Bypass/Conveyance

The impact of variation in reservoir elevation on bypass/conveyance of fish from the collection location is one of a need for a design that accommodates bypass/conveyance at maximum reservoir elevation as well as minimum reservoir elevation. The fish must be lifted to that same conveyance elevation when the reservoir elevation is low as to when the reservoir is high, or have multiple ports through the dam. The profiled projects (Appendix A) accommodated this need in five different ways:

- Fish are pumped approximately 15 ft vertically to the fish transfer facility and lifted in hoppers from the level of fish handling facility to the truck loading facility at Round Butte by crane;
- Fish are lifted in hoppers from the fish transfer ferry to the truck loading facility on the dam deck by crane at Upper Baker;
- Fish will be lifted in hoppers by crane from a variable elevation fish collection well to a truck loading facility at Howard Hanson;
- Fish were transported through the Green Peter Dam via one of four laterals which was connected to the collection facility with a flexible hose. As the collection horn moved with the varying reservoir level, the flexible hose would be manually connected to the appropriate lateral; or
- Fish were held in a live well until bypassed below the Round Butte dam in batches utilizing a controlled lock release of the column of water the fish were in. This method is from the abandoned system at Round Butte. Any of these methods may be transportable to the Willamette Projects.

4.2.5 Head-of-reservoir Longitudinal Location Change With Reservoir Elevation Change

In addition to the design issues already related associated with reservoir elevation change, a facility at the head-of-reservoir faces an additional challenge related to the elevation change: the longitudinal location along the river that defines the head-of-reservoir also changes as the reservoir elevation changes.

We have not found precedents of operating facilities that have been designed to meet this challenge. However, three approaches logically present themselves:

- Define the head of reservoir at a fixed-longitudinal location – Based on the minimum reservoir level, the draft of the FSC and the NTS, and the reservoir bathymetry, select a location where the FSC and NTS will not ground or will ground on a prepared pad, but still allow operation throughout the fish passage/collection season.
- Follow the head of reservoir by moving the FSC and exclusionary net system longitudinally to follow the "head of reservoir."
- Instead of an FSC with exclusionary net system, opportunistically utilize mobile traps to collect fish at the "head of reservoir."

4.2.6 Total Project Head

The issue of total project head primarily affects the safe bypass/conveyance and outfall/release of collected juvenile fish. Delivery of fish from forebay to tailrace of dams with heads exceeding 250 ft, requires the alternatives already discussed in Section 4.2.3 of truck transport or a very long pipeline to convey fish and dissipate the energy associated with the head difference at a reasonable rate, or using some other means of dealing with the elevation difference. Exploring alternative means would have more value at forebay or at-dam sites where there are potentially much shorter distances between collection and release sites, making trucking or a long pipeline less desirable.

Several abandoned fish passage facilities in the Willamette system provide examples of features to avoid in a bypass route: excessive freefall into down well (Cougar Abandoned), introduction upstream of RO control gate (Cougar Abandoned), sharp bends (Fall Creek), and impact on walls (Fall Creek) (Appendix A).

Applicable profiled projects with features recommended as potentially transportable to the Willamette Projects include:

- The Carmen-Smith Concept utilizes a long pipeline (3,310 ft) and a roughened pipe material (corrugated steel pipe) to assist in safely managing the associated energy of the approximate 85 feet of elevation difference and ensuring outfall impact velocities meet the NMFS criterion of less than 25.0 ft/s (NMFS 2008c).
- The abandoned Green Peter Facility also used material selection to assist in the dissipation of energy associated with the large head of the Project. A 300 foot length of vinyl lined pipe located upstream of the outfall was referred to as the deceleration zone. Initial mortality rates through the bypass pipe were low but increased over time as transport pipes became rusty and possible problems arose with the flexible hose that connected to various ports on the dam to allow for changes in forebay elevation (Appendix A).
- The abandoned Round Butte system made use of a simple and inventive mechanism and operational procedure that resulted in the downstream juvenile migrants being temporarily constrained to the upper portion of the water column in a long pipe with a downstream control valve. The valve was partially opened and the water level in the pipe was allowed to drain down to an acceptable head level before opening the valve fully and passing the fish and remaining water. Additional details of this system can be found in Section 3.5.2.
- The Howard Hanson design incorporates a vertical fish well which is operated as a temporary holding tank until a desired fish density or specified time has passed at which point a brail/hopper is lifted through the water column collecting all fish at which point they are discharged into a monitoring/truck-and-haul facility. Additional details of this system can be found in Section 3.4.6 with more detailed data presented in Appendix A.

5.0 Information Gap Analysis

5.1 Identification of Information Gaps

Table 5-1 and 5-2 present reviews of the information that is available to support design of fish collection facilities at Cougar and Lookout Point Dams respectively by the information categories defined in Section 2.3 and 2.4. The reviews include synopses of the information under each category, citations of where the information was found, comments on application of the information, and finally, a one word descriptor of the quality of the information. The following descriptors were applied based on the authors' experience with similar past projects and current understanding of the available data:

- Unavailable – This category is self-explanatory; there was no information found.
- Inadequate – There was information found, but it was considered inadequate in quality or completeness to use as a basis for design.
- Adequate – Information found was considered adequate to use as a basis for conceptual level design, but could be improved for detailed design.
- Good – Information found was considered to be completely satisfactory for detailed design purposes.
- Excellent – Information found is considered to exceed the requirements for designing fish collection facilities.

Table 5-1 Cougar Dam Required Information Gap Analysis

Category	Information Available	* Information Quality	Citation	Comments
Biological				
Species	Spring Chinook, bull trout and resident trout will be the targeted species. Past studies showed that longnose, dace, whitefish, sculpin and largescale sucker were captured in the reservoir. Possibly hatchery rainbow trout.	Excellent	NOAA 2008, Taylor 2000, Ingram and Korn 1969, USACE 2010, Zymonas and Hogansen 2010	Species of concern will be dependent on future fish management as self-sustaining runs of anadromous salmon do not exist upstream of the Project. Resident rainbow, cutthrout, and bull trout have been collected in the reservoir.
Size	Fish size ranges from approximately 60-280mm. The average size of spring Chinook juveniles passing the project was between 111-160mm, dependent on migration year. Adult fish entering system may be larger than 500mm.	Good	Taylor 2000, Ingram and Korn 1969, USACE 2010, Zymonas and Hogansen 2010	Fish size will be dependent on environmental conditions and the number of adult fish released upstream. Reservoir rearing conditions will also impact fish production levels. The effects the water temperature structure has on reservoir productivity, compared to when the biological studies were conducted is unknown. A change in reservoir productivity may alter fish size and timing.
Timing	Year-round with peaks in the early spring/summer and mid-December through late January.	Good for dam site - Inadequate for head of reservoir site.	Taylor 2000, Ingram and Korn 1969, Zymonas and Hogansen 2010	Facility design needs to take into consideration that new life histories may develop over time as fish re-colonize upstream habitat. To maintain species diversity, facilities need to operate over as long a time period as possible. Timing of fish collected at head of reservoir was not reported. Project operations are also likley to affect fish run-timing.
Migratory Behavior	Limited. Run-timing data available, known that fish rear in reservoir which alters migration behavior.	Inadequate (although 2010 data collections may help)	Ingram and Korn 1969	Information is needed on fish migration behavior in the reservoir and in the vicinity of both existing and proposed structures.
Reservoir Survival	10-30% (combined reservoir survival and collection. Both dead and live fish captured were included in the estimate).	Inadequate (although 2010 data collections may help)	Ingram and Korn 1969	The estimate should be considered a minimum survival value. Does not include mortality associated with marking (fin-clips) reservoir rearing by released hatchery test fish, or fish that were not collected in sampling facilities; which was later determined to be quite high by researchers.
Daily cycle	No diel data.	Inadequate		Based on data collected at other projects, fish are likely to migrate throughout the day and night. Need for data will depend on operational considerations for new facility i.e. will it need to be manned 24 hours a day for operational or safety considerations.
Abundance	Spring Chinook juvenile abundance is expected to be less than 100,000 for a facility located near the dam. Trapping in the late 90's indicated less than 20,000 smolts passed the project (Taylor 2000). Screw trapping at head of reservoir in 2009) indicate mean fry abundance of ~265,000 (Zymonas and Hogansen). Juvenile abundance is likley to increase as outplanting practices improve and wild fish become established. Resident trout and Bull trout expected to be less than 250 fish.	Adequate	Taylor 2000, Ingram and Korn 1969, Zymonas and Hogansen 2010	Spring Chinook juvenile abundance will vary based on environmental conditions and adult run-size back to upstream spawning areas. Low collection efficiency (3.8%) (Zymonas and Hoganson) of screw trap at head of reservoir results in large confidence interval on fry entering reservoir. The number of rainbow trout planted (if any) each year will likely determine the numbers captured in collection facilities. Resident rainbow trout and bull trout numbers will vary based on environmental conditions, and response to reintroduced spring Chinook.
Physical				
Bathymetric and Topographic Mapping	May have limited bathymetry survey in the area near the WTC tower (conducted for WTC construction thus late 1990's). EC-TG has electronic copy of survey data available for a limited area near the WTC tower. Data for other areas of the reservoir are likely limited to pre-dam contours of topography. Aerial photographs of the entire reservoir during construction are referenced in the WTC DM, Section 4.12.2.b, also in Section 6.5.1. The bathymetry survey is referenced as used for a HEC-RAS model of the reservoir in Section 6.5.1 and dated to 1995.	Adequate	USACE, 1998 (Section 4.12..2.b)	Meld pre-dam topography with detail near the intake tower to provide input to reservoir modeling. Existing data may be adequate for conceptual design of at-dam facilities, but inadequate for site selection for head-of-reservoir or in-tributary facilities. Detailed site-specific multi-beam bathymetry will be required for final design.

Table 5-1 Cougar Dam Required Information Gap Analysis

Category	Information Available	* Information Quality	Citation	Comments
Hydrology	Hydrologic analysis including flood frequency, reservoir storage, sediment transport, drawdown plan was conducted for the WTC tower design as described in the WTC tower DM, Section 6.1. Analysis was based on the following: "The U.S. Geological Survey has operated since 1947 the South Fork McKenzie River near Rainbow, Oregon streamflow gage (Station Number 14159500) located at River Mile 3.9 approximately 0.6 miles downstream of Cougar Dam (see figure 6-1). The drainage area contributing flow at this gage is about 208 square miles. Since 1964, this gage has measured Cougar Lake releases. The regulated outflows from 1964-95 were converted to unregulated flows based on project operations data. Thus, 48 years of average daily unregulated flow data were available for analyses. From October 1957 through September 1987, the U.S. Geological Survey operated a gage above Cougar Lake, near Rainbow, Oregon on the South Fork McKenzie River (Station Number 14159200). The drainage area contributing flow at this gage is about 160 square miles. This gage was located upstream of East Fork McKenzie River and Walker Creek at River Mile 10.4, 100 feet upstream from Tipsoo Creek (approximately 0.7 miles downstream of French Pete Creek). The data from this gage, in conjunction with data from Station Number 14159500, was used in the sedimentation analysis to estimate the proportion of flow contributed by the East Fork McKenzie River and Walker Creek."	Good	USACE, 1998 (Section 6,1 & 7.1)	Hydrologic and fish timing data should be correlated to determine facility design flows.
Water Quality	Have tailrace TDG study information available (see EC-HY) Water quality is described in the WTC DM, Section 7.1, including water quality modeling performed by Corps Hydrologic Engineering Center (HEC). The HEC-5, WESMIN, and WESTEX models were applied during the WTC Tower design. Water quality data for Cougar was collected in the Reservoir over the past 20 years as documented by Larson, 2000. USACE had a temperature string installed in 2007 near the WTC tower that currently measures forebay water temperature real-time from forebay elevations 1680 to 1504 via 24 sensors. Data is collected at 30 second intervals.	Good	Larson, Douglas W., 2000. Wilamette Reservoirs Oregon. Detroit, Big Cliff, Green Peter, Foster, Blue River, Cougar. Limnological and Water-Quality Studies 1950-2000. Portland State University, September 2000.	Tailrace water quality data (TDG) may be pertinent to selecting release location. Forebay temperature data will be adequate to assess potential thermocline impacts on fish access to a collector.
Hydraulic Setting	No previous current meter surveys, numerical modeling specific to hydraulic setting, or information about flow patterns are readily available for Cougar. The exception is any hydraulic information available from the water quality modeling conducted for the WTC Tower design as described above.	Inadequate		May need hydrodynamic modeling to examine hydrothermally driven currents effect on fish access to a collector as well as overall surface circulation impacts on collector location/orientation.
Existing Structures	Drawings are available for existing dam and WTC structures, including all outlets (Regulating outlets, spillways, powerhouse, diversion tunnel).	Excellent	Available from EC-HC Dam Safety Section, also: USACE, 1998. (Section 2.3)	Recent information developed for WTC structure design.
Debris Loading	From WTC Tower DM, Section 2.3: "The South Fork McKenzie River watershed above Cougar Reservoir is mountainous and heavily wooded. Logging operations in the area will be a constant source of debris which will accumulate on the pool. Debris control at the dam is achieved by a floating boom anchored across the reservoir upstream from the dam. Periodic disposal of the floating debris is accomplished by beaching and burning." No reference to specific loading amounts. From Detroit Dam Sonar Image Report: "The sonar image scans indicate that the sediment / debris field has completely filled-in the deep sump below the lower North RO inlet to a depth in excess of 90 feet since 1960. The vertical area of the prism drawn in Drawing 1A contains 6,700 ft. sq. so the cubic yard volume of the debris prism would be calculated as 248.148 Cu Yd per lineal ft. from the face of the dam (assuming a constant original rock bottom contour). If this debris prism were dredged 100 feet out from the dam, 24,815 CY of sediment/debris would be removed. If the debris prism was dredged 250 feet from the dam the resulting dredging would remove 63,037 CY of sediment /debris." A similar report is available in hard copy for Foster Dam. Both may provide a range of debris loadings that may be applied to Cougar.	Inadequate	USACE, 1998. (Section 2.3) Northwest Maritime Industrial, LLC, 2010.	Comparable data from Detroit may not be acceptable for conceptual design because of different land use practices in the Cougar and Detroit basins. More detailed information may be required for detailed design. Records of debris boom O&M may provide estimates of floating debris load. Sediment load information may not be relevant for at-dam options, but may be critical for in-tributary or head-of-reservoir locations. Accumulations of sediment and submerged debris at the dam will show up in detailed multi-beam bathymetric survey mapping.

Table 5-1 Cougar Dam Required Information Gap Analysis

Category	Information Available	* Information Quality	Citation	Comments
Geologic Mapping	WTC DM references both the Cougar Dam DM and a more recent geologic mapping by the State of Oregon as a source for geologic information for the Cougar Dam area. See WTC DM, Section 5.4 for a summary of geologic setting near the intake and diversion tunnel. WTC DM Section 5.5.2 summarizes the foundation geologic conditions.	Adequate	USCEC, 1956. Priest et al., 1983	
Geotechnical Data	Description of geotechnical data from WTC DM, Section 5.2/5.3: "The adoption of geotechnical design values, the establishment of existing geotechnical features, and the geologic conditions associated with the geotechnical features are all based mostly on records that exist from the original design and construction of Cougar Dam. It must be pointed out that this documentation is incomplete... The lack of significant data has been taken into account in the selection of geotechnical parameters for design and the geologic features to be encountered." Limited new explorations were made in the accessible portions of the diversion tunnel, but otherwise no new explorations were performed for the WTC design (Section 5.9). Used the original design and construction geotech records for Cougar construction. A description of the foundation conditions is in WTC DM Section 5.5.2. Need to investigate these and whether anything has been done since, perhaps for the Cougar Trap design.	Adequate	USCEC-NPP, 1964. USCEC-NPP, 1956. USCEC-NPP, 1957. USCEC-NPP, 1960. USCEC-NPP, 1983	Okay for conceptual design, but detailed site/concept specific geotechnical and possible geophysical investigation may be required for detailed design.
Operational				
Design Flows	Have design flows from information available from EC-HR and from outflow frequency conducted for the WTC DM.	Good	EC-HR;USACE, 1998 (Section 6.1).	
Water Level	Have water level ranges and daily fluctuation rates (from daily pool change for 1963-2001)	Excellent	Provided by EC-HR	
Temperature Control	The guide describes the temperature targets for the McKenzie River downstream of Cougar; the Cougar WTC sliding weir operation; the HEC-5Q model development and operation for forecasting downstream temperatures with different gate operations; reference to the downstream temperature monitoring site at South Fork McKenzie River near Rainbow, OR (USGS Station No. 14159500); and description of typical weir operations and forecasting.	Good	USACE, 2005	
Power Plant Operations	Analysis of outflow frequency conducted for the WTC DM.	Good	EC-HR; USACE, 1998 (Section 6.1)	
Spill Operations	Analysis of outflow frequency conducted for the WTC DM.	Good	EC-HR; USACE, 1998 (Section 6.1)	

* Information Quality: Unavailable; Inadequate; Adequate; Good; Excellent

Table 5-2 Lookout Point Dam Required Information Gap Analysis

Category	Information Available	* Information Quality	Citation	Comments
Biological				
Species	Rainbow Trout, Large Scale Sucker, Northern Pikeminnow, Redside Shiners, Oregon Chub, Spring Chinook. Introduced species include; brown bullhead, white crappie, largemouth bass, blue gill, smallmouth bass, channel catfish. Spring Chinook are the target species for reintroduction above the reservoir. Target spring Chinook spawning escapement above the dam of 500 adults.	Excellent	Lunstrum et al., 1997, Tranquilli, Helms and Wade 2005, Taylor Powerpoint Presentation, April 5, 2010	Large number of introduced species such as large- and smallmouth bass. These species are known predators of juvenile salmonids. Oregon Chub are an ESA listed species.
Size	Data collected upstream of the project indicate that spring Chinook juvenile size ranged from <60 to >100mm; dominated by fish <60 mm. Spring chinook collected in project tailrace ranged in size from 60-300mm; in 2009 two distinct size classes 90-130mm and 190-240mm.	Adequate	Taylor Powerpoint Presentation, April 5, 2010	Fish captured in tributaries are young-of-the-year fish recently emergent from the gravel. Any traps located upstream of the project will likely catch large numbers of these smaller fish. Fish collected below the project consist of multiple age classes. Some of these fish likely reared in the reservoir for at least 1-year, others are subyearling fish migrating directly through the system.
Timing	Sampling in upstream tributaries showed the majority (90%+) of fish collected migrated from March-June. Some fish were collected in late fall through February. Trapping in the tailrace indicated the majority of migrants were collected from November through January, with fish also collected in May of 2008.	Adequate	Taylor Powerpoint Presentation, April 5, 2010, Fish Commission of Oregon 1959	Run-timing appears to vary dependent on trapping location. Factors responsible may include fish age and size, the level of reservoir rearing by juvenile Chinook and project operations such as reservoir level.
Migratory Behavior	No site specific data.	Inadequate		
Reservoir Survival	From a release of 311,00 fry in June 2009, biologists estimated that 22% to 59% have passed the dam as of the end of 2009.	Inadequate	Taylor Powerpoint Presentation, April 5, 2010	This is a minimum survival estimate as many of the fry released are likely to rear in the reservoir and migrate in 2010.
Daily cycle	No site specific data.	Inadequate		
Abundance	In 2009, it was estimated that 22,000 to 59,000 Chinook juveniles passed the project.	Adequate	Taylor Powerpoint Presentation, April 5, 2010	Given a spawning escapement target of 500 spring Chinook adults, yearling smolt likely to range from 25,000 to 50,000 or 50,000 to 100,000 if fish migrate as subyearlings. Numbers may exceed 100,000 if juveniles migrate from the system as fry. Estimates are based on an egg-to-yearling and egg-to-subyearling survival rate of 5% and 10% respectively **.
Physical				
Bathymetric and Topographic Mapping	Available data for bathymetry is limited to pre-dam topography. No bathymetry data (cross-sections) for tributaries.	Inadequate		Pre-dam bathymetry provides sufficeint resolution for site selection in-reservoir. For an in-tributary facility, river cross-section still needed for HEC-RAS analysis of potential flood impacts of structure to determine feasibility.
Hydrology/ Water Quality	Most recent hydrologic frequency analysis available is dated 1997. Included analysis of inflow data to LOP reservoir from CROHMS database as regulated by Hills Creek Dam for Water Years 1962 - 1997 (mean daily data) and outflow data for WYs 1962-1997 from two sources (1962-1983 from USGS gage #14150000, 1984-1997 from CROHMS database). Inflow data also available from 2 USGS gauges (USGS 14148000, 1911-Current, M.Fork) & (USGS 14147500, 1911-1994, N Fork). FEMA floodplain mapping is also available. USACE collected a manual forebay temperature profile from May 2009 through October 2009 and plans to install a permanent temperature string in the LOP forebay in 2010.	Adequate	USACE Lookout Point Frequency Analysis, 1997. Lookout Point Project Middle Fork Willamette River LOP Water quality data for forebay is available from EC-HY.	
Hydraulic Setting	None known so far.	Unavailable		No additional information is required for conceptual level studies of head-of-reservoir or in-tributary sites, but may need hydrodynamic modeling to examine hydrothermally driven currents effect on fish access to a collector as well as overall surface circulation impacts on collector location/orientation for in-reservoir or at-dam facilities.

Table 5-2 Lookout Point Dam Required Information Gap Analysis

Category	Information Available	* Information Quality	Citation	Comments
Existing Structures	No existing structures in the head of reservoir or likely tributary locations. However a former timber staging area is located on the right bank NF Willamette River just upstream of the confluence of the NF and MF Willamette rivers. Historical aerial photos of the site are available. A dam on the NF at the site was removed.	Adequate		
Debris Loading	From Detroit Dam Sonar Image Report: "The sonar image scans indicate that the sediment / debris field has completely filled-in the deep sump below the lower North RO inlet to a depth in excess of 90 feet since 1960. The vertical area of the prism drawn in Drawing 1A contains 6,700 ft. sq. so the cubic yard volume of the debris prism would be calculated as 248.148 Cu Yd per lineal ft. from the face of the dam (assuming a constant original rock bottom contour). If this debris prism were dredged 100 feet out from the dam, 24,815 CY of sediment/debris would be removed. If the debris prism was dredged 250 feet from the dam the resulting dredging would remove 63,037 CY of sediment /debris." A similar report is available in hard copy for Foster Dam. Both may provide a range of debris loadings that may be applied to Lookout Point.	Inadequate	Northwest Maritime Industrial, LLC, 2010.	Comparable data from Detroit may not be acceptable for conceptual design because of different land use practices in the Lookout Point and Detroit basins. More detailed information may be required for detailed design. Records of debris boom O&M may provide estimates of floating debris load. Sediment load information may not be relevant for at-dam options, but may be critical for in-tributary or head-of-reservoir locations. Accumulations of sediment and submerged debris at the dam will show up in detailed multi-beam bathymetric survey mapping.
Geologic Mapping	Cougar Dam WTC DM refers to State of Oregon geologic mapping. Need to check and see if this reference applies to Lookout Point study area as well as a source for geologic mapping.	Adequate	Priest et al., 1983	
Geotechnical Data	Old Geotech at LOP dam available from LOP DM, but not likely relevant for head of reservoir sites.	Unavailable		Not required for conceptual design, but detailed site/concept specific geotechnical and possible geophysical investigation may be required for detailed design.
Operational				
Design Flows	LOP operating flows available from EC-HR: 6-hr inflow and hourly project outflow data available.	Good	EC-HR/EC-HY	
Water Level Ranges	Water level ranges available from EC-HR: hourly data available.	Good	EC-HR	Note that these reservoir levels are measured at-dam.
Power Plant	Power plant operations available from EC-HR: hourly data available.	Good	EC-HR	
Spill Operations	Spill operations available from EC-HR: hourly data available.	Good	EC-HR	

* Information Quality: Unavailable; Inadequate; Adequate; Good; Excellent

** Data are meant to provide an example of possible production. The 500 fish target is approximately double what was presented in the Biological Opinion (NMFS 2008c).

5.2 Recommended Studies

The studies that are recommended to fill in data gaps to support design of fish collection facilities at Lookout Point and Cougar Dams are described in Sections 5.2.1 and 5.2.2 and summarized in Tables 5-3 and 5-4, respectively. The prioritization of the studies and durations, are based on the optimistic generic schedule presented in Chapter 2 and assumes the level of interaction between design and modeling efforts will not delay the latter.

The biological studies presented below are needed to determine the most appropriate strategy for achieving biological objectives and to locate and size collection facilities. These studies fill in the gaps in our knowledge regarding the most appropriate strategy (in-tributary or in-reservoir) for moving forward with facility design.

The in-tributary strategy focuses on the collection of fish before they enter the reservoir. In this way juvenile migrants are not exposed to the reservoir environment where mortality rates can be high due to predation by other fish species. A collection system located in-tributary has the potential to collect more fish than an in-reservoir system (given equal collection efficiency) as more fish are alive at this point in space and time. However, data collected at multiple projects in the Willamette show that the fish population entering the reservoir is composed primarily of smaller fish (<60 mm). Smaller fish are more susceptible to injury and mortality from collection, handling, transport and release than fish of greater size. In addition, smaller fish have lower juvenile-to-adult survival rates than larger fish. The in-tributary strategy achieves the primary objective (maximize adult production) by assuming the decreased survival rates associated with collection and fish size can be overcome by capturing the maximum number of juveniles possible. Because these facilities are located near the spawning grounds, the facilities need to be designed to handle a large number of the smaller fry.

In contrast, the in-reservoir strategy takes the approach that juvenile losses associated with entry into, and passage through, the reservoir are acceptable given the expected benefits of allowing juveniles to rear in this environment. The two primary benefits are larger fish size at migration (80-160 mm) and less susceptibility to injury and mortality associated with collection, handling and transport than fish caught in-tributary. As long as both reservoir (rearing and migration success) and juvenile to adult survival rates are high, the in-reservoir strategy is likely to produce a larger and more diverse adult population than the in-tributary strategy. Therefore, passage facilities located here are likely to have a higher proportion of larger, older fish than the in-tributary system, especially if fry survival through the reservoir is low.

The biological studies proposed are designed to reduce the uncertainties required to choose between the two strategies.

The physical study recommendations are similar for Cougar and Lookout Point dams. However, the priorities are different due to RPA measure 4.9 assigning a head of reservoir focus for Lookout Point. In each case, the highest priority has been assigned to studies that support the study of alternatives for the collection strategy that has been preliminarily selected for that dam, i.e. at-dam or forebay facilities for Cougar and in-tributary or head-of-reservoir facilities for Lookout Point. Moderate to low priorities have been assigned to studies that would support study of alternatives for other collection strategies. These moderate to low priority studies while not of immediate need, should be considered in the case the selected strategy proves infeasible and an alternative must be pursued. Finally, moderate to low priority studies have also been identified that would support detailed design. These latter studies should be considered in the planning process due to the lead-times that may be required for implementation.

Table 5-3 Cougar Dam Recommended Studies

Study	Priority *	Approximate Duration	Timeframe/ Seasonal Constraints	Order of Magnitude Cost	Objective	Scope Description
Biological Studies						
Juvenile to Adult Survival Study	High	5-years	Adult returns would not be complete for 10 years - may affect ability to meet construction schedule	$50-150k per year	Determine juvenile to adult survival rates for fry and smolts to determine preferred size class for collection	A random sample of juvenile Chinook collected at head of reservoir and in the tailrace would have coded wire tags (CWT) implanted and be transported and released downstream. Data would be used to estimate juvenile-to-adult survival rates for fry and smolts
Juvenile Migration Timing, Size and Abundance at Head of reservoir	Moderate	1-year	None	$50-100k	Determine population life-history and demographics	Data would be collected using screw traps or Merwin traps located at the head of the reservoir to collect information on juvenile migration timing, abundance and size. Will help to size collection facilities and transport systems if a head of reservoir site were to be considered. (Initial data collected in 2009 and continuing into 2010)
Juvenile Chinook Migratory Behavior and Survival Rate through Reservoir	Moderate	2-years	None	$400-600k per year	Determine juvenile behavior and survival in reservoir environment	Hatchery and wild Spring Chinook juveniles of sufficient size for active tags (95 mm +) would be collected using screw traps located at the head of the reservoir or just upstream. A paired or single release protocol (Burnham, et al. 1987) would be used to estimate fish in-season survival and behavior through the reservoir. The use of acoustic tags would also allow information to be gathered on fish vertical and horizontal distribution for smolt stages, but not for the smaller fry and parr.

Study	Priority *	Approximate Duration	Timeframe/ Seasonal Constraints	Order of Magnitude Cost	Objective	Scope Description
Reservoir Rearing	Moderate	2-years	None	$75-150k	Determine success of reservoir rearing	Juvenile Chinook entering the reservoir would be collected at the head of the reservoir, PIT tagged and released below the trap. Traps would be operated downstream to estimate juvenile production, growth rates and timing.
Physical Studies						
Forebay CFD Modeling	High	6 months	None	$300-500k	Examine 3-D circulation patterns in the forebay and tower cul-de-sac regions to guide design orientation of a collector and any guidance enhancing devices.	A 3-D CFD numerical model study should be performed.
Reservoir Hydrodynamic Modeling	Moderate	6 months	None	$200-400k	Examine hydrothermally-driven current structure and potential impacts on fish movement in reservoir.	A 3-D hydrodynamic numerical model study should be performed using EFDC model or equivalent. Duration based on optimistic generic schedule in Section 2 and assumes the level of interaction between design and modeling efforts will not delay the later.
Debris Load Study	Moderate	12 months	Annual record of debris handling may be required	$50-100k	Estimate woody debris and sediment load for the South Fork McKenzie River for detailed design.	A report should be prepared based on existing information and possible season worth of debris data.
Reservoir Bathymetric Survey	Low	2 months	Summer-time full-reservoir	$150-250k	Provide bathymetric data for site-selection level information.	A single beam survey of the thalweg and cross sections at ¼ to ½ mile spacing should be performed.
Aerial Photogrammetry or LiDAR Study	Low	2 months	Winter-time/ low-reservoir/ minimum leaf cover	$25-75K	Provide topographic/bathymetric data for site selection level information.	This should be supplemented with a ground survey for data verification and for collection of property, right of way, and utility information

Study	Priority *	Approximate Duration	Timeframe/ Seasonal Constraints	Order of Magnitude Cost	Objective	Scope Description
In-Tributary Bathymetric Cross Section Survey	Low	2 months	Summer/ low-flows	$25-75K	Provide cross-section data needed to perform River Hydraulics Modeling (see below)	River cross-sections would be needed to ensure capture of relevant river features (every 500-1,000 ft).
River Hydraulics Modeling	Low	3 month	None	$75-150k	Evaluate flood impacts associated with in-tributary alternatives.	A 1-D numerical model study should be performed using HEC-RAS or equivalent. Needs river cross sectional data to proceed.

* Priority: High, Medium, Low

<u>Biological Studies</u>

Juvenile to Adult Survival Study- Priority (High)

The alternatives analysis is looking at facilities located at in the reservoir and in upstream tributaries. The results of limited juvenile trapping studies indicate that the size of fish collected in reservoir versus in-tributary may be substantially different. Zymonas and Hogansen 2010 reported that the majority of fish entering the reservoir were fry (length <60mm) . In contrast, Taylor 2000 estimated that juvenile fish (parr and smolts) passing the Cougar Dam ranged in size from approximately (80-160mm). Allowing fish to rear in the reservoir apparently produces a larger, older fish which may increase species life-history diversity.

The survival rate to adulthood for the two groups (fry versus parr/smolts) is likely to be substantially different for the following reasons:

1. Larger size generally results in higher juvenile survival rates to adulthood (Zabel and Achord 2004).
2. Collection and handling is generally more harmful to smaller fish which increases injury, mortality and stress; resulting in lower survival
3. Release sites for transported fry must have conditions that prevent predation by other fish species and birds at the release point, but also have hydraulic conditions such that poor swimming fry do not get swept into downstream areas where predators may be even more abundant.
4. Fry may rear for an extended period in the lower river which may affect resulting survival rates.

A key assumption in the analysis is that collected fish will survive to adulthood at a sufficient rate to maintain the population over time. Thus, before proceeding with the construction of a juvenile collection system, especially one that collects mainly fry, data need to be collected to confirm this assumption.

The study would be undertaken by operating a screw or Merwin traps at the head of the reservoir and in the tailrace of Cougar Dam. All fish collected from each location would be uniquely marked (by location), transferred to shore and released downstream of the dam. Fish returning to Cougar Dam would be checked for marks and enumerated. Separate survival rates would be calculated for each group. The tailrace group may not be needed if the reservoir traps collected enough larger juveniles (>100 mm) that could act as a surrogate for reservoir reared fish[2].

This discussion points out the need to clearly define fisheries management objectives for spring Chinook, and the role fish passage facilities will play in their achievement. If fish runs need to be self-sustaining above the project then overall survival rates are an important factor that may need to be quantified. However, if the objective is to simply maintain habitat connectivity, then just the act of catching and transporting all life stages (alive) to the next free-flowing reach would be sufficient and juvenile to adult survival rates would not be needed.

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[2] Test fish could also be seined from the reservoir. This would eliminate any delayed effects passage through turbines may have on the collected juveniles.

Because results of this study would take up to 10 years to complete, the timeframes presented for typical facility development and implementation in Table 2-1 would need to be extended if the studies were implemented.

Juvenile Migration Timing, Size and Abundance at Head of Reservoir- Priority (Moderate)

Data for this analysis may be forthcoming from ODFW in a report to be issued in the near future. Until then, it is assumed that information on juvenile migration timing, and size and abundance of fish entering the reservoir are insufficient for designing a fish passage system at the head of reservoir. The study would use screw or Merwin style traps to collect the needed data. Fish collection efficiency of the traps would be developed by marking and releasing fish upstream of the traps for recapture. This trap efficiency value would also be used to estimate the total number of fish entering the reservoir over the course of the migration season. At least once per week, trap catches would be enumerated hourly to determine diel distribution.

Juvenile Chinook Migratory Behavior and Survival Rate through Reservoir- Priority (Moderate)

Information on spring Chinook migratory behavior through the reservoir will be helpful in locating collection facilities. Study results may show that fish follow certain pathways during their migration (shore-line, thalwag etc.) or concentrate in areas that make them more susceptible to collection. If acoustic tags were incorporated into the study design, information on fish (95mm +) vertical and horizontal distribution in the reservoir and at the face of the dam could be obtained (Steig 1999). This data would also help to locate the collection facility and entrance location(s).

Additionally, reservoir survival data are useful in locating a collection system and determining loss due to fish and bird predation associated with reservoir passage. If reservoir loss is high, then collection at the head of the reservoir or in-tributary may be more successful. If reservoir loss is low, then locating a collector closer to the dam may allow for fish to rear in-reservoir which may result in increased production and larger migrants with higher survival rates to adult.

Development of reservoir survival rates for fry will be problematic due to an inability to tag these small fish with active tags, and their propensity to rear in a reservoir environment where they experience high mortality. Tagging the fry with coded-wire-tags would allow estimates of total survival from release to recapture in subsequent years to be developed. These data, when combined with the juvenile to adult survival study results, could then be used to determine which strategy (in-tributary or in-reservoir) produces the most adults.

The USACE will begin collecting reservoir survival data at Cougar as part of a pilot study in 2011.

Reservoir Rearing –Priority (Moderate)

Data collected in the Cougar tailrace indicate that approximately ~20,000 juvenile spring Chinook passed the project in 1998 and 1999 (Taylor 2000). A bimodal juvenile length frequency was observed in fish indicating fish of at least two age classes were present. The larger sized fish may be indicator that reservoir rearing might be an important trait that increases fish size and abundance as hypothesized by Ingram and Korn 1969. Quantifying the importance of reservoir rearing is important in defining where to locate a fish collection system. If reservoir rearing has population benefits, then locating the collector near the dam may be the preferred alternative.

Physical Studies

Forebay CFD Model – Priority (High)

It will be necessary to evaluate the hydrodynamic conditions of the forebay and tower cul-de-sac region close to the proposed structures. This evaluation should provide discernment of the relative influence of different structures and different operational conditions. The EFDC model is a 3-D hydrodynamic model designed for simulating free-surface flows. However it contains an approximation in the formulation of vertical momentum terms. This approximation is valid for the Cougar reservoir except for the near field local region very close to the structure. Therefore it would be possible to extend the applicability of an EFDC model by increasing the resolution in the forebay such that near-field transition zone is reproduced. However, to simulate the hydrodynamics in the local zone of structure influence, another tool, either a near-field local CFD model setup at a very high resolution or a physical scale model including the tower would be required. The CFD model is recommended as the output may be interrogated more readily for the flow field parameters of interest to designers and biologists and to graphically display these outputs.

Reservoir Hydrodynamic Model – Priority (Moderate)

The Cougar Dam alternatives report is examining the feasibility of using at-dam facilities to collect migrating juvenile fish. Stratification of the reservoir in mid- to late- summer may affect surface currents in the reservoir and the ability of fish to access a collector located at the dam, i.e., cooler tributary inflows will plunge below the thermocline, resulting in an entrainment zone near the head of reservoir and potentially adverse surface currents away from the dam. This was the experience that led Portland General Electric to develop the combined fish collection and selective water withdrawal (SWW) facility at Round Butte Dam (Battelle 2006) to both satisfy the water quality requirements of temperature of releases, and to correct the confounding surface currents in the reservoir that prevented fish from finding the historic fish collection facilities.

The Round Butte design investigations employed the BETTER 2-D vertical water quality model to simulate the behavior of reservoir as it undergoes annual transformation from the fully mixed reservoir in the winter to highly stratified two-layer system in the summer. The HEC-5, WESMIN and WESTEX models were used for this purpose for design of the Cougar WTC structure. However, in addition, the Round Butte design team used the 3-D hydrodynamic model EFDC to determine whether selective water withdrawal would address the surface current problem. The model was applied to the reservoir during different seasons corresponding to varying levels of stratification. A similar study for Cougar Dam could be used during the alternatives study to address feasibility questions.

Debris Load Study – Priority (Moderate)

The Detroit Dam information may not provide an accurate order of magnitude picture of the potential accumulation of sediment and debris which may have occurred/will occur at Cougar, based on different land use practices for the basins.. In the longer term, detailed design will require more site specific estimates of floating debris volumes that may need to be boomed or otherwise handled. This may be estimated from review of the O&M records for the existing Cougar boom, if they exist, or by monitoring debris management activities for a year. Sediment loads may be calculated by using empirical formula to calculate the bed load transport of the tributaries for a typical annual hydrograph.

Reservoir Bathymetric Survey – Priority (Low)

While the available data are adequate for conceptual design of at-dam facilities, site selection and conceptual design for head-of-reservoir or in-tributary alternatives, would be highly dependent on the invert profile of the river channel, which is not available from the pre-dam mapping. A bathymetric survey to determine the invert profile of the river channel should be performed to provide information if these locations may eventually be explored. A high level of detail is not required for this site-selection screening level survey. Cross sections every ¼ to ½ mile with a couple of cross-tie lines parallel to the thalweg should be adequate to establish the channel invert profile and typical cross-sections for conceptual-level design.

Aerial Photogrammetry or LiDAR Study - Priority (Low)

While the available bathymetry and topography data are adequate for conceptual design of at-dam facilities, site selection and conceptual design for head-of-reservoir or in-tributary alternatives, would benefit from the overlap provided by having a LiDAR study performed in tandem with a bathymetry study. Having overland contours would be particularly beneficial for determining and selecting potential sites large enough to handle an in-tributary facility and the required sorting and transportation facility. A study undertaken during a time of low pool and minimum leaf cover (i.e. winter) would allow adequate overlap with bathymetry and the best resolution of land contours. This study should be supplemented with a ground survey for data verification and for collection of property, right of way, and utility information.

In-Tributary Bathymetric Cross Section Survey – Priority (Low)

While this study is not needed for conceptual designs for at-dam facilities, this study would be needed for an in-tributary facility. This data is needed to perform the River Hydraulics Modeling described below. River cross sections would be needed every 500-1,000 ft for a large section of the tributary in question. Extents of tributary in question needed to be surveyed would be determined by site specific conditions (e.g. populated areas upstream?).

River Hydraulics Modeling – Priority (Low)

While the river hydraulic modeling is not needed for conceptual design of at-dam facilities, site selection and conceptual design for in-tributary alternatives, would be highly dependent on any potential upstream flood impacts an in-tributary facility would cause. A 1-D numerical model study utilizing HEC-RAS or similar software should be performed to determine these impacts. This study cannot be performed until bathymetry (cross-sections) has been obtained for the tributary in question. Cross-sections would be needed to ensure capture of relevant river features (every 500-1,000 ft).

Table 5-4 Lookout Point Dam Recommended Studies

Study	Priority *	Approximate Duration	Timeframe/ Seasonal Constraints	Order of Magnitude Cost	Objectives	Scope Description
Biological Studies						
Juvenile to Adult Survival Study	High	5-years	Adult returns would not be complete for 10 years - may affect ability to meet construction schedule	$50-150k per year	Quantify juvenile to adult survival rates for fry and smolts to determine preferred size class for collection	A random sample of juvenile Chinook collected at head of reservoir and in the tailrace would be CWT, transported and released downstream of Dexter Dam. Data would be used to estimate juvenile-to-adult survival rates
Juvenile Migration Timing, Size and Abundance at Head of reservoir	High	2-years	None	$100-200k	Determine population life-history and demographics	Data would be collected using screw traps or Merwin traps located at the head of the reservoir to collect information on juvenile migration timing, abundance and size. Will help to size collection facilities and transport systems
Juvenile Chinook Migratory Behavior and Survival Rate through Reservoir	Moderate	2-years	None	$400-600k per year	Determine juvenile behavior and survival in reservoir environment	Hatchery and wild Spring Chinook juveniles of sufficient size for active tags (95 mm +) would be collected using screw traps located at the head of the reservoir or just upstream. A paired or single release protocol (Burnham, et al. 1987) could be used to provide an estimate of in-season survival and behavior through the reservoir. Specifics regarding objectives and sampling capabilities need to be clearly established. If acoustic tags were used to estimate survival rates, data on fish vertical and horizontal information at key points of interest could also be determined.

Study	Priority *	Approximate Duration	Timeframe/ Seasonal Constraints	Order of Magnitude Cost	Objectives	Scope Description
Reservoir Rearing	Moderate	2-years	None	$75-150k	Determine success of reservoir rearing	Juvenile Chinook entering the reservoir would be collected at the head of the reservoir, PIT tagged and released below the trap. Traps would be operated downstream to estimate juvenile production, growth rates and timing.
Physical Studies						
In-Tributary Bathymetric Cross Section Survey	High	2 months	Summer/low -flows	$25-75K	Provide cross-section data needed to perform River Hydraulics Modeling (see below)	River cross-sections would be needed to ensure capture of relevant river features (every 500-1,000 ft).
River Hydraulics Modeling	High	3 month	None	$75-150k	Evaluate flood impacts associated with in-tributary alternatives.	A 1-D numerical model study should be performed using HEC-RAS or equivalent. Needs river cross sectional data to proceed.
Aerial Photogrammetry or LiDAR Study	Moderate	2 months	Winter-time/ low-reservoir/ minimum leaf cover	$25-75K	Provide topographic/ bathymetric data for site selection level information.	This should be supplemented with a ground survey for data verification and for collection of property, right of way, and utility information
Debris Load Study	Moderate	12 months	Annual record of debris handling may be required	$50-100k	Estimate woody debris and sediment load for the North Fork and Middle Fork of the Willamette river for detailed design.	A report should be prepared based on existing information and possible season worth of debris data.
Reservoir Bathymetric Survey	Low	2 months	Summer-time/ full-reservoir	$150-250k	Provide bathymetric data for site-selection level information.	A single beam survey of the thalweg and cross sections at ¼ to ½ mile spacing should be performed.

Study	Priority *	Approximate Duration	Timeframe/ Seasonal Constraints	Order of Magnitude Cost	Objectives	Scope Description
Reservoir Hydrodynamic Modeling	Low	6 months	None	$200-400k	Examine hydrothermally-driven current structure and potential impacts on fish movement in reservoir.	A 3-D hydrodynamic numerical model study should be performed using EFDC model or equivalent if mid-reservoir or at-dam locations are to be studied.
Forebay CFD Modeling	Low	6 months	None	$300-500k	Examine 3-D circulation patterns in the forebay to guide design orientation of a collector and any guidance enhancing devices.	A 3-D CFD numerical model study should be performed if mid-reservoir or at-dam locations are to be studied.

* Priority: High, Medium, Low

<u>Biological Studies</u>

Juvenile to Adult Survival Study- Priority (HIGH)

The alternatives analysis is looking at facilities located at in the reservoir and in upstream tributaries. The results of limited juvenile trapping studies indicate that the size of fish collected in reservoir versus in-tributary may be different. Trap catches in the NFMFW in 2007 were dominated by fry (< 60mm). In contrast, the vast majority of juveniles captured in the Lookout Point dam tailrace ranged from 80-280 mm. It is assumed these fish for the most part represent a population that reared for a substantial period of time in the reservoir. The survival rate to adulthood for the two groups is likely to be substantially different for the following reasons:

1. Larger size generally results in higher juvenile survival rates to adulthood.
2. Collection and handling is generally more harmful to smaller fish which increases injury, mortality and stress; resulting in lower survival
3. Release sites for transported fry must have conditions that prevent predation by other fish species and birds at the release point, but also have hydraulic conditions such that poor swimming fry do not get swept into downstream areas where predators may be even more abundant.

A key assumption in the alternatives analysis is that collected fish will survive to adulthood at a sufficient rate to maintain the population over time. Thus, before proceeding with the construction of a juvenile collection system, especially one that collects mainly fry, data need to be collected to confirm this assumption.

The study would be undertaken by operating a screw or Merwin traps at the head of the reservoir and in the tailrace of Lookout Point Dam. All fish collected from each location would be uniquely marked (by location), transferred to shore and released downstream of Dexter Dam. Fish returning to Dexter Dam would be checked for marks and enumerated. Separate survival rates would be calculated for each group. The tailrace group may not be needed if the reservoir traps collected enough larger juveniles (>100 mm) that could act as a surrogate for reservoir reared fish.

This discussion points out the need to clearly define fisheries management objectives for spring Chinook, and the role fish passage facilities will play in their achievement. If fish runs need to be self-sustaining above the project then overall survival rates are an important factor that may need to be quantified. However, if the objective is to simply maintain habitat connectivity, then just the act of catching and transporting all life stages (alive) to the next free-flowing reach would be sufficient and juvenile to adult survival rates would not be needed.

Juvenile Migration Timing, Size and Abundance at Head of Reservoir- Priority (High)

No site specific data currently exists for the number or size of juveniles entering the Lookout Point reservoir. Data collected in the NFMFW in 2007 can be used as a surrogate, but are likely biased due to fish behavior where the better swimming larger fish can elude the trap, and trap location (NFMFW) which does not account for production from the Middle Fork Willamette both above and below its confluence with the NFMFW. The collection of these data will help in sizing collection, holding, transport and release facilities.

Juvenile Chinook Migratory Behavior and Survival Rate through Reservoir- Priority (Moderate)

Information on spring Chinook migratory behavior through the reservoir will be helpful in locating collection facilities. Study results may show that fish follow certain pathways during their migration (shore-line, thalwag etc.) or concentrate in areas that make them more susceptible to collection. If acoustic tags were incorporated into the study design, information on fish vertical and horizontal distribution in the reservoir and at the face of the dam could be obtained. These data would also help to strategically site the collection facility and entrance location(s).

Reservoir survival data are useful in locating a collection system and determining loss due to fish and bird predation associated with reservoir passage. If reservoir loss is high, then collection at the head of the reservoir or in-tributary may be more successful. If reservoir loss is low, then locating a collector closer to the dam may allow for fish to rear in-reservoir which may result in increased production and larger migrants.

Acquiring direct representative estimates of reservoir survival probability for fry will be problematic due to an inability to tag these small fish with active tags, and their propensity to rear in a reservoir environment where they can experience high mortality. Tagging the fry with coded-wire-tags may be possible and would allow estimates of total survival from release to recapture in subsequent years to be developed. These data, when combined with the juvenile to adult survival study results, could then be used to determine which strategy (in-tributary or in-reservoir) produces the most adults.

For fry and parr stages, It may not be practical to obtain useful estimates of vertical and horizontal distribution. First, they are too small to implant with active tags so that technology is not useful. Second, hydro-acoustic monitoring in multi-species, multi-life stage fish communities will be problematic. The admixture of different fish species and life stages limits the usefulness of any inferences.

Reservoir Rearing- Priority (Moderate)

Data gathered as part of the project profiles indicate that the Lookout Point reservoir may provide rearing habitat for spring Chinook. Reservoir rearing may increase total juvenile smolt production from the upper basin which may lead to larger returns of adult fish. Qualitative estimates of reservoir rearing potential for spring Chinook would provide the information needed to determine how far down reservoir the collection facility should be located to increase juvenile abundance, if needed to achieve fisheries management objectives.

<u>Physical Studies</u>

In-Tributary Bathymetric Cross Section Survey – Priority (High)

This data is needed to perform the River Hydraulics Modeling described below. This has a direct impact on site selection for in-tributary concepts. River cross-sections are needed in adequate resolution to capture all relevant river features (500-1,000 ft) for any and all potential tributaries. Extents of tributary in question needed to be surveyed would be determined by site specific conditions (e.g. populated areas upstream?).

River Hydraulics Modeling – Priority (High)

Feasibility of in-tributary facilities will depend on upstream flood impacts. A 1-D numerical model study utilizing HEC-RAS or similar software should be performed to determine these impacts. This study cannot be performed until bathymetry has been obtained for the tributary in question. Cross-sections frequency would be needed to ensure capture of relevant river features (every 500-1,000 ft).

Aerial Photogrammetry or LiDAR Study - Priority (Moderate)

A study undertaken during a time of low pool and minimum leaf cover (i.e. winter) would allow adequate overlap with bathymetry and the best resolution of land contours which would assist in site selection for head-of-reservoir or in-tributary concepts. Overland contours will assist in identifying potential in-tributary sites with adequate area to fit a large screen system and associated sorting and transportation facilities. This study should be supplemented with a ground survey for data verification and for collection of property, right of way, and utility information.

Debris Load Study – Priority (Moderate)

The Detroit Dam information may not provide an accurate order of magnitude picture of the potential debris and sediment which may have to be dealt with for facilities in the Lookout Point reservoir and tributaries, based on different land use practices for the basins. In the longer term, detailed design will require more site specific estimates of floating debris volumes that may need to be boomed or otherwise handled. This may be estimated from review of the O&M records for the existing Lookout Point boom, if they exist, or by monitoring debris management activities for a year. Sediment loads may be calculated by using empirical formula to calculate the bed load transport of the tributaries for a typical annual hydrograph.

Reservoir Bathymetric Survey – Priority (Low)

Site selection and conceptual design for head-of-reservoir or in-tributary alternatives, would be highly dependent on the invert profile of the river channel, which is provided at 50 ft contours from the pre-dam mapping. This resolution should be adequate for preliminary stages. A bathymetric survey to determine the invert profile of the river channel should be performed to provide information if these locations may eventually be explored. A high level of detail is not required for this site-selection screening level survey. Cross sections every ¼ to ½ mile with a couple of cross-tie lines parallel to the thalweg should be adequate to establish the channel invert profile and typical cross-sections for conceptual-level design.

Reservoir Hydrodynamic Model – Priority (Low)

The Lookout Point Dam alternatives report is not examining the feasibility of using mid-reservoir or at-dam facilities to collect migrating juvenile fish. If facilities at these locations are investigated in the future, stratification of the reservoir in mid- to late- summer may affect surface currents in the reservoir and the ability of fish to access a collector located at the dam, i.e., cooler tributary inflows will plunge below the thermocline, resulting in an entrainment zone near the head of reservoir and potentially adverse surface currents away from the dam. This was the experience that led Portland General Electric to develop the combined fish collection and selective water withdrawal (SWW) facility at Round Butte Dam (Battelle 2006) to both satisfy the water quality requirements of temperature of releases, and to correct the confounding surface currents in the reservoir that prevented fish from finding the historic fish collection facilities.

The Round Butte design investigations employed the BETTER 2-D vertical water quality model to simulate the behavior of reservoir as it undergoes annual transformation from the fully mixed reservoir in the winter to highly stratified two-layer system in the summer. In addition, the Round Butte design team used the 3-D hydrodynamic model EFDC to determine whether selective water withdrawal would address the surface current problem. The model was applied to the reservoir during different seasons corresponding to varying levels of stratification. A similar set of numerical model studies could be employed for Lookout Point Dam during an alternatives study to address feasibility questions if mid-reservoir and at-dam facilities are studied in the future.

Forebay CFD Model – Priority (Low)

Again, if in the future, mid-reservoir and at-dam facilities are studied for Lookout Point Dam, in order to select the best option for further design development and to carry out that development, it will be necessary to evaluate the hydrodynamic behavior of the forebay and regions near the proposed structures. This evaluation should provide discernment of the relative influence of different structures and different operational conditions. The EFDC model is a 3-D hydrodynamic model designed for simulating free-surface flows. However it contains an approximation in the formulation of vertical momentum terms. This approximation is valid for the Lookout Point reservoir except for the near field local region very close to the structure. Therefore it would be possible to extend the applicability of an existing EFDC model if used for the reservoir hydrodynamic modeling by increasing the resolution in the forebay such that near-field transition zone is reproduced. However, to simulate the hydrodynamics in the local zone of structure influence, another tool, either a near-field local CFD model setup at a very high resolution or a physical scale model including all applicable structures would be required. The CFD model is recommended as the output may be interrogated more readily for the flow field parameters of interest to designers and biologists and to graphically display these outputs.

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Appendix A

Project Profiles

Appendix A Table of Contents

Leaburg Diversion

Synopsis: The existing system consists of three wedge-wire v-screen arrays deployed to exclude downstream migrating juvenile salmon from continuing down the power canal. Fish are returned to the McKenzie River via a transport flume. The project is equipped with 3 roller gates to divert flow towards the power canal. This existing v-screen system would be applicable to an in-tributary off-channel system and demonstrates the impact debris may have on operations.

PHYSICAL PARAMETERS	CITATION
Development History	FERC 2005
• Fish Screen Construction: 1983 • Evaluated and Modified: 1987 • Evaluation and Relicensing: 1997 • Screen Upgrades: 2003-2004 • Additional Evaluation: 2007	
Costs	DOE 1994
• Construction: n/a • O&M: Annual downstream costs are $381,200 (1993 dollars)	
Baseline Information	FERC 2007
• Physical or CFD model studies: None • Upgrades based on field evaluations.	
Design Criteria	
• Screens designed using approach velocity for fry criteria of 0.5 fps. NMFS has since lowered this value to 0.4 fps based on biological testing.	
Collector Location and Purpose	
• In-Tributary. • Fish screens located in the power canal to prevent downstream migrants from entering project turbines (i.e. excluding fish from canal system).	
Guidance/Exclusion	FERC 2007
• Total exclusion of power generating flows through v-screen facility spanning power canal.	
Collection	FERC 2005
• Collection Flow: dependant on powerhouse flow – maximum of 2,500 cfs • Fish Collection Facility Operations: Facility operated year round. • The collection facility consists of 3 v-screens spanning the power canal.	
Dewatering	FERC 2007
• Dewatering takes place via 3 v-screen systems (2,340 cfs) • Fish laden water exits via an underdrain located at the apex of each v-screen (160 cfs). • Existing pump back system can decrease bypass flow to 25 cfs; not currently used. • Screens include 18 screen panels (6 per “v”) for a total screen area of 3,457 ft^2. • Ten additional screens (5 on each side of the canal) for a total area of 1,200 ft^2 are located upstream of the v-screens to decrease approach velocity. • The opening between screen bars is two millimeters. • Approach velocities for the screen area are between 0.53 (total screen area) and 0.67 feet/sec (cleaned area only) at a flow of 2,500 cfs. • Screens cleaned with rotary backwash system.	
Bypass or Conveyance	FERC 2007
• Bypass flow: 160 cfs • The underdrain manifold upwells to a 440 foot long flume that drops steeply to the tailrace below the dam.	
Outfall Release	FERC 2007
• Fish are returned to the tailrace below the dam via a flume.	

Project Operations	FERC 2005, FERC 1996
• Project Head: 22 feet at dam (89 feet on turbines) • Pool Range: 4 feet • Powerhouse Capacity: 2500 cfs • Instream flow and ramping requirements: Minimum instream flow of 1,000 cfs.	
BIOLOGICAL PARAMETERS	**CITATION**
Baseline Information	FERC 1996, FERC 2007 and NMFS and USFWS 2001
• Critical studies used in reviewing the project include: several Federal licensing documents and reports, a biological opinion consultation, and an environmental mitigation report.	
Species of Concern	FERC 1996, NMFS and USFWS 2001
• Spring Chinook, Summer Steelhead, Resident Rainbow, Cutthroat Trout, Mountain Whitefish and Bull Trout. • Predation on migrating juveniles by other species was not a major concern for the project.	
Life Stages Observed or Targeted	FERC 1996, NMFS and USFWS 2001
• Juveniles: Fry (<60mm) to smolt (60-250mm). • Steelhead Kelt and Bull Trout adults.	
Number Observed or Expected	
• Salmonid Juveniles – 100,000's over season • Adults- 100's over season	
Collection Period	NMFS and USFWS 2001
• Screens operated year-round. Chinook fry migrate primarily from December through May with peak movement occurring in February and March. Chinook fingerlings (no size defined) pass the dam throughout the year, with the peak occurring in October and November. Steelhead smolts pass the facility from mid-March to June with the peak period in mid-May. Few bull trout pass the project, but both adults and juveniles have been trapped at the facility.	
Site Selection Location Rationale	
• Located in the power canal to prevent fish from entering project turbines.	
Sorting Handling Requirements	
• Fish are diverted by the fish screens into a bypass system which delivers them downstream below the project. No sorting or transport facilities were required in design.	
Facility Performance Standards and Metrics	NMFS and USFWS 2001, FERC 2007
• Initially fry passage performance was poor, but after extensive evaluations and modifications, fry survival has been significantly improved. • NMFS proposed smolt and fry survival rate standards for improved system 99% and 96%, respectively. • Field data results for fry (<60mm); 4 to 13% mortality rate (96%-87% survival) with a bypass apex partially plugged with debris; 8 to 9% mortality with a single screen washer out of service; 2% to 4% with clean screens***,*** 7% to 25% with debris on the screens. • After updating of the system, no smolt mortalities or injuries were observed for bypass flume • Total survival for smolts passing through the entire system was estimated at 99.5%. Fry survival rates were greater than 99% for most tests; with the majority of mortality (1%) the result of handling.	
Site Specific Concerns/Issues and O&M	NMFS and USFWS 2001
• Screen cleaning and high potential for debris accumulation was a concern expressed by NMFS during Section 7 ESA consultation. Caused by a lack of an ability to inspect bypass conduits for debris accumulation in initial design. Identification of debris problems and the ability to inspect and clean facility structures is of critical importance in reducing fish mortality and injury. • The Leaburg diversion screens were a special exemption during settlement discussions with NMFS.	

Cowlitz Falls Riverine Collector Concept

Synopsis: This is a conceptual design of a collector downstream from the tailrace of Cowlitz Falls Dam. The concept includes an inflatable dam used to divert flow and fish to an in-stream inclined floor screen, sorting and truck loading facility. The purpose of the system is to collect downstream migrants for truck transport below two more dams to the lower river. The alternative was rejected as part of the review process due to concerns over the high velocity floor screen. The relevant features include: inflatable dam, inclined floor screen, and application to an in-tributary system. Also of note, during the conceptual design it was learned that the current inflatable dam technology maxes out at 20 ft in height.

PHYSICAL PARAMETERS	CITATION
Development History	AECOM 2009a
• Initial collection facilities installed at Cowlitz Falls Dam but had low collection efficiency. • New test fish screen installed: 2006 • Evaluated and modified screen : 2007 • Developed five conceptual designs: 2008-2009 • Riverine collector considered as part of alternatives analysis.	
Costs	
• Construction: No costs developed • O&M: No O&M developed	
Baseline Information	
• Physical or CFD model studies: None	
Design Criteria	NMFS 2008
• NMFS (2008) fish passage criteria for fish handling and sorting. No NMFS criteria for high velocity floor screens. System was designed to achieve an approach velocity for the screen area of 1.7 ft/s and a maximum channel velocity (6 ft/s).	
Collector Location and Purpose	AECOM 2009a
• In-Tributary. • Located approximately 900 feet downstream of dam. The option and location was examined as part of an alternatives analysis for Cowlitz Falls Dam. The alternative was rejected as part of the review process.	
Guidance/Exclusion	AECOM 2009a
• Inflatable water-filled rubber dam used to divert fish and flow to off-channel screen system. Largest rubber dam based on current technology is 20 ft high. The barrier is water filled because of buoyancy concerns with the level of expected submergence.	
Collection	AECOM 2009a
• Collection Flow: Design flow of 10,500 cfs diverted to collection facility • Fish Collection Facility Operations: Facility would operate April to mid-October • Maximum approach channel velocity: 6 ft/s	
Dewatering	AECOM 2009a
• Dewatering consists of a high velocity inclined floor screen with angle (from horizontal): 15º to 19º (40 ft long and 140 ft wide). • Inclined screen with porosity 50- 60%.	
Bypass or Conveyance	AECOM 2009a
• Inclined floor screen leads to transport channel. • Maximum diverted bypass flow in transport channel: 40 cfs.	
Outfall Release	AECOM 2009a
• Loaded onto trucks for transport to the existing Cowlitz Falls Fish Facility, or transport directly to a downstream location.	

Project Operations	AECOM 2009a
• Powerhouse Capacity: 10,500 cfs • Instream flow and ramping requirements: Minimum instream flow of 1,000 cfs • Special flood passage requirements: Flood protection required for screen, fish bypass, and the fish holding and transfer facility. Rubber dam would be completely deflated for flood events.	
BIOLOGICAL PARAMETERS	**CITATION**
Baseline Information	AECOM 2009a, Tacoma Power 1999
• Critical biological studies used in reviewing the project include a conceptual design report and a technical study report.	
Species of Concern	
• Coho, Spring Chinook, Steelhead, Sea-run Cutthroat Trout. • Predation by Northern Pikeminnow on juvenile migrants is of concern. • Sea-run Cutthroat trout, Rainbow, Northern Pikeminnow, Whitefish, Sculpin and Dace may also be collected at the project.	
Life Stages Observed or Targeted	
• Salmonid Juveniles: Fry (<60mm) to smolt (60-250mm). • Steelhead and Sea-run Cutthroat Adults (All Sizes).	
Number Observed or Expected	
• Salmonid Juveniles – 100,000’s over season • Adults- 100’s over season	
Collection Period	
• Juvenile collection period would extend from April through mid-October.	
Site Selection Location Rationale	AECOM 2009a, Tacoma Power 2000
• Facility to be located in Cowlitz Falls Tailrace. Site selected based on efforts to meet the required 75-95% fish collection efficiency target. This target has yet to be achieved at Cowlitz Falls Dam. The facility would provide a second location for fish collection.	
Sorting Handling Requirements	
• Fry, juveniles and adults need to be sorted into separate tanks. Facilities needed for identifying marked fish (PIT Tags, CWT) and tagging fish for survival and performance studies. Accurate counts of fry, juveniles and adults required to size transport trucks and number of trips. Juveniles and steelhead kelts transported to stress relief ponds located at the Cowlitz Salmon Hatchery. • Marking and enumeration requires anesthesia facility and disposal of chemicals	
Facility Performance Standards and Metrics	Tacoma Power 2000
• 75%-95% Fish Collection Facility- The combined facilities (Cowlitz Falls and the tailrace collector) to have a 75%-95% collection efficiency. Standards were developed as part of the Cowlitz Settlement Agreement • >98% fry and juvenile survival rate- Percentage of fry or juveniles that enter the collection facility that are transported and released alive downstream.	
Site Specific Concerns/Issues and O&M	Tacoma Power 1999
• Stress relief ponds needed to allow fish to recover from transport; however the presence of the parasite *Ceratomyxa Shasta* in the lower Cowlitz River poses a problem as held fish are exposed to the parasite which can cause severe mortality on juvenile Chinook and steelhead. <u>Successful fish passage designs require an extensive look at environmental and biological conditions at both collection and release facilities.</u> • Debris load may result in increased mortality on collected juveniles. <u>Accounting for expected or future debris loading and handling at passage facilities impacts facility design considerations.</u> • Uses a high velocity screen with unknown impacts (descaling, mortality rates) on collected juveniles. <u>Any experimental facility poses risk in regards to effects on fish survival and injury.</u>	

Cougar In-Tributary Concept

Synopsis: This is a conceptual design of a collector in a tributary to the Cougar Dam reservoir. The concept includes an inflatable rubber dam used to divert fish and flow to an in-stream v-screen system from which fish are carried in a transport pipe to holding ponds. The design called for a concrete ogee spillway at the end of the v-screen system to maintain the water level through the screen area. This concept was one of three that survived the alternative study (USACE 2000) but none were recommended for implementation and none have been designed or constructed. Additional research into reservoir hydraulics and fish behavior was recommended before selection of a downstream passage alternative. Concerns of inability to capture fish above 1,210 cfs were expressed regarding this concept. The design is applicable to in-tributary collection.

PHYSICAL PARAMETERS	CITATION
Development History	USACE 2000
• Historical downstream migrant collector located in intake structure (abandoned late 1960's). • Conceptual design developed: 2000	
Costs	USACE 2000
• Construction: $6.4 million (estimated) • O&M: n/a	
Baseline Information	USACE 2000
• Physical or CFD model studies: Physical model testing may be required to fully develop concept; no studies performed.	
Design Criteria	NMFS 1995
• NMFS (1995) fish passage criteria.	
Collector Location and Purpose	USACE 2000
• In-Tributary • Located above the maximum pool level of Cougar Reservoir (Elev. 1,699) in the South Fork McKenzie River. This concept and location was examined as part of an alternatives analysis for Cougar Dam. No concept was carried on to construction.	
Guidance/Exclusion	USACE 2000
• Inflatable rubber dam used to divert fish and flow to low velocity v-screen system.	
Collection	USACE 2000
• Collection Flow: Design flow of 1,210 cfs. This value corresponds to a 10% exceedance flow. 1,170 cfs through v-screens, 40 cfs through adult ladder. • Fish Collection Facility Operations: Operation possible year round. • The entrance is 50 feet wide and 10 feet deep. • Design entrance velocity is 2.3 ft/s	
Dewatering	USACE 2000
• Dewatering system consists of primary v-screens (150 feet long) and secondary screens (12 feet long). • Primary v-screen (1,120 cfs); Secondary screens (30 cfs); Bypass flow exiting secondary screens (20 cfs). • The design approach velocity for the screen area is 0.4 ft/s. • V-screen entrance: 50 feet; apex and secondary screens: 2 feet • Primary screens would be cleaned with a brush system; Secondary screens would be cleaned with a water backwash system. • Dewatering flume with wedge-wire screens on sides would decrease flow to 4 cfs passing into raceways • Ogee spillway located at the end of the v-screen system to maintain the water level through the screen area.	
Bypass or Conveyance	
• Bypass flow entering raceways is 4 cfs. • Loaded into fish trucks from holding raceways for transport directly to a downstream location.	

Outfall Release	
• Details on release point not developed for conceptual design	
Project Operations	USACE 2000
• Special flood passage requirements: Rubber dam would be deflated during events greater than the 10% exceedance flow; Screen velocity criteria would be violated during flood events.	
BIOLOGICAL PARAMETERS	**CITATION**
Baseline Information	Ingram and Korn 1969, NOAA 2008, and USACE 2000
• Critical biological studies used in reviewing the project include an alternatives study and fish passage evaluation reports.	
Species of Concern	Ingram and Korn 1969, NOAA 2008
• Spring Chinook, Rainbow Trout, Cutthroat Trout, Bull Trout • Predator species such as northern pikeminnow were not identified as a concern in the project area. • Other species likely to be collected include, longnose dace, whitefish, sculpin, sucker, and any hatchery fish (trout etc.) released upstream of the project.	
Life Stages Observed or Targeted	
• Chinook Juveniles: Fry (<60mm) to smolt (>60mm)	
Number Observed or Expected	USACE 2000
• Salmonid Juveniles – Design considerations included the possibility of handling of 500,000; with the majority arriving at the facility over two 60-day periods. • Barge/collector holding facilities sized to accommodate 37,000 smolts. The average number of smolts to be collected expected on a daily basis was 4,167. Fish holding facilities were sized to achieve 0.3 cubic feet of water per pound of fish.	
Collection Period	Ingram and Korn 1969
• Collection/bypass possible year-round; with anadromous collection peak occurring in April-June, and January. Historical data indicate that spring Chinook were collected in the old facility in all months sampled.	
Site Selection Location Rationale	USACE 2000
• Located in tributary upstream of reservoir. The option and location was examined as part of an options analysis for Cougar Dam.	
Sorting Handling Requirements	
• V-screens would divert fish into holding facilities. The fish would then be sorted and transferred to a truck loading facility every few (3) days. Trucked fish would be transported and released to the lower river. • Sorting facilities would be used to separate adult and juvenile fish (eliminates predation of adults on juvenile migrants).	
Facility Performance Standards and Metrics	USACE 2000
• Facility must meet NMFS screening criteria (at time of construction), or have passage tests showing better than a 90% survival rate. • Reservoir rearing by juvenile spring Chinook was considered important, but this system would eliminate that capability. • Must accommodate upstream passage of adults. This facility requires an adult fish ladder to be included in the design to meet this standard. • Must collect a large proportion of juvenile migrants (multiple sizes) with minimal risk of injury or mortality.	

Site Specific Concerns/Issues and O&M	USACE 2000, Ingram and Korn 1969
• System would not be operable when flows are greater than 1,210 cfs; although an option allowed for partial collection at higher flows. Inability for the facility to operate at higher flows was expected to decrease system juvenile collection efficiency. <u>Facility designs need to consider flow quantity and timing and their impacts on system effectiveness.</u> • The BiOp calls for stocking rainbow trout (or juvenile steelhead) and cutthroat trout in the McKenzie River basin to mitigate for dam operation and construction. If these fish were stocked upstream of Cougar Dam they may be collected in large numbers. <u>The number and disposition of non-target species entering a collection system need to be accounted for in facility design and operation.</u> • Reservoir rearing by Chinook and other species is not possible under this alternative<u>. Habitat needs and life-histories of target species may determine facility location and therefore should be reviewed as part of the facility selection process.</u> • Large debris and sediment load anticipated at the screens. <u>Environmental factors that may decrease system effectiveness or increase juvenile mortality should be identified early in the facility design process.</u>	

Wapato Irrigation Diversion

Synopsis: This existing system utilizes 15 rotary drum screens to prevent downstream migrating juvenile salmon from entering an irrigation canal. All fish excluded by the screens pass through a flow control structure and are returned to the Yakima River via a transport pipe. The system includes two bypass water return pumps that are not used during normal operations. The facility provides an example of a system that uses self-cleaning rotary drum screens and could be applicable to an in-tributary collection system.

PHYSICAL PARAMETERS	**CITATION**
Development History	Neitzel et al. 1987
• Constructed: 1987 • Evaluated: 1987	
Costs	
• Construction: n/a • O&M: n/a	
Baseline Information	EHI 1985
• Physical or CFD model studies: 1:25 physical model performed to design angle of screens to flow as well as channel transition configuration.	
Design Criteria	
• None	
Collector Location and Purpose	Neitzel et al. 1987
• In-Tributary. • Fish screens located 1 km downstream of the head gates of the Wapato Canal with intent of providing fish free water for irrigation purposes.	
Guidance/Exclusion	Neitzel et al. 1987
• Total exclusion of irrigation flows provided by rotary drum system spanning irrigation canal.	
Collection	Neitzel et al. 1989
• Collection flow: Canal capacity is 2,000 cfs • Fish Collection Facility Operations: Facility operates when irrigation canal is in use (March through October) • Collection facility consists of 15 rotary drum screens spanning canal. • Juveniles pass through one of three fish bypass pipes to a flow control structure, and out a fish return pipe to the Yakima River.	
Dewatering	Neitzel et al. 1989
• Dewatering takes place through 15 rotary drum screens install in the canal at an angle of 26 degrees to the canal flow. • Each drum is 24 feet wide and 15 feet in diameter. • Depth across the face of the screens is 12 feet when the canal is full. • 3 bypass pipes carry 150 cfs to a separation chamber which further dewater the fish to 30 cfs. • Screen design flow: 2,000 cfs.	
Bypass or Conveyance	Neitzel et al. 1989
• Bypass flow is 30 cfs. • Juveniles pass through one of three fish bypass pipes to a separation chamber, and out a fish return pipe to the Yakima River.	
Outfall Release	Neitzel et al. 1989
• The fish return pipe leads directly to the Yakima River.	
Project Operations	
• Water quality control: Irrigation channel in use March through October	
BIOLOGICAL PARAMETERS	**CITATION**
Baseline Information	Neitzel et al. 1987, Neitzel et al., 1989
• The critical studies used in reviewing the project were two fisheries evaluation reports.	

Species of Concern	Neitzel et al., 1989
• Spring and fall Chinook, Resident Trout , Steelhead, Coho • Sculpin, Dace, and Mountain Whitefish may also be bypassed	
Life Stages Observed or Targeted	
• Juvenile and adults all sizes	
Number Observed or Expected	
• Hundreds of juvenile fish pass the screens each day	
Collection Period	Neitzel et al., 1989
• Facility is operational whenever canal is in operation (March-October). Primary fish passage is in the spring and early summer	
Site Selection Location Rationale	
• Screens located near head of diversion canal to eliminate juvenile entrainment into this irrigation water diversion	
Sorting Handling Requirements	
• Fish are diverted and released through a pipe back to the river without handling	
Facility Performance Standards or Metrics	Neitzel et al. 1987, Neitzel et al., 1989
• Less than 2% of Chinook salmon fry (<60mm) passed through the screens. • Wild steelhead released through the system exhibited descaling rates of less than 2.2% (maximum), with an average descaling rate for all tests of 1.4%. These same values for spring Chinook were 7.5% (maximum) and 2.4% (average), respectively. • Descaling rates for steelhead and spring Chinook passing through the outfall pipe was 1.5% and 5.9%, respectively. • Steelhead and spring Chinook mortality rate through the system was less than 1.5%. • Approximately 43% of the steelhead and 62% of the spring Chinook test fish took less than 96 hours to pass through the system during low flows (1,040 cfs). At high flows (1,700), 50% of the steelhead released during the day and night were recaptured within 12 hours and 0.5 hours, respectively. For spring Chinook, 50% of the test fish released in the day and night were recaptured within 2 hours and 0.5 hours, respectively. • Peak daily migration occurred during nighttime hours.	
Site Specific Concerns/Issues and O&M	
• Juvenile migration delay through the system at low flows was observed at the facility. <u>Systems need to be designed such that fish are unable to reside within the system for long periods (reduces stress).</u> • Predation on bypassed fish by other species did not appear to be a problem at the facility at the time the studies were conducted. <u>Environmental conditions at or near fish release sites need to be considered in when locating outfalls or releasing fish directly to the river.</u>	

Upper Swift Juvenile Collector Concept

Synopsis: This is a conceptual design of a system using a ten foot inflatable dam to divert fish and flow to a full exclusionary v-screen array to capture all migrating juvenile salmon for truck transport to a release point below Merwin dam. Juvenile salmon are directed to a collection facility via a transport pipe. This facility provides an example of the use of a rubber dam to divert river flow to v-screens located in the stream channel. The system was eliminated as an alternative due to impact (debris and water levels) large flood flows would have on the structure and inability to achieve performance metrics.

PHYSICAL PARAMETERS	CITATION
Development History	PacifiCorp 2001
• Conceptual Design: 2001	
Costs	
• Construction: n/a • O&M: n/a	
Baseline Information	
• Physical or CFD model studies: None	
Design Criteria	NMFS 1995
• NMFS (1995) fish passage criteria.	
Collector Location and Purpose	
• In-Tributary. • This alternative is located at the upstream end of Swift Lake and is not affected by reservoir fluctuations. The alternative was rejected as part of the review process.	
Guidance/Exclusion	PacifiCorp 2001
• Inflatable rubber dam used to divert fish and flow to four v-screens.	
Collection	PacifiCorp 2001
• Collection Flow: Design flow of 6,700 cfs (1,675 cfs per v-screen) – This is the estimated 10% exceedance flow for this site. • Fish Collection Facility Operations: Operation possible year round. • The collection facility consists of four v-screens. • Juveniles are transported via a bypass chamber to a juvenile collection and handling facility located on the right bank.	
Dewatering	PacifiCorp 2001
• The dewatering system consists of two groups of two v-screens along each bank of the river. Each screen is approximately 411 feet long and 8 feet high. • 50 cfs past each v-screen; combined bypass of 4 screens = 200 cfs; flow at the end of the secondary off channel screen location = 30 cfs. • A rubber dam would be used to impound water to the full 8 foot screen depth. • The design approach velocity for the screen area is 0.4 ft/s. • V-screen entrance: 48 feet; Apex: 5 feet • Screen design flow: 1,675 cfs per v-screen for a total flow of 6,700 cfs. • Bypass control gates located at the end of the v-screen system to maintain uniform flow through the screen area.	
Bypass or Conveyance	PacifiCorp 2001
• Bypass flow is 30 cfs in pipe to sort and transfer facility. • Loaded into fish trucks for transport directly to a downstream location below Merwin Dam.	
Outfall Release	PacifiCorp 2001
• Truck release via collection facility.	

Project Operations	PacifiCorp 2001
• Special flood passage requirements: The structure should accommodate flood flows of 80,000 cfs. The rubber dam can accommodate 74,000 cfs when deflated.	
BIOLOGICAL PARAMETERS	**CITATION**
Baseline Information	Pacificorp 2007
• The critical biological study used in reviewing the project was PacifiCorp's fish passage monitoring plan.	
Species of Concern	
• Coho, Chinook, Steelhead and Bull Trout • Hatchery and wild rainbow trout may also be collected (but are not targeted) • Predation at release points from northern pikeminnow and hatchery coho a concern. Also, there is concern that released fish may prey on native fall chinook inhabiting lower Lewis River	
Life Stages Observed or Targeted	PacifiCorp 2007
• Salmonid Juveniles: Fry (<60mm) to smolt (60-250mm) • Steelhead and Bull Trout Adults (all sizes)	
Number Observed or Expected	
• Salmonid Juveniles – 100,000's over season • Adults- 100's over season	
Collection Period	PacifiCorp 2007
• Year round, with peak collection occurring in spring and summer (April through October). There may be a large fall dispersal migration of spring Chinook juveniles.	
Site Selection Location Rationale	
• Facility located at head of reservoir. Eliminates any losses associated with juvenile passage through the reservoir.	
Sorting Handling Requirements	
• Fry, juveniles and adults need to be sorted into separate tanks. Facilities needed for identifying marked fish (PIT Tags, CWT) and tagging fish for survival and performance studies. Accurate counts of fry, juveniles and adults required to size transport trucks and number of trips. Juveniles and steelhead kelts transported to stress relief ponds located in lower river. Bull trout adults and juveniles released back upstream of Swift Dam. • Marking and enumeration requires anesthesia facility and disposal of chemicals.	
Facility Performance Standards and Metrics	PacifiCorp 2007
• 80% Overall Downstream Survival (ODS) rate standard- Defined as the percentage of juvenile salmonids entering the reservoir (or just upstream) that survives to release. • 95% Fish Collection Efficiency (FCE) standard- The percentage of juveniles that enter the zone of influence of the collection facility that are collected. • 98% fry and 99% smolt survival rate standard- Percentage of fry or juveniles that enter the collection facility that are transported and released alive downstream. • Performance standards were developed as part of a Settlement Agreement.	

Site Specific Concerns/Issues and O&M	
• Debris effects on juvenile salmon mortality and injury. The ability to eliminate debris loading and handling effects on collected fish needs to be accounted for in facility design. • Ability to operate through peak flow period in spring. A good understanding of species run-timing is needed to size facilities. • Juvenile salmonids need to be released below wild fall Chinook rearing area to reduce possible predation. Effects of transport and release of bull trout juveniles downstream of Merwin Dam has unknown impact on population productivity, abundance and diversity. Both fish collection and release criteria should be developed to reduce negative interactions with target and non-target species. • Stress relief ponds needed to allow fish to recover from transport. Alleviating stress effects to fish from handling, transport and release should be incorporated into facility design when needed. • Fish using reservoir tributaries not collected by system must migrate through turbines or spillway. The distribution and abundance of fish populations is critical in locating collection facilities. • Importance of reservoir rearing for coho and spring Chinook unknown; may reduce population abundance potential. Life-history and habitat needs of the target species need to be described prior to implementing passage facilities. • Handling stress on steelhead kelts may result in large mortality. Because both adult and juvenile fish may encounter passage systems, design criteria are needed for both. • System was rejected as an alternative as it was unlikely performance metrics could be achieved. Biological performance criteria for the system need to be developed early in the process to eliminate those systems with a low probability of achieving objectives.	

Willamette Falls Hydroelectric Project

Synopsis: This facility utilizes several applicable technologies to safely pass juvenile migrants downstream. The powerhouse approach channel has a louver-type trashrack installed to direct fish away from the powerhouse intakes and towards two bypass routes at the end of the channel. One bypass route is an Eicher screen installed on the last powerhouse unit penstock. An Eicher screen is very similar to a modular inclined screen (MIS) however the Eicher screen is deployed in a circular pipe while the MIS is deployed in rectangular conduits. The other bypass route, referred to as the North Fish Bypass (NFB), is via a high flow adjustable spillway. The two bypass routes merge downstream before plunging into the tailrace. The layout of the powerhouse, nearly parallel to the river bank, and the high flow through the bypass (400-500 cfs) play a large role in the success of the bypass system. The project also employs a flow control structure (FCS) consisting of a rubber inflatable dam used to concentrate downstream flow over a particular part of the falls to facilitate safer downstream migrant passage. The relevant features include: louvers to guide fish, Eicher screen, high flow bypass, and operating experience with inflatable rubber dam on Willamette system.

PHYSICAL PARAMETERS	CITATION
Development History	ENSR/AECOM 2007, PGE 2008, Normandeau 2009
• Construction of Unit 13 fish bypass: 1991 • Upgrades to Unit 13 fish bypass: 1999 • Construction of NFB structure: 2006 • Construction of FCS: 2007 • Evaluation: 2007-2009	
Costs	PGE 2006, PGE 2008
• Construction: $7.4 million for FCS; NFB upgrades: $5.1 million • O&M: n/a	
Baseline Information	ENSR/AECOM 2006a, ENSR/AECOM 2006b
• Physical or CFD model studies: A 1:12 scale physical model (AECOM) of the forebay was used to develop improvements to the louver system to guide fish towards bypass entrance. A 1:8 scale physical model (AECOM) was used to develop design details of the bypass. 1:30 scale model (AECOM) of tailrace was used to select bypass outfall location as well as to support the FCS (inflatable rubber dam) design.	
Design Criteria	NMFS 2004 (draft)
• NMFS fish passage criteria: 2004 (draft)	
Collector Location and Purpose	
• At-Dam. • Louver-type trashrack located in front of powerhouse intakes. The louvers are designed to keep fish from entering the turbines and direct them towards an Eicher screen located in the furthest downstream turbine intake and a high flow bypass.	
Guidance/Exclusion	PGE 2006, PGE 2008
• Guidance consists of training wall and louver-type trashrack towards Eicher screen and bypass spillway. • Facility also employs an FCS to congregate flow over falls in a location with acceptable downstream depths to improve passage efficiency. The FCS consists of a spillway divided into three sections separated by concrete piers. Each section is 50 feet wide at the base, 70 feet wide at the top, and 13.4 feet deep. Each section is fitted with an inflatable rubber dam which can be independently raised (maximum height of 9 ft) and lowered manually or with a Programmable Logic Control System for automatic control of the bladder pressure. The target maximum flow rate for the structure is 15,000 cfs.	
Collection	
• None	
Dewatering	
• Dewatering occurs via Eicher screen.	

Bypass or Conveyance	ENSR/AECOM 2007, PGE 2006
• The NFB consists of a five foot wide concrete channel with a design flow of 500 cfs starting in the north end of the powerhouse forebay, passing through the South Siphon Spillway and extending approximately 150 feet beyond the powerhouse into the tailrace. • Unit 13 Bypass with a design flow of 390 cfs includes an Eicher screen discharging to a bypass though the Unit 13 turbine, through an upwell with an adjustable wier that controls bypass flow and into an plunge pool that connects to the NFB via a link chute	
Outfall Release	PGE 2006
• Release is 150 feet downstream of the powerhouse in the tailrace.	
Project Operations	ENSR/AECOM 2007, PGE 2008
• Project Head: 25 feet • Pool Range: Run-of-River • Powerhouse Capacity: 5,850 cfs • Special flood passage requirements: FCS maximum design flow 15,000 cfs	
BIOLOGICAL PARAMETERS	**CITATION**
Baseline Information	Karchesky and Pyper 2009
• The critical study used in this review was the results of a three year fish passage evaluation.	
Species of Concern	Karchesky and Pyper 2009
• Chinook and steelhead	
Life Stages Observed or Targeted	Karchesky and Pyper 2009
• Chinook and steelhead smolts. Test fish size was 153 mm and 219 mm for Chinook and steelhead juveniles, respectively.	
Number Observed or Expected	Karchesky and Pyper 2009
• Tens of thousands over season	
Collection Period	Karchesky and Pyper 2009
• Spring and fall	
Site Selection Location Rationale	
• The two bypass routes are located in the powerhouse approach channel and are designed to keep fish from entering the project turbines. The FCS is located at the apex of the falls and is designed to direct migrants toward a safer drop over the falls.	
Sorting Handling Requirements	Karchesky and Pyper 2009
• Subsampling with bypass back to river.	
Facility Performance Standards or Metrics	Karchesky and Pyper 2009
• 98% survival for fish passing the powerplant (license application and settlement agreement). • Mean fish guidance efficiency of the system for Chinook and steelhead were 97.3% and 103% (value exceeded 100% due to sampling variance), respectively. • Steelhead and Chinook survival rates through all components of the modified fish bypass was greater than 98%. • Fish injury rates were estimated at less than 0.5% for both Chinook and steelhead. • Survival rates through the North Fish Bypass were estimated in excess of 99% for bypass flows ranging from 250 to 400 cfs. • Combined fish injury, descaling and neurological damage (referred to as malady rate) were less than 0.5%. • In previous testing, malady rate was estimated at ~40% for both test species. The high rate was attributable to the use of test fish from upstream areas that were already injured etc. The reduction in malady rate was linked to using test fish of high quality and reduction in the large hydraulic vortices which formed along the inner intake screens during early testing. • Turbine passage survival for Chinook and steelhead were estimated at 82% and 85.1%, respectively.	

Site Specific Concerns/Issues and O&M	
• Fish guidance efficiency (FGE) estimates were based on large test fish (150-200 mm). Estimates of fry FGE and survival were not collected as acceptable field research technology was not available. It is likely that due to their poor swimming ability, FGE for fry would have been much lower as they would be swept through the louver system. <u>Determining the life stages and size of test fish to be used in analyzing system performance needs to be taken into consideration in study designs.</u> • System effectiveness for pacific lamprey juveniles is unknown and could require modifications in the future to protect this species if it is listed under ESA. <u>Passage facilities need to work for all species of interest.</u>	

Upper Baker Collector

Synopsis: This existing system employs full exclusionary netting and a pumped v-screen system on a floating structure to collect all downstream migrants in the reservoir. Once migrants are collected they are sorted and placed in a hopper which gets ferried to the dam (~150 feet) for truck transport around Upper and Lower Baker Dams. This is the only functional floating surface collector (FSC) in operation and it is achieving high fish collection efficiency for target species (>70%). The relevant features include: floating structure to follow forebay fluctuation (50 feet), full exclusionary netting, and a pumped v-screen collector.

PHYSICAL PARAMETERS	CITATION
Development History	ENSR/AECOM 2007
• Original Gulper constructed: 1960 • Evaluation studies and upgrades: 1978-2004 • Design of FSC: 2003-2006 • New FSC Constructed: 2007-2008	
Costs	
• Construction: $50 million • O&M: $250,000/ year	
Baseline Information	ENSR 2005a, ENSR 2005b, ENSR 2006
• Physical or CFD model studies: CFD study performed by AECOM to locate FSC in forebay and determine exclusion netting alignment and configuration. Physical model study performed by AECOM of preliminary design to investigate pump intake conditions and screen balance requirements.	
Design Criteria	NMFS 2008
• NMFS (2008) fish passage criteria	
Collector Location and Purpose	
• In-Reservoir. • FSC located in forebay (~150 feet upstream of dam) at the Upper Baker Dam.	
Guidance/Exclusion	AECOM 2007
• Full exclusionary netting with full depth of 285 feet consisting of ¼ inch nylon mesh except for 3/32 inch mesh at the top 30 feet • The design approach velocity for the netting is 0.13 ft/s.	
Collection	AECOM 2007
• Collection Flow: 500 cfs pumped collection flow with design capacity to increase to 1,000 cfs. Note: pump capacity is currently available for 1,000 cfs but facility would not be in criteria if operated at this flow. Additional primary screens can be added to the facility if it decided to be operated at 1,000 cfs and NMFS performance goals are not being met. • Fish Collection Facility Operations: Facility operates March to August. • The collection facility consists of large v-screen with a net transition structure (NTS) attached to the front. • The NTS transitions from 50 feet tall and 75 feet wide at the entrance to 16 feet tall and 16 feet wide at the entrance to the v-screen. • Entrance Velocity: 2.0 ft/s (500 cfs attraction flow).	
Dewatering	AECOM 2007
• Primary v-screens (350 cfs) with louver porosity adjustment; secondary screens (147 cfs) with sliding perforated plate porosity adjustment. • V-screen system consists of primary (40 feet long) and secondary screens (50 feet long). • Capture velocity (8 ft/s) achieved in secondary screen channel.	
Bypass or Conveyance	AECOM 2007
• Bypass flow exiting secondary screens (3 cfs). • Hopper ferried to dam face and crane transfer to trucks.	
Outfall Release	AECOM 2007
• Release facility located below Lower Baker.	

<table>
<tr><td>Project Operations</td><td>AECOM 2007</td></tr>
<tr><td colspan="2">• Project Head: 285 feet
• Pool Range: 50 feet
• Powerhouse Capacity: 5,050 cfs
• Water quality control: Modified downward-discharging pumps in early design to side-discharging pumps due to concerns of re-suspending bottom sediments.
• Special flood passage requirements: Nets are designed to sink at flood flows.</td></tr>
<tr><td>BIOLOGICAL PARAMETERS</td><td>CITATION</td></tr>
<tr><td>Baseline Information</td><td>Puget Sound Energy 2006, Puget Sound Energy 2009 and NMFS 2008b</td></tr>
<tr><td colspan="2">• The critical studies used in reviewing the project were a draft environmental impact statement, a power point presentation by PSE, and a NMFS consultation report.</td></tr>
<tr><td>Species of Concern</td><td>Puget Sound Energy 2006</td></tr>
<tr><td colspan="2">• Coho, Chinook, Steelhead (including resident form), Sockeye (and Kokanee), Cutthroat Trout, Bull Trout (native char), Pink Salmon (although few in numbers).
• Predation by bull trout on migrants was a concern in facility design and operation.</td></tr>
<tr><td>Life Stages Observed or Targeted</td><td></td></tr>
<tr><td colspan="2">• Juveniles: Fry (<60mm) to smolt (60-250mm)
• Bull Trout (Native Char) Adults and Steelhead kelts</td></tr>
<tr><td>Number Observed or Expected</td><td></td></tr>
<tr><td colspan="2">• Over 500,000 anadromous juveniles collected in a single year. The peak daily count has been over 50,000.
• Adults- 100’s</td></tr>
<tr><td>Collection Period</td><td></td></tr>
<tr><td colspan="2">• Collection period runs from March to August.</td></tr>
<tr><td>Site Selection Location Rationale</td><td></td></tr>
<tr><td colspan="2">• Facility located in-reservoir near the dam. Reservoir rearing (Baker Lake) is important for the key species collected, sockeye salmon. Therefore, a facility located further up the reservoir would seriously impact sockeye production and was eliminated as an alternative.</td></tr>
<tr><td>Sorting Handling Requirements</td><td></td></tr>
<tr><td colspan="2">• Fry, juveniles and adults need to be sorted into separate tanks. Facilities needed for identifying marked fish (PIT Tags, CWT) and tagging fish for survival and performance studies. Accurate counts of fry, juveniles and adults required to size transport trucks and number of trips. Juveniles and steelhead kelts transported to stress relief ponds located at Concrete, WA.
• Marking and enumeration requires anesthesia facility and disposal of chemicals.</td></tr>
<tr><td>Facility Performance Standards and Metrics</td><td>NMFS 2008b and Puget Sound Energy 2009</td></tr>
<tr><td colspan="2">• 75% passage efficiency (BiOP) - Expected to consist of 85% reservoir passage, 90% collection and 98% survival.
• Recent Performance- 2009 study Powerpoint presentation indicated a mean coho and sockeye collection efficiency of 81% and 76%, respectively.</td></tr>
<tr><td>Site Specific Concerns/Issues and O&M</td><td></td></tr>
<tr><td colspan="2">• Stress relief ponds needed to allow fish to recover from transport. Effects of fish handling and transport facilities may be stressful and require mitigation; identification of these facilities should be part of the design process.
• Riverine conditions (water depth and velocity) at release site needs to be such that predation by other species is not substantial. Facility designs should not only identify fish collection requirements, but also transport and release needs.
• Guide net mesh size not expected to impinge/gill fry. However, data to confirm this assumption is not collected over the full depth of netting. The size of fish expected to utilize passage facilities needs to be identified.
• Bull Trout concentration in front of collector entrance increases predation rates on other species. The effects other species may have on system performance needs to be considered in the design.</td></tr>
</table>

Cougar In-Reservoir Concept

Synopsis: This is a conceptual design utilizing partial exclusionary netting to guide juvenile fish towards two floating surface collectors (FSC). Collected fish are stored on a separate collection barge until they can be transferred to a smaller barge with a holding tank that would be propelled to a shore-based truck loading facility (every 2-3 days). This concept was one of three that survived the alternative study (USACE 2000) but none were recommended for implementation and none have been designed or constructed. Additional research into reservoir hydraulics and fish behavior was recommended before selection of a downstream passage alternative. The relevant features include: floating surface collector, pumped v-screen system, and exclusionary netting.

PHYSICAL PARAMETERS	CITATION
Development History	USACE 2000
• Historical downstream migrant collector located in intake structure (abandoned late 1960's). • Conceptual design developed: 2000	
Costs	USACE 2000
• Construction: $9.8 million (estimated) • O&M: n/a	
Baseline Information	USACE 2000
• Physical or CFD model studies: Physical model testing may be required to fully develop concept; no studies performed. • Fish monitoring study recommended to determine if two FSC would be necessary as well as determine best location for FSC(s)	
Design Criteria	NMFS 1995
• NMFS (1995) fish passage criteria	
Collector Location and Purpose	USACE 2000
• In-Reservoir. • Located mid-reservoir. This concept and location was examined as part of an alternatives analysis for Cougar Dam. No concept was carried on to construction.	
Guidance/Exclusion	USACE 2000
• Partial exclusionary netting with depth of 75 feet and 2,500 feet long consisting of ¼ inch (opening) nylon mesh. • The design approach velocity for the net area is 0.1 ft/s.	
Collection	USACE 2000
• Collection Flow: 220 cfs pumped flow per FSC. • Fish Collection Facility Operations: Operations possible year round. • The collection facility consists of two separate FSCs with v-screens. • Each FSC entrance would be 10 feet wide and 6 feet deep.	
Dewatering	USACE 2000
• Each FSC would have a dewatering system consisting of primary v-screen (43 feet long) and secondary parallel screens (12 feet long). • Primary v-screens (181 cfs) with 40% porosity and baffled adjustment; Parallel secondary screens (27cfs) with 40% porosity and baffled adjustment • V-screen entrance: 10 feet; apex and secondary parallel screen width: 1.8 feet • Maximum velocity (3.7 ft/s to 2.2 ft/s) achieved in secondary screen channel. Bypass flow exiting secondary screens (12 cfs). • The design approach velocity for the screen area is 0.4 ft/s.	
Bypass or Conveyance	USACE 2000
• Bypass flow = 12 cfs • Fish stored on collection barge. Fish then transferred to transport barge and ferried to dam face, with crane transfer to trucks.	
Outfall Release	
• Details on release point not developed for conceptual design	

Project Operations	USACE 2000
• Project Head: 449 feet • Pool Range: 183 feet • Powerhouse Capacity: 1,350 cfs • Water quality control: Temperature requirements	
BIOLOGICAL PARAMETERS	**CITATION**
Baseline Information	Ingram and Korn 1969, USACE 2000
• Critical biological studies used in review include an alternatives report and the results of biological studies.	
Species of Concern	Ingram and Korn 1969
• Spring Chinook, Rainbow Trout, Cutthroat Trout, Bull Trout • Predator species such as northern pikeminnow were not identified as a concern in the project area. • Other species likely to be collected include, longnose dace, whitefish, sculpin, sucker, and any hatchery fish (trout etc.) released upstream of the project.	
Life Stages Observed or Targeted	
• Chinook Juveniles: Fry (<60mm) to smolt (>60mm)	
Number Observed or Expected	USACE 2000
• Salmonid Juveniles – Design considerations included the possibility of handling of 500,000; with the majority arriving at the facility over two 60-day periods. • Barge/collector holding facilities sized to accommodate 37,000 smolts. The average number of smolts to be collected expected on a daily basis was 4,167. Fish holding facilities were sized to achieve 0.3 cubic feet of water per pound of fish.	
Collection Period	Ingram and Korn 1969
• Collection/bypass possible year-round; with anadromous collection peak occurring in April-June, and January. Historical data indicate that spring Chinook were collected in the old facility in all months sampled.	
Site Selection Location Rationale	USACE 2000
• Located mid-reservoir. The option and location were examined as part of an options analysis for Cougar Dam. The option was rejected as part of the review process.	
Sorting Handling Requirements	
• Fish would be collected in a floating barge and then transferred to a truck loading facility every few days. Trucked fish would be transported and released to the lower river. Juvenile stress relief ponds were not investigated for the option. • Sorting facilities would be used to separate adult and juvenile fish (eliminates predation of adults on juvenile migrants)	
Facility Performance Standards and Metrics	USACE 2000
• Facility must meet NMFS screening criteria, or have passage tests showing better than a 90% survival rate. • Reservoir rearing by juvenile spring Chinook was considered important. • Must accommodate upstream passage of adults. • Must collect a large proportion of juvenile migrants (multiple sizes) with minimal risk of injury or mortality.	

Site Specific Concerns/Issues and O&M	USACE 2000
• Reservoir fluctuation (may impact system effectiveness and cost). Project operations need to be considered in facility design and options that alter these operations should at least be considered if they may improve facility performance. • The facility was rated negatively because 1) fish must be transferred twice as part of collection and transport activities (increases fish stress, injury and mortality), 2) reduced reservoir rearing capacity (decreased fish abundance), and 3) fish may swim under guide nets resulting in lower juvenile collection efficiency. Fish behavior and the impacts facilities have on fish stress survival and injury should be documented as part of the facility selection process. • Debris, and its impacts on fish survival and facility operations, would be a concern for this type of facility and any similar facilities proposed for Cougar or Lookout Point.	

Carmen-Smith Project

Synopsis: This system is being designed to prevent downstream migrating juvenile salmon from entering the powerhouse intake at Trail Bridge Dam which is part of the Carmen-Smith Hydroelectric Project. The system will include a full exclusionary screen and bypass system with fish returned to the river downstream of the dam via a 3,310 ft transport pipe. Employs a tilting flume and variable weir to adjust to changing reservoir levels. This provides an example of a large fixed v-screen facility in a forebay and required structures for fish passage.

PHYSICAL PARAMETERS	CITATION
Development History	
• Currently in preliminary design phase.	
Costs	
• Construction: n/a • O&M: n/a	
Baseline Information	
• Physical or CFD model studies: Potential for CFD study.	
Design Criteria	NMFS 2008
• NMFS (2008) fish passage criteria.	
Collector Location and Purpose	EWEB 2007
• At-Dam. • V-screen structure located near dam to preclude fish from powerhouse intake. • Entrance aligned to intercept existing flow path of water in reservoir.	
Guidance/Exclusion	EWEB 2007
• Guidance is primarily via surface currents. • Total exclusion of power generating flows through surface v-screen facility.	
Collection	EWEB 2007
• Collection Flow: Utilizes power generating flow up to 2,000 cfs for fish collection, does not operate when power plant is not operating. • Fish Collection Facility Operations: Operates only when powerhouse is operating. No supplemental pumps to operate facility if not drawing water for power plant. • The collection facility consists of two fish collection entrances with a v-screen in each.	
Dewatering	EWEB 2007
• The v-screen system consists of primary screens (20 feet tall and 68 feet long), secondary screens (30 feet long), and tertiary screens (12 feet tall and 6 feet long) to decrease flow. • Even flow distribution maintained by baffles located 3 feet behind the primary and secondary screen panels. Note: authors have misgivings on if this arrangement will work as intended. • V-screen entrance: 18 feet; Apex: 2 feet • Secondary screen panels are trapezoidal in shape (16 feet tall down to 2 feet tall). • Both screens lead to common tertiary v-screen (30 cfs). • Screens will be cleaned with a mechanical brush system • Screened off water enters conduit (16 feet diameter) that leads to powerhouse intake. • The design approach velocity for the screen area is 0.37 ft/s. • Screen design flow: 2,000 cfs	
Bypass or Conveyance	EWEB 2007
• Bypass flows exiting tertiary screens is 30 cfs • A tilting flume (110 feet long) with a slope of 1.5% to 11.8% in conjuncture with an adjustable weir ensures a constant flow to bypass pipe across all reservoir elevations. • 30-inch bypass pipe (3,310 feet long, dropping approximately 85 ft) with a slope of 1.5% to 19.7% returns fish to river downstream of dam. Travel time in pipe = 4.3 minutes • Bypass pipe includes portion of corrugated steel pipe to facilitate in dissipation of energy from 85 ft of elevation drop.	

Outfall Release	EWEB 2007
• The bypass pipe will discharge at the upper end of a riffle at an angle of 30 degrees to the river.	
Project Operations	EWEB 2007
• Project Head: 88 feet • Pool Range: 12 feet • Powerhouse Capacity: 2,000 cfs • In-stream flow and ramping requirements: Trail Bridge dam is operated as a re-regulating facility.	
BIOLOGICAL PARAMETERS	**CITATION**
Baseline Information	EWEB 2006 (See Exhibit-E)
• The critical biological study used in project review was the FERC Final License Application.	
Species of Concern	EWEB 2006
• Spring Chinook, Resident Trout (Brook, Rainbow, Cutthroat), and Bull Trout. • No major fish predator species identified in the area of the project. • Other species that could migrate past the project include; sculpin, mountain whitefish, Pacific lamprey.	
Life Stages Observed or Targeted	
• Juvenile and adults all sizes.	
Number Observed or Expected	
• Data collected at the Trail Bridge turbine using hydroacoustics and fish sampling indicate that the number of juvenile fish passing the facility will be in the thousands (yearly).	
Collection Period	
• Year–round.	
Site Selection Location Rationale	
• Located in power canal. Designed to keep fish from entering power facility (i.e. exclusion screens).	
Sorting Handling Requirements	
• Fish will be diverted into a pipe and released to the river below the project. Fish sampling facilities are required to evaluate screen performance (i.e. direct mortality and loss).	
Facility Performance Standards or Metrics	
• The facility will be designed to NMFS passage facility guidelines for juvenile salmonids. Juvenile and adults survival rates are expected to be high (>98% for fry, juveniles and adults).	
Site Specific Concerns/Issues and O&M	
• Debris load at, and cleaning of, large v-screens need to be considered in designing and locating these type of facilities.	

Round Butte Selective Water Withdrawal Facility

Synopsis: This newly constructed facility combines a floating double v-screen fish collection facility with a selective water withdrawal tower for temperature control of power plant discharges. Fish are pumped to a handling facility where they are sorted by size and transported to a shore-based truck loading facility to be hauled to the lower end. This is an example of a facility designed to change reservoir hydraulics and operate over a relatively narrow range (20-ft) of reservoir elevations. The design takes advantage of a structure that was needed to control river temperatures in the lower river. Additionally, the system uses a Hydrostal pump for transferring fish to the transport system. Facility is being evaluated for fish passage effectiveness in 2010. The relevant features include: floating structure to follow forebay elevation; unique v-screen application; bulk of power generation flow is being used to collect fish; compatibility with temperature control; and use of pump for fish transfer.

PHYSICAL PARAMETERS	CITATION
Development History	PGE 1999
• Original System Abandoned: 1966 • Design: 1996 to 2007 (included initial alternatives study; field studies; modeling; design documentation report; detailed design; plans and specifications) • Construction: 2008-2009 • Evaluation: 2010 (first full season)	
Costs	
• Construction: $108 million • O&M: n/a	
Baseline Information	Battelle 2006, Khan et al 2004, ENSR 2007
• Physical or numerical model studies: Hydrodynamic (EFDC) and CFD numerical modeling performed to examine selective withdrawal impacts on hydrothermal regime and currents in reservoir, plus location and orientation of the facility. Physical model studies performed at 1:20 scale of the overall structure and ~1:5 scale of the tertiary screen, large fish separator, and downwell and piping to pump suction. • Reservoir temperature and current monitoring to document hydrothermal regime for numerical model calibration.	
Design Criteria	NMFS 2008
• NMFS (2008) fish passage criteria with modification of screen approach velocity component.	
Collector Location and Purpose	
• At-Dam. • Floating fish collection facility atop a selective water withdrawal tower located adjacent to the existing power intake.	
Guidance/Exclusion	
• Guidance is primarily via surface currents to the selective water withdrawal facility. • Total exclusion of power generating flows through surface v-screen facility and exclusion screening on bottom intakes.	
Collection	PGE 1999
• Collection Flow: Utilizes dominant power generating flow of ~6,000 cfs entirely for fish collection and does not operate when power plant is not operating. • Fish Collection Facility Operations: Operates February through August (see biological description). The fish collection system is driven by power generating flow and only operates when the power plant is operating, on a daily peaking schedule. There are provisions to possibly add a supplemental pumping system at a later date. • The collection facility consists of two fish collection entrances with a v-screen in each. • Each entrance is 30 feet wide and 40 feet in depth. • Design entrance velocity: 2.2 ft/s	

Dewatering	PGE 1999
• Primary and secondary v-screens with 0.125 inch wedge wire with 3/16 inch slot opening and 60% porosity with baffled adjustment: capture velocity (6.7 ft/s) achieved in capture channel. • Screen design flow: 3,000 cfs per screen (2); • The v-screen system consists of primary (90 feet long), secondary screens (30 feet long), and tertiary screens (10 feet long) to decrease flow. • V-screen entrance: 30 feet; Apex: 2.05 feet • The design approach velocity for the screen area is 0.71 ft/s. • Both screens feed into a common tertiary V-screen (48 cfs) with 57.3% porosity. • Collector includes 5 Surface Exclusion Plates (SEPs) which provide the capability to intake an additional 1,000 cfs for the powerhouse. The intakes are fully screened.	
Bypass or Conveyance	
• Bypass flow exiting tertiary screens is 12 cfs. • Fish are passed through the capture channel, to a large fish separator, through a down well to a 19.5 inch diameter steel pipe that connects to the suction of a Hydrostal pump. Fish are then pumped to a sorting and fish transfer facility (described in the Biological section) for truck transport below the dam.	
Outfall Release	
• Release facility is located downstream of dam.	
Project Operations	
• Project Head: 385 feet • Pool Range: 75 feet maximum; 20 ft normal. • Powerhouse Capacity: 14,000 cfs • Instream flow and ramping requirements: Plant is operated as a peaking facility and downstream flow is controlled by a re-regulating dam. • Water quality control: Selective water withdrawal tower for temperature control of power plant discharges.	
BIOLOGICAL PARAMETERS	**CITATION**
Baseline Information	PGE (1999) and USDOI (2004)
• Critical studies used in reviewing the project were an alternatives study and a federal fishway prescriptions document.	
Species of Concern	PGE (1999)
• Coho, Chinook, Steelhead (including resident form), Sockeye (and Kokanee), Bull Trout, and other native species. • Pacific Lamprey (possibly in the future). • Bull trout predation on juveniles entering the system was identified as a concern.	
Life Stages Observed or Targeted	
• Juveniles: Fry (<60mm) to smolt (60-250mm). • Steelhead Kelt, Bull Trout and Kokanee Adults.	
Number Observed or Expected	
• Salmonid Juveniles – 100,000's; with an expected peak daily count of over 25,000. • Adults- 100's over the course of season.	
Collection Period	
• Collection possible year-round; with anadromous collection period extending from February to July, and other species through August. • System would be able to operate year-round if needed.	

<table>
<tr><td>Site Selection Location Rationale</td><td></td></tr>
<tr><td colspan="2">• Facility located in-reservoir near the dam. Reservoir rearing is important for one of the key species being collected, sockeye salmon. Therefore, a facility located further up the reservoir would seriously impact sockeye production and was eliminated as an alternative. Additionally, the need for a facility to provide water temperature control in downstream reaches provided an opportunity to include fish screens in the design.
• Facility operations are designed to change reservoir flows such that fish are attracted to the structure, and also eliminate eddies and back currents near the dam. Lack of attraction flows to the old collection facility was deemed the primary reason the historical system was ineffective.</td></tr>
<tr><td>Sorting Handling Requirements</td><td></td></tr>
<tr><td colspan="2">• Fry, juveniles and adults need to be sorted into separate tanks. Facilities needed for identifying marked fish (PIT Tags, CWT) and tagging fish for survival and performance studies. Accurate counts of fry, juveniles and adults required to size transport trucks and number of trips. Juveniles and steelhead kelts transported and released to lower river. Medium-sized resident fish measuring 8-15 inches, including 2-3 year old kokanee and bull trout to be sorted and returned to Lake Billy Chinook.
• Marking and enumeration requires anesthesia facility and disposal of chemicals</td></tr>
<tr><td>Facility Performance Standards or Metrics</td><td>USDOI (2004)</td></tr>
<tr><td colspan="2">• 93%-96% smolt survival standard (fishway prescription from USDOI)
• >75% Reservoir Survival standard (fishway prescription from USDOI)</td></tr>
<tr><td>Site Specific Concerns/Issues and O&M</td><td></td></tr>
<tr><td colspan="2">• Intake tower affects river temperatures downstream and possibly reservoir productivity in regards to primary and secondary production. If reservoir productivity decreases, sockeye production may also decrease. Facility impacts on water quality upstream and downstream of the facility need to be considered in the design process.
• Fish are released directly into the river; riverine conditions (water depth and velocity) at release site need to be such that predation by other species is not substantial. A well designed facility requires that impacts to fish from all phases of the passage process (collection, separation, transport and release) be accounted for.
• Bull trout concentration in front of collector entrance may increase predation rates on other species. Impact to bull trout productivity and abundance from the transport and release of juvenile/adults to lower river is unknown. Impacts of the facility on non-targeted fish species need to be considered in facility design and operation.</td></tr>
</table>

Cougar Dam Abandoned (Fish Horns)

Synopsis: This abandoned system utilized several intake ports at different elevations in the intake tower that led to a tall vertical pipe (fish well) which discharged fish upstream of the regulating outlet control gate. The facility is an example of a structure with multiple intakes designed to pass flow over a wide range of reservoir elevations. Additionally, this fish facility provides an example of internal hydraulics that produced unfavorable conditions for good fish survival.

PHYSICAL PARAMETERS	CITATION
Development History	Ingram and Korn 1969, USACE 2000
• Downstream migrant collector located in intake structure constructed: 1963 • Evaluation of downstream passage (1965-1967) • Downstream migrant collector abandoned (late 1960's)	
Costs	
• Construction: n/a • O&M: n/a	
Baseline Information	
• Physical or CFD model studies: None	
Design Criteria	
• NMFS fish passage criteria: None	
Collector Location and Purpose	Ingram and Korn 1969
• At-Dam. • Fish Horns located in intake structure to allow passage of downstream migrants to the lower river.	
Guidance/Exclusion	
• None	
Collection	Ingram and Korn 1969
• Collection Flow: Determined by head over operating horn –maximum allowable head was 50 feet which resulted in 350 cfs. Each horn utilized a butterfly valve to control the flow. The valve was only operated in as fully opened or fully closed. • Fish Collection Facility Operations: Operation possible year round • Collection consists of five fish horns located on the intake tower with centerlines spaced 39.5 feet apart. • Each fish horn was 20 feet high and 9 ft wide.	
Dewatering	
• None	
Bypass or Conveyance	Ingram and Korn 1969
• Each horn narrowed to a 36-inch diameter pipe which led to a five foot diameter vertical fish well. • Vertical fish well released downstream migrants into the regulating outlet upstream of the control gate.	
Outfall Release	Ingram and Korn 1969
• The regulating outlet passes into an ogee chute and to a stilling basin near the powerhouse.	
Project Operations	USACE 2000
• Project Head: 449 feet • Pool Range: 183 feet • Powerhouse Capacity: 1,350 cfs	
BIOLOGICAL PARAMETERS	**CITATION**
Baseline Information	Ingram and Korn 1969, Taylor 2000, USACE 2010, Zymonas and Hogansen 2010
• Site specific studies were used in evaluating this facility for biological performance	

Species of Concern	
• Spring Chinook, Rainbow Trout, Cutthroat Trout, Bull Trout • Predator species such as northern pikeminnow were not identified as a concern in the project area • Longnose dace, whitefish, sculpin, and sucker were also collected during reservoir sampling	
Life Stages Observed or Targeted	Ingram and Korn 1969, Taylor 2000
• Chinook Juveniles: Fry (<60mm) to smolt (>60mm). Spring Chinook exhibited size modes of 80-85, 130-40 and 195 mm. • From 1998-2000 spring Chinook captured in screw traps located at the turbine outlet ranged in size from 60-280mm. The average size of the spring Chinook captured was between 111 and 134 mm, dependent on year sampled.	
Number Observed or Expected	Taylor 2000, Ingram and Korn 1969
• Salmonid Juveniles – 100,000's per migration season were expected. In 1964-65 over 70,000 spring Chinook were estimated to have passed the project. • Taylor (2000) estimated that 14,000 spring Chinook migrated through the regulating valve and from 1,477-3,924 migrated through the turbines in 1998-99.	
Collection Period	Ingram and Korn 1969, Taylor 2000
• Collection/bypass possible year-round; with anadromous collection peak occurring in April-June, and January. However, spring Chinook were collected in all months sampled. • Taylor (2000) and Zymonas and Hogansen (2010) reported that peak catches of Chinook occurred in mid-December and late January, which coincided with low average pool elevations (elevation ranged from 1520-1580). The data provided by Taylor indicated that average daily catch was highest at reservoir elevation 1,580 over this time period (See Figure 1 in Taylor 2000).	
Site Selection Location Rationale	
• Facility constructed as part of dam design (no studies undertaken for site selection). Each horn passed 350 cfs (dependent on reservoir elevation). System was ineffective as the percentage of juvenile fish released in the reservoir (or upstream) that entered the system was low based on tagged releases of juveniles.	
Sorting Handling Requirements	
• Fish were passed through the system and released to the tailrace. Sampling facilities were not required as part of design.	
Facility Performance Standards and Metrics	Ingram and Korn 1969, Taylor 2000
• Managers indicated that a passage efficiency of 70% was needed for the program to be successful. • High mortality was associated with the fish passage facility. Fish passage survival through turbines was actually higher for Chinook (see below). • Anywhere from 10-30% of the tagged hatchery fish (fin-clips) released in-reservoir or upstream of the reservoir were estimated to have entered the fish passage system. Fish released closest to the facility had the lowest recapture rate (~10%). The low number entering the system may have been influenced by fish losses due to marking and release procedures as well as reservoir rearing by the tagged fish. However, estimates of these possible impacts on study results were not developed by the researchers. Thus the minimum passage efficiency for the system was approximately 30%. • The mortality of marked fish passing through the passage system was ~65%. Not an unexpected result given that bypassed fish travelled through both a pressurized pipe and a butterfly valve; two structures that produce unfavorable hydraulic conditions for fish. This assumption was supported by physical observation on recovered test fish that showed severe hemorrhaging of the gills. • Researchers reported that wild Chinook mortality in 1965, 1966 and 1967 were 40%, 30% and 28%, respectively. However, these are minimum mortality estimates as large numbers (1,000's) of dead wild fish were also found later in the regulating outlet by SCUBA divers. • Greater than 90% of juvenile Chinook were captured using gill nets in the top 0-15 ft of the water column. In June 1966, Chinook were captured in larger number (up to 51% of total	

catch) in the 15-30 ft depth range. Reservoir temperature data indicated that temperatures near the surface (top 10 ft) had increased to approximately 65 degrees F; contrasted to approximately 55 degrees F at depths greater than about 15 ft.

- Estimated mortality of juvenile Chinook passing through the turbine and regulating outlet from 1998 to 2000 ranged from 7.1% to 44.9%.
- Approximately 80% of the Chinook migrated out of the regulating outlet. The regulating outlet is shallower than the penstock opening. Juvenile Chinook mortality rates through the regulating outlet in 1998-99 were 32.3%, with steelhead mortality measured at 40%.
- Estimated Chinook turbine mortality ranged from 7.1% to 18.1% from 1998-2000. Juvenile steelhead turbine passage mortality ranged from 30% to 44.9% over this same time frame.
- In 2009-2010, juvenile Chinook (hatchery origin) survival rates through the projects regulating outlet ranged from approximately 80-100 percent. In contrast, juvenile survival rates through the project's turbines at minimum load and maximum efficiency range was 79 percent and 66 percent, respectively. Test fish size ranged from 89 to 206 mm with smaller fish showing higher survival rates (72% versus 62%).
- As project discharge increased from 0.4 kcfs to 1.2 kcfs in 2009-2010, the number of Chinook passing the project increased from ~200 per day to upwards of 1,700 per day. The fork length of fish collected in the screw trap located in the tailrace ranged from ~60 mm to 165 mm, with the majority consisting of fish between 120-145 mm.
- It also appeared that in early 2009, a decrease in reservoir elevation also resulted in an increase in the number of Chinook captured per day in the tailrace. The authors concluded that Chinook abundance is strongly influenced by seasonality and project discharge (although sampling limitations may bias data). Chinook migration peaked in December through January in 2008 and 2009. A second, although smaller peak was observed in the April/May time frame.

Site Specific Concerns/Issues and O&M	Ingram and Korn 1969

- Designers did not seem concerned that fish would be unable to migrate through the reservoir. Research also indicated that spring Chinook reared in the reservoir and this impacted (delayed) their expected migration timing. <u>Fish behavior needs to be accounted for in locating passage facilities</u>.
- Bypass design indicates that hydraulic effects to juveniles passing through the fish horn, butterfly valves etc. were not considered in system design. Failure to account for hydraulic effects of facilities on fish led to high mortality rates. <u>Following fish passage design criteria developed by NMFS will prevent such mistakes in future facility design</u>.
- The reservoir exhibited large fluctuations in elevation during the evaluation periods for fish passage. These fluctuations made interpretation of study results difficult. <u>Project operations need to be considered when evaluating future facilities for passage effectiveness.</u>
- Because of smolt depth distribution in the reservoir, researchers suggested that a surface oriented collection system may be more effective at collecting juveniles. <u>A review of past fish passage work and facilities should be reviewed periodically as this may provide insights on improving facility designs.</u>

Green Peter Abandoned Fish Collection Facility

Synopsis: The abandoned system consisted of a floating collection horn, attraction water pumps, separator unit, and transport pipe. Once the fish had been collected and screened off from the majority of the flow, they were transported down the back of the dam in a 24-inch pipe that discharged 300 feet downstream. This facility provides an example of a floating collection system connected to the dam that operated over a range of reservoir elevations. Another relevant feature is the high velocity bypass pipe. The system was considered successful for Chinook but not for steelhead.

PHYSICAL PARAMETERS	**CITATION**
Development History	USACE 1995
• Downstream migrant collector constructed: 1967 • Evaluation of downstream passage (1967-1971, 1979-1987) • Downstream migrant collector abandoned (1987)	
Costs	
• Construction: n/a • O&M: n/a	
Baseline Information	
• Physical or CFD model studies: None	
Design Criteria	
• NMFS fish passage criteria: None	
Collector Location and Purpose	USACE 1995
• At-Dam. • Floating collection horn attached to dam to allow for passage of downstream migrants to the lower river.	
Guidance/Exclusion	
• None	
Collection	Wagner and Ingram 1973
• Collection Flow: 200 cfs of attraction flow provided from 2 pumps • Fish Collection Facility Operations: System was operated October through June. • Horn entrance was 20 feet high and 6 feet wide • Horn designed to operate with the centerline 15 to 30 feet deep for forebay elevations from 1,015 ft (maximum pool) to 922 ft (minimum conservation pool) • Approach velocity of 0.1 ft/s 18 feet from the horn. Increases to 10 ft/s at throat of horn.	
Dewatering	Wagner and Ingram 1973
• Dewatered across horizontal perforated plate – approximately 6 to 10 cfs remaining.	
Bypass or Conveyance	Wagner and Ingram 1973
• Bypass flow of 6 to 10 cfs conveyed via 12-inch flexible hose attached to one of four 12-inch laterals through dam to a 24-inch transport pipe.	
Outfall Release	Wagner and Ingram 1973
• Pipe outfall includes 300 feet of vinyl lined pipe acting as deceleration zone before entering rubber lined chute that discharged into the tailrace. • Total head on outfall pipe up to approximately 300 ft.	
Project Operations	USFWS 1961, USACE 1995
• Project Head: 319 feet • Pool Range: 128 feet • Powerhouse Capacity: 4,600 cfs • Instream flow and Ramping requirements: Plant is operated as a peaking facility and downstream flow is controlled by a re-regulating dam.	

BIOLOGICAL PARAMETERS	CITATION
Baseline Information	Wagner and Ingram 1973, USFWS 1961, Buchanan et al., 1993
• Critical biological studies used in reviewing the project were an evaluation of fish facilities report, a fishery restoration draft reconnaissance study, and a report regarding resources affected by the Project.	
Species of Concern	Wagner and Ingram 1973, USFWS 1961
• Spring Chinook, Coho, Sockeye, Winter and Summer Steelhead. • Resident Fish: Rainbow and Cutthroat Trout , Suckers and Dace were also observed at the project	
Life Stages Observed or Targeted	Wagner and Ingram 1973
• Anadromous Juveniles- During the evaluation period, spring Chinook ranged from 90-180 mm in length; steelhead averaged from 176-197mm dependent on migration year; sockeye were similar in size to steelhead. • Some adult Chinook and steelhead were collected each year (generally less than 2% of all adult fish released above the project)	
Number Observed or Expected	Wagner and Ingram 1973, Buchanan et al., 1993
• From 242,000 to 800,000 collected each year over a 4-year period. The vast majority (89%) of the fish passing the dam were spring Chinook. • 25,000 migrants observed in a single day. • Over 16,000 trout captured in single year (1971). • In 1987 and 1988 only 1,400 naturally produced steelhead smolts were estimated to have passed the dam.	
Collection Period	Wagner and Ingram 1973, Buchanan et al, 1993
• Sampling for testing purposes occurred from October until June. Sampling did not take place in the summer in order to keep subsmolt (size not defined) from emigrating from the reservoir. • Approximately 50% of the total migration occurred in the fall. However, these numbers may be biased as the system was not operated in the summer. • Steelhead and sockeye migration occurred primarily in April and May. • In the 1980's wild steelhead smolts migrated three weeks later in the year than hatchery fish.	
Site Selection Location Rationale	
• Facility constructed as part of dam design (no studies undertaken for site selection).	
Sorting Handling Requirements	Wagner and Ingram 1973
• In operational mode, fish were to be passed through the system and released to the tailrace. During facility testing, fish were subsampled at the head of the collector/bypass system. • For evaluation studies, handling facilities were required for marking (fin-clips, dart tags, string tags) test fish and developing passage estimates.	
Facility Performance Standards and Metrics	Buchanan et al., 1993, Wagner and Ingram 1973
• Researchers set a 70% collection efficiency goal for the study (i.e. 70% of marked fish released in the reservoir had to be collected at the facility). • Collection efficiency was estimated at > 80% for Chinook, and less than 57% for steelhead over a three year period in the late 1960's. The system was considered a success for Chinook. Steelhead migration success in the late 1980's was less than 40% for most releases. • Smolts passing through 350 ft of rusted pipes had a mortality rate exceeding 30% at times. However, total mortality from handling during the evaluation period was less than 5%. • Smolt collection numbers were higher (1.5 to 3.3 times higher) with mercury vapor lights for Chinook and steelhead. Sockeye catch numbers were about two-thirds less with the use of these lights. Lights appeared to be more effective for Chinook when placed closer to the surface. Mercury lights placed at a depth of 24 feet were more effective for steelhead and sockeye but sample size was very low. • Researchers thought the system was most effective running two fish pumps (higher attraction flows) and operating the mercury lights (at least for Chinook).	

- Researchers concluded that catch for all species was highest when the horn (fish entrance to the system) was at 17 ft versus 24 ft.
- In 1982, 90% of the steelhead released just upstream of the dam went through the bypass. Authors concluded that fish arriving at the dam were collected in high numbers at the bypass facility. In contrast, only 40% of the steelhead smolts (2+) released near the upper end of the reservoir migrated to the dam. Authors concluded that 50 km of shoreline may confuse migrant steelhead. Note that 2-year old hatchery steelhead were used in the tests. These fish exhibited small size and a precocious life history (early maturation). Researchers eliminated these fish from the experiment to the extent possible.
- Approximately 35-90% of the steelhead smolts released successfully migrated through the reservoir in the 1980's, but decreased over the years examined (e.g. in 1980 the estimate was ~70%, in 1988- ~40%).
- No Chinook, steelhead smolts or other predator fish species were observed near the entrance of the downstream bypass (1980's studies).
- Large numbers of northern pikeminnow (squawfish) and introduced largemouth bass may consume large numbers of migrating Chinook as evidenced by the 50-fold decrease in Chinook survival compared to those observed in the 1960's. In the 1960's the survival rate for planted hatchery presmolts was ~15%, in the 1980's survival was 0.5%.
- Only 46% of the 156 <u>adult</u> hatchery steelhead migrated successfully from Foster Dam to Green Peter Dam.
- Fewer than 2% of the steelhead pre-smolts and 50% of the smolts released above Green Peter Dam successfully migrated past the dam.

Site Specific Concerns/Issues and O&M	Buchanan et al., 1993, Wagner and Ingram 1973

- The use of dart tags may have biased study results by 10%. Hatchery steelhead marked with dart tags exhibited high residualism rates. <u>Tagging effects on test fish need to be accounted for in study design to quantify bias.</u>
- Coho stocking upstream of dam was halted due to concerns that these fish may residualize in the reservoir and prey on migrating Chinook and steelhead. Also, the large coho smolts produced in other reservoirs returned as jacks rather than adults. <u>Actions that may impact the success of passage facilities or fish performance should not be implemented unless their effects can be accounted for.</u>
- Schools of fish entering the system resulted in biased estimates of the number of fish passing the dam. This occurred because the facility was subsampled based on time (i.e. fish were sampled every other hour, etc.). <u>Assumptions regarding study methodologies should be clearly stated so that biases are known.</u>
- Disposition of resident trout collected was a concern. <u>The need for separating target species from others should to be identified in the design phase so that facilities are sufficient to meet fisheries management objectives.</u>
- Based on tagged fish recoveries, reservoir rearing appeared to be important for spring Chinook. <u>A good understanding of the habitat needs and life-history of the species being targeted for collection needs to be clearly documented when designing fish passage structures.</u>

Fall Creek Abandoned Fish Collection Facility

Synopsis: The system consisted of three sizes of fish horns at three different elevations located on the dam embankment. The horns led to a transport pipe that passed through the dam and terminated near the regulating outlet. Fish collection efficiency for the facility was considered low due to poor location of the fish horns and a passage route that included a sharp right-angle turn into a concrete wall at the exit. This system is still used to provide water for the adult fish trap as well as downstream temperature control purposes. Operations have been modified to limit downstream fish passage via this route by only operating horns at greater than 20 feet of depth. This facility is an example of poor fish conveyance and a hazardous (high mortality) passage route.

PHYSICAL PARAMETERS	CITATION
Development History	E-mail March 18,2010
• Downstream fish horns constructed: 1965 • Downstream passage evaluation: 1991 • System operations changed to reduce fish passage because of high mortality. However, it is still operated as it provides water for the adult trap.	
Costs	
• Construction: n/a • O&M: n/a	
Baseline Information	
• Physical or CFD model studies: None	
Design Criteria	
• NMFS fish passage criteria: None	
Collector Location and Purpose	E-mail March 18,2010
• At-Dam. • Fish horns located on face of dam near regulating outlet intake to bypass downstream migrants to the lower river. Fish Horns located at 3 elevations to allow for reservoir fluctuation.	
Guidance/Exclusion	
• None	
Collection	E-mail March 18,2010
• Collection Flow: Maximum collection flow is 280 cfs at full pool. • Fish Collection Facility Operations: Currently operating to minimize fish passage (operating horns at greater than 20 feet of depth). • Collection consists of nine fish horns arranged in groups of three at 800-feet, 765-feet, and 720-feet elevations on the face of the dam. • Three large (12 ft by 6 ft) horns, three intermediate (10 ft by 4.8 ft) horns, and three small (8 ft by 3.5 ft) horns. Each elevation has one of each size. • Attraction flow into transport system can be varied by operating ball valves at the base of each horn.	
Dewatering	E-mail March 18,2010
• Perforated plates (separator unit) located downstream of the dam allow water to fall through the perforations to a supply pool that provides attraction water for the adult fish facility.	
Bypass or Conveyance	E-mail March 18,2010
• Bypass includes 36-inch (large horn), 24-inch (intermediate horn), and 18-inch (small horn) transport pipes that constrict to 24-inches and 18-inches. • Immediately downstream of the dam, the pipes expand and rise abruptly into a deceleration unit, through the separator unit, and into a concrete conduit that leads to the fishway approach channel.	
Outfall Release	E-mail March 18,2010
• Outfall release is at the fishway approach channel from the concrete conduit.	

Project Operations	
• Project Head: 181 feet • Pool Range: 161 feet • Water quality control: Horns currently used for downstream temperature control.	
BIOLOGICAL PARAMETERS	**CITATION**
Baseline Information	E-mail March 18,2010, Downey and Smith 1992, Smith and Korn 1970, USFWS 1962
• Critical biological studies used in reviewing the project include correspondence with Corps employee, two evaluations of fish passage reports, and a report on fish and wildlife resources.	
Species of Concern	Smith and Korn 1970, USFWS 1962
• Chinook, Steelhead, Coho • Bullheads, whitefish and resident trout were found in the project area	
Life Stages Observed or Targeted	Smith and Korn 1970
• Steelhead, spring Chinook, and coho were collected in the system	
Number Observed or Expected	Smith and Korn 1970, Downey and Smith 1992
• Approximately 75,000 Chinook and 6,200 steelhead collected over 4-years. Coho catch data in 1968 was approximately 500 fish • Researchers estimated 275,000 spring Chinook smolts migrated out of the system in 1991	
Collection Period	
• The system was operated year-round. Peak steelhead passage was in May. Spring Chinook peak passage varied by year but generally occurred in the spring (May and June) and the fall (November and December) • Currently operated to minimize fish collection and for downstream temperature control.	
Site Selection Location Rationale	Smith and Korn 1970
• System was built into the dam. No biological studies undertaken to site facility prior to dam construction. Facility consists of three fish horns (in groups of three) located at three reservoir elevations (800, 765, and 720 ft elevations). Entrances to the transport system were located 150 ft offshore from the face of dam.	
Sorting Handling Requirements	Smith and Korn 1970
• Fish bypassed to lower river through pipes; bypass system was designed to reduce water velocity prior to discharge point.	
Facility Performance Standards or Metrics	Smith and Korn 1970, Downey and Smith 1992
• Juvenile capture standard was set at 70% based on professional opinion. Measured as the number of marked fish recaptured at the juvenile facility divided by the number released • Recoveries of marked juvenile Chinook releases never exceeded 15.6%; steelhead recaptures never exceeded 6.2%. Migration was primarily at night (10 PM) however fish were collected in all hours sampled. • More fish (in the 100's) were collected when Mercury vapor lights were operating. Few fish (in the 10's) were collected when lights were off. • Most fish passing through the system were injured (>94%). Injury rates varied based on the horn fish entered with injury higher for fish passing through the upper horn (highest reservoir elevation and highest pressure change) and smallest for the lowest horn (lowest reservoir elevation and lowest pressure change). • Passage through the ball valves, rusty pipes, high velocities and exposure to perforated plating and concrete walls were deemed responsible for most mortality. Fish exhibited descaling, pop-eye, head and other body location injuries. Sampling methods also likely caused fish injury. • Fish mortality rates for fish taken from the sample station varied from 3-14%, with an additional delayed mortality of 3-7.5%. • Tests conducted on fish passage through the smallest sized horns resulted in mortalities upwards of 70% (~30% survival). • Predation by other species on bypassed juveniles was also a concern expressed by the researchers.	

• Results from the early 90's indicated that 68.3% of the spring Chinook were killed during passage through the system (for a survival rate of ~32%, far below the 70% standard). Spring Chinook passage survival through the regulating outlet was 59% under a modified reservoir drawdown scenario. • Daily smolt mortality was positively correlated with flow (r=0.714, P< 0.01 with 41 d.f.) and pool level (r=0.756, P< 0.01 with 41 d.f.). Multiple regression analysis indicated that pool elevation and discharge flow combine to explain 64.3% of the variation measured in total (direct plus delayed) daily mortality of smolts migrating through the regulating outlet structures in 1991.	
Site Specific Concerns/Issues and O&M	Downey and Smith 1992, Smith and Korn 1970, USFWS 1962.
• Although the facility was considered ineffective, large number of smolts passed via the regulating outlets. Based on these data researchers suggested that passage of anadromous fish at Fall Creek dam be continued. <u>The establishment of clear biological objectives and metrics is needed to determine whether facility development should be continued or abandoned.</u> • Low juvenile collection efficiency was hypothesized to be the result of poor location of the fish horns and low attraction flows to the facility. Researchers concluded that facilities must be located where fish are located. <u>Fish behavioral studies should be implemented to better locate facilities.</u> • Collection efficiency was not affected by discharge levels through the horns; however researchers were of the opinion that maximum discharge was the most effective at collecting juveniles. <u>If possible, prototype facilities that allow for testing variable conditions (flow, location etc.) are of value when designing passage facilities.</u> • Reservoir filling operations in the spring (February–May) may have reduced attraction flows to the fish horns as total project discharge was decreased during these time periods. Additionally, the reservoir fluctuates approximately 100 ft in elevation; which complicates fish collection or bypass. <u>Project operations need to be considered when developing and testing fish passage facilities.</u> • The reservoir (6.8 miles in length) provided excellent rearing habitat for spring Chinook. Fish were able to reach lengths of 160-165 mm by December. <u>Fish behavior and life-history may be altered from normal due to the habitat provided by large reservoirs; biological evaluations are needed to determine how important reservoir rearing may be to achieving biological objectives.</u> • The reservoir was drained in 1968 and 1969 to streambed to flush juveniles from the reservoir to downstream reach via the regulating outlets; researchers considered this action effective. However, estimates of actual passage rates and survival through these outlets were biased (low) by sampling methods. <u>Before conducting tests, clear performance criteria and metrics need to be established.</u> • Testing procedures affected resulting estimates of juvenile passage mortality and injury. <u>The effect studies and inherent methods have on results needs to be clearly thought out and accounted for prior to implementation.</u>	

Howard Hanson Design

Synopsis: This design includes a vertical array of five collectors, each consisting of a fish horn and a Modular Inclined Screens (MIS) with the two nearest the varying reservoir water surface operating. The purpose is to collect all downstream migrants for truck transport to the lower river. The series of vertical fish collectors and the use of MISs are relevant features, as well as the vertical fish well.

PHYSICAL PARAMETERS	CITATION
Development History	ENSR/AECOM 2007
• Design: 2004-2010 • Not yet constructed	
Costs	USACE 2009
• Construction: currently being developed • O&M: n/a	
Baseline Information	USACE 2009
• Physical or CFD model studies: A 1:50 scale general physical model (NHC) was used to evaluate potential impacts of the facility on spillway capacity. A 1:15 scale sectional physical model (AECOM) was used to investigate overall fish facility design including forebay approach flow. A 1:8 scale physical model (AECOM) was used to analyze the hydraulics of the collector horn, inclined screen, bypass and fish well.	
Design Criteria	NMFS 2008, USACE 2009
• NMFS (2008) fish passage criteria with modifications to velocity gradient criterion. New high velocity screen criteria were developed for the facility in consultation with NMFS. • Water velocity gradient upstream of screen of 0.3 ft/s per linear foot of approach, when velocity is between 2-6 ft/s. A higher gradient is acceptable when the velocity is above the fish capture velocity (6 ft/s)	
Collector Location and Purpose	ENSR/AECOM 2007
• At-Dam. • A vertical array of fish collectors located at the dam adjacent to existing intake tower with the purpose of collecting fish for downstream passage by truck.	
Guidance/Exclusion	
• None	
Collection	USACE 2009
• Collection Flow: 600 cfs per collector • Fish Collection Facility Operations: Facility will be able to operate year round. • Collection facility consists of five horns for near surface fish collection at various reservoir levels each with a MIS. • Each collector entrance is 22 feet wide and 14.5 feet tall • Collectors spaced at 22 foot intervals between 1067.6 feet and 1155.5 feet (centerline) • Maximum of two collectors will be operated at any one time. • Average velocity at entrance or horn = 2 ft/s, average velocity at downstream end of horn = 6 ft/s	
Dewatering	USACE 2009
• Each collector will have a dewatering system consisting of a 17 degree inclined screen (27 feet long). • The design approach velocity for the screen area is 1.7 ft/s. • Maximum screen bar spacing 2.1 mm, minimum screen bar spacing 1.75 mm • Inclined screens (575 cfs) have 40%-60% porosity. • At 600 cfs average velocities over the screen are 6ft/s – at 200 cfs the average velocity is 2 ft/s	

Bypass or Conveyance	USACE 2009
• Bypass pipe flow (25-35 cfs). • Bypass maintains an 8 ft/s capture velocity at 25 cfs. • Each bypass pipe discharges into a fish well (17 feet wide, 19 feet long and 139 feet deep). • Fish removed from fish well via a basket are directed to a holding tank (96 cubic feet) when the basket is hoisted. Design cycle time is 40 minutes. • Transferred to monitoring facility.	
Outfall Release	USACE 2009
• Truck transferred to release facility 4.5 miles below dam.	
Project Operations	USACE 2009
• Project Head: 230 feet • Pool Range: 97 feet • Instream flow and ramping rate: Minimum instream flow of 223 cfs. • Water quality control: Fish collection horns at different elevations aid in drawing water from 1 of 5 elevations to improve consistency of downstream temperature.	
BIOLOGICAL PARAMETERS	**CITATION**
Baseline Information	Dilley and Wunderlich 1993, ENSR/AECOM 2007, USACE 2009
• The critical studies used in reviewing the project include a design document report and a fish passage report.	
Species of Concern	Dilley and Wunderlich 1993
• Chinook, Coho and Steelhead • Rainbow trout and Cutthroat trout were also observed at the project • Researchers note possible predation concerns on delayed migrants, but did not list species of concern	
Life Stages Observed or Targeted	Dilley and Wunderlich 1993
• Yearling and subyearling Chinook, coho and steelhead observed during initial fish monitoring activities.	
Number Observed or Expected	Dilley and Wunderlich 1993
• In 1992, researchers observed 1,645 yearling Chinook, 178,996 subyearling Chinook, 7,489 yearling coho, 31,632 subyearling coho and 32 steelhead smolts. Fish lengths ranged from 46 mm to over 175 mm.	
Collection Period	Dilley and Wunderlich 1993
• Monitoring activities were conducted year-round. Proposed facility would be able to operate year-round.	
Site Selection Location Rationale	Dilley and Wunderlich 1993
• Proposed system to be located at the dam. All sampling and monitoring was conducted in 1991 and 1992 with no bypass system in place	
Sorting Handling Requirements	
• Fish are bypassed to below project. Facility will include ability to monitor fish condition and passage.	

Facility Performance Standards or Metrics	ENSR/AECOM 2007, Dilley and Wunderlich 1993
• New facility survival standard: Achieve 95% juvenile survival rate. • New facility will be designed to meet NMFS fish passage criteria at time of construction. • Juvenile movement past the dam in 1992 was characterized by 1) a pulse of fish during the spring months comprised mainly of Chinook subyearlings and a moderate amount of coho and Chinook yearlings, 2) a pulse of coho yearlings in early summer with pulses of subyearling Chinook occurring throughout the summer, and 3) a large pulse of both Chinook and coho subyearlings in October and November. • Project operations did not appear to affect the number of yearling Chinook or coho passing the dam in 1992. Subyearling Chinook counts increased with project discharge. Virtually all subyearling coho (97%) passed the dam during the fall drawdown. Steelhead abundance was too low to draw any conclusions regarding project operations. • Fish passed the dam's deeply submerged exits only sparingly until reservoir levels dropped and flows increased.	
Site Specific Concerns/Issues and O&M	ENSR/AECOM 2007, Dilley and Wunderlich 1993, USACE 2009
• Spring reservoir refill may cause substantial delay and entrapment of fish in the reservoir resulting in residualization and early maturity. Migration delay resulted in a large number of juveniles emigrating in the fall according to work conducted in the 1990's. Project reservoir drawdown and timing may affect migration timing and thus the life-history of these migrants. <u>Project effects on fish behavior and life-history need to be considered in facility design.</u> • New facility required to operate at all reservoir elevations (varies by 97 feet). <u>Project operational limitations need to be identified prior to facility development.</u> • Debris is expected to be an issue at the facility particularly during the first few years of operation. <u>Identification of debris impacts to the facility and fish survival and injury need to be documented and accounted for in designs</u>.	

Appendix B

Meeting Notes

Meeting Notes

Client:	USACE Portland District (USACE PDX)
Project Name:	Willamette Downstream Fish Passage Design Requirements Report
AECOM Project Number:	6014-8335
Date:	March 18, 2010
Location:	Web-Meeting
Meeting Purpose:	30 % Progress Review Meeting
Prepared By:	Chick Sweeney

In Attendance			
Name	**Company**	**Telephone**	**E-mail Address**
Al Giorgi – Principal Biologist	BioAnalysts	425-883-8295	al.giorgi@bioanalysts.net
Dave Griffith – Project Biologist	USACE PDX	503-808-4773	david.w.griffith@usace.army.mil
Liza Roy – Technical Lead	USACE PDX	503-808-4849	elizabeth.w.roy@usace.army.mil
Chick Sweeney – Task Order Manager	AECOM	206-719-5327	chick.sweeney@aecom.com

Action Item Number	**Action Item**	**Responsibility**
0001	Provide photos of full and drawn down Cougar and Lookout Point reservoirs	Liza Roy
0002	Provide a better quality graphic of Willamette Basin Map	Liza Roy
0003	Provide description of Fall Creek fish facility operations	Dave Griffith – done
0004	Provide lists of Cougar and Lookout Point information in Chapter 5 table format	Liza Roy – done
0005	Provide comments on example project profile tables	Liza Roy – done
0006	Enter review comments in Dr Checks	Dave Griffith – done and Joe Orlins

Summary

The meeting commenced about 10:00 AM and all self-introduced.

Chick Sweeney reviewed the agenda (attached).

Chick Sweeney went through the 30 % Submittal section by section, providing an overview, and then went through the Dr Checks comments entered to date in order. Liza asked whether Joe Orlins had completed his ITR, as his comments were not in Dr Checks. Chick said he had not and was on leave for the week. The following lists the discussion points and provides informal feedback on the Dr Checks comments stated during the meeting:

- Chapter 1 - Introduction:
  - Abbreviation for the U.S. Army Corps of Engineers will consistently be “USACE” throughout the report.
  - RPA measure numbers will be referenced in the text where described.
  - Statements on feasibility of fish passage design will emphasize “high head” rather than “priority” dams.
  - Photos of Cougar and Lookout Point reservoirs at full pool and during drawdown will be included to emphasize reservoir range and projects should be referenced in description of ranges and heads.
  - A larger better quality graphic of Willamette Basin map should be used for Figure 1-1.
- Chapter 2 – Conceptual Framework, will be moved to become an introductory section of Chapter 4.
- Chapter 3 – Design Requirements
  - An error in the work flow lines in Figure 3-1 will be corrected; an explanation of the risk analysis decision points in the figure will be added to the text.
  - A new section, 3.2 Biological Goals, will be added to explain that these goals need to be established before embarking on a project, and discussing the alternative ways goals may be established.
  - References will be moved to Chapter 7 (currently in footnotes).
  - “Resident” will be added to the list of species.
  - Fish run timing should consider when fish naturally arrive in the reservoir, rather than when they pass as the latter may be an operationally-driven behavior.
  - Reservoir survival, rearing, and impact on where fish collection should occur to best benefit the resource was discussed, i.e. might it be best to collect part of a run at head of reservoir for transport while letting the rest rear in the reservoir and be collected at the dam. Did this scenario drive the dual RPA measures to investigate a head of reservoir collection prototype as well as dam-based collection at Lookout Point? It was clarified that the combined NMFS/USACE goal is to collect fish at the dams and transport them downstream.
  - “Hydraulic Setting” explanation will be clarified.
  - An explanation of “Existing Structures” operations will be added.
  - An introductory sentence indicating fish passage operations are trumped by flood passage operations will be added.
  - Regulating outlet operations, ramping rate requirements, and temperature and water quality control operations will be added.
- Chapter 4 – Reference Projects
  - The definitions of in-tributary, in-reservoir, and at-dam will be clarified.
  - Project profiles will include:
    - Reason why selected, i.e. transportability of model system or applicable components to other projects, in introductory synopsis.
    - A rough history of project development.
    - Information used as a design basis.
    - Design criteria.
    - Special O&M requirements.
    - Exclusionary components where applicable.
    - Construction and O&M costs, where available.
    - The biological performance goals and their source, i.e. BiOp or Settlement Agreement.
  - No good examples of high head dam fish passage have been identified in other areas of the U.S. or internationally. The Pacific Northwest region is breaking ground in this area.
  - Upper Baker FSC flexibility in location will be commented on and any differences in conveyance at Swift in-reservoir design will be added.

  - Dave Griffith confirmed that the present the Fall Creek fish horns are used to provide water for the adult facilities, but are not operated when the water level is within 20 ft of the horn elevation to limit downstream fish passage and prevent fish injury.
  - North Fork existing facility will be profiled, but new design plans mentioned.
  - It may not be necessary to profile all listed projects if only limited components are applicable. This can be covered in analysis in Chapter 5.
- Chapter 6 – Analysis and Synthesis of Profiled Projects
  - Liza Roy has already been using the table format in an Excel spreadsheet to prepare a list of information available for Cougar Dam. Much of the Cougar information is being derived from the recent DM for the temperature control tower. Lookout Point does not have a similar DM for a recently added structure, so information is not as readily available.
  - Dave Griffith indicated it will be necessary to explore information on Cougar and Lookout Point in more depth than just reviewing the BiOp as the basis for much of what is in the BiOp is pretty sketchy.
  - The information availability columns in the gap analysis tables will characterize the quality of information using a key list of descriptors, i.e. unavailable, abysmal, inadequate, adequate, good, and excellent.

Chick Sweeney started to go through example project profile tables for Leaburg Diversion Dam, but the review was not finished due to time constraints. The example tables were e-mailed to Liza Roy so she could complete her review following the meeting.

Liza Roy was not able to provide her update on the information available for Cougar and Lookout Point dams due to time constraints. She will e-mail the partially completed tables to Chick Sweeney after the meeting.

The meeting adjourned at 12:00 PM.

Agenda

USACE Portland District

Willamette Downstream Fish Passage Design Requirements Report Project

30 % Progress Review Web-Meeting

March 18, 2010

10:00 Introductions – All

Review 30 % Submittal and Dr. Checks Comments – Chick Sweeney

Update on Status of Project Summaries – Chick Sweeney and Al Giorgi

Update on Design Information Available for Cougar and Lookout Point Dams – Liza Roy

Issues and Resolution – All

12:00 Adjourn

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Meeting Notes

Client:	USACE Portland District (CENWP)
Project Name:	Willamette Downstream Fish Passage Design Requirements Report
AECOM Project Number:	6014-8335
Date:	April 21, 2010
Location:	CENWP 9th Floor Lewis & Clark Room
Meeting Purpose:	60 % Progress Review Meeting
Prepared By:	Chick Sweeney

In Attendance			
Name	**Company**	**Telephone**	**E-mail Address**
Al Giorgi – Principal Biologist	BioAnalysts	425-883-8295	al.giorgi@bioanalysts.net
Kevin Malone – Staff Biologist (via telephone)	BioAnalysts	Call-in: 866-203-6896 Conference Code: 571-415-7536	kmmalone@wavecable.com
Dave “Griff” Griffith – Project Biologist	CENWP	503-808-4773	david.w.griffith@usace.army.mil
Elizabeth “Liza” Roy – Technical Lead	CENWP	503-808-4849	elizabeth.w.roy@usace.army.mil
Charles “Chick” Sweeney – Task Order Manager	AECOM	206-719-5327	chick.sweeney@aecom.com

Action Item Number	**Action Item**	**Responsibility**
0001	Update 30 % report as a working draft for 90 % and send to Liza early the week of April 26th.	Chick Sweeney
0002	Send Willamette AFEP presentation link to Al, Chick, and Kevin.	Dave Griffith - done
0003	Review Cougar 10 % AR for to identify alternative specific data needs for Willamette DFP DRR 90 % submittal	Chick Sweeney and Al Giorgi
0004	Update Lookout Point available physical data for Willamette DFP DRR 90 % submittal	Liza Roy
0005	Obtain PGE presentation of Round Butte project to the Corps for purposes of using the schematic drawings.	Chick Sweeney

Summary

The meeting commenced at ~ 8:15 AM.

Chick reviewed the ITR Dr. Checks comments from Joe Orlins. They were relatively minor. The major input from Liza was a suggestion that the multiple risk decision point boxes in the Figure 3-1 flow chart would be clearer if the question being asked were in the box or described in accompanying text. This is consistent with Mike Langeslay's comment on the 30% report as well. Liza also noted that on future task orders that ITRs would become ATRs, indicating Agency Technical Reviews. CENWP is still working on understanding the procedure for implementing ATRs on current and future TOs. Liza asked if the 30 % report had been updated as a working draft for the 90 % per Chick's previously stated intention; it has not. Liza needs to provide a courtesy copy to others and would like the updated version if available. Chick will try to update and send it to Liza prior to next week.

There were no biological data yet entered in the table for Cougar Dam. Griff will send draft information and the Willamette AFEP presentation. He also outlined the plan for biological monitoring in 2010, which includes a Didson camera on the intake tower, mobile hydroacoustic survey and sampling in the reservoir, and screw trap monitoring below the dam.

We reviewed the available physical data for Cougar Dam and added a few clarifications and comments in the table. Comments included:

- Nomenclature for various areas of the reservoir include reservoir upstream from the log boom, forebay downstream from the boom, and tower cul-de-sac inside of a line from peninsula through island on west side of the forebay. Liza provided a figure showing these areas as defined for the Cougar Downstream Passage Alternatives Study.
- Pre-dam topography and detailed bathymetry near the tower location can be melded to provide information adequate for reservoir modeling.
- Tailrace TDG information may be important in selecting fish release location/s.
- It may be necessary to perform hydrodynamic (EFDC-type) modeling to define hydrothermal currents and stratification effects on fish access to potential collection sites.
- Cougar 10 % AR should be reviewed so we can recognize and recommend any alternative-specific data needs; the specific alternative nomenclature from the report should not be referenced, i.e. describe the alternatives in generic terms, i.e. floating surface collector, etc.

We reviewed the available biological and physical data listed in the table for Lookout Point. Liza is going to provide an update of the physical data.

We reviewed the Cougar In-Tributary Concept and the Round Butte At-Dam Existing Facility project profiles and drawings, with an emphasis on the Round Butte example, and made edits on the Round Butte example in the meeting. Some of the key points made were:

- A text paragraph should be included in the report referencing the figures and the profile table which provides a functional description of the project telling where the fish and flow go from the collection entrance through the bypass and fish evaluation and/or transfer facility for the fish-laden water and through the ultimate "disposal route" for the screened water.
- The figures should be simplified as is easily achievable to clearly provide a schematic of the route of the fish-laden flow and the "disposal flow". It was suggested that this might be done by shading the appropriate areas of the drawings different colors keyed to this differentiation and including flow arrows, or fish art, and/or call-outs. It was also suggested that the schematics presented in PGE's presentation to the Corps on the Round Butte project may provide a better starting point than the design drawings. Chick will try to obtain

the presentation while at a meeting at PGE next week.

- The introductory synopsis in each profile must be fleshed out to make the story clearer on the relevance of the project to today in the Willamette Basin.
- The edited Round Butte profile provides the organization and level of detail desired for all of the profiles.

We started reviewing the comprehensive analysis table and decided that this was redundant to other data provided in the profiles and did not lead to a clear comparison/extrapolation to the Willamette basin project needs. We decided to instead use the location groupings identified for the past projects (in-trib, head of reservoir, in-reservoir, at-dam) and provide a consistent summary of the design issues relevant to the Willamette Valley projects for each location grouping. Information from the project profiles will be used to demonstrate how each of these issues was dealt with in the examples and to make recommendations of which approaches are applicable to the Willamette Valley projects. A brief discussion of the biological decision process guiding location choice will precede the summary of design issues by location.

It was also concluded that the durations of and sequence of studies that may be required to provide required design information for Cougar and Lookout Point , plus the overall design and implementation process, might be best illustrated in a generic Gantt Chart schedule. The schedule will include the flow chart activities in Figure 3-1 with study durations based on information from the past projects in the literature search.

The meeting was adjourned at ~ 12:15 PM.

Agenda

USACE Portland District

Willamette Downstream Fish Passage Design Requirements Report Project

60 % Progress Review Meeting

April 21, 2010

8:00 Update on Status of Responses to Dr Checks Review of 30 % Submittal

8:15 Review Lists of Available Data for Cougar and Lookout Point and Discuss Data Gaps Identified and Potential Studies Required

9:00 Review Table presenting status of Project Profile development and Review and Discuss Example Project Profiles and Accompanying Schematic Figures

- Cougar In-Tributary Concept
- Upper Baker In-Reservoir Existing Facility
- Round Butte At-Dam Design

10:00 Break

10:15 Review of Project Profiles and Figures (continued)

11:00 Review and Discuss Analysis Table Template

11:30 Identify and Discuss Any Over-arching Themes or Problems

12:00 Adjourn

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Meeting Notes

Client:	USACE Portland District (CENWP)
Project Name:	Willamette Downstream Fish Passage Design Requirements Report
AECOM Project Number:	6014-8335
Date:	June 2, 2010
Location:	CENWP 9th Floor Lewis & Clark Room
Meeting Purpose:	90 % Submittal Presentation Meeting
Prepared By:	Chick Sweeney

In Attendance			
Name	**Company**	**Telephone**	**E-mail Address**
Al Giorgi – Principal Biologist	BioAnalysts	425-883-8295	al.giorgi@bioanalysts.net
Dave "Griff" Griffith – Project Biologist	CENWP	503-808-4773	david.w.griffith@usace.army.mil
Elizabeth "Liza" Roy – Technical Lead	CENWP	503-808-4849	elizabeth.w.roy@usace.army.mil
Charles "Chick" Sweeney – Task Order Manager	AECOM	206-719-5327	chick.sweeney@aecom.com
Lawrence Schwabe	CTGR		Lawrence.schwabe@grandronde.org
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Stephanie Burchfield	NMFS		Stephanie.burchfield@noaa.gov
Chris Budai	CENWP		Christine.M.Budai@usace.army.mil

Action Item Number	Action Item	Responsibility
0001	Submit Power Point presentation to Liza Roy	Chick Sweeney - Done

Summary
Al and Chick made the presentation contained in electronic file, Willamette DFP DRR Presentation.pptx, which has been provided to CENWP Technical Lead, Elizabeth Roy. The presentation started at about 8:45 AM and it and subsequent discussion ended about 12:15 PM.

Appendix C

Review Comments

Comment Report: All Comments
Project: Willamette Design Requirements Report
Review: 30% Submittal
Displaying 48 comments for the criteria specified in this report.

1219 ms to run this page

Id	Discipline	Section/Figure	Page Number	Line Number
3132897	Design Team Leader	n/a'	n/a	Section 3.4 Project Operations
What about RO vs Turbine flow/fish passage? What about Temperature Control Operations - Annual cycle, typical, extremes if any? Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 15-Mar-10				
1-0	Evaluation **Concurred** Bullets covering regulating outlet operations, ramping rate requirements, and temperature/water quality control operations will be added. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10			
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Jeff Ament ((503) 808-4950) Submitted On: 29-Apr-10			
	Current Comment Status: **Comment Closed**			
3132927	Design Team Leader	n/a'	n/a	Section 4.3.3 Cougar Abandoned...
In case you didn't know - the existing fish horns were removed to construct the temperature control tower Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 15-Mar-10				
1-0	Evaluation **Concurred** This information is noted and will be added to the description. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10			
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Jeff Ament ((503) 808-4950) Submitted On: 29-Apr-10			
	Current Comment Status: **Comment Closed**			
3132932	Design Team Leader	n/a'	n/a	Section 4.3.5 Fall Creek Abandoned...
I know that they still use this system to pass flow - are you sure they purposely limit fish passage? Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 15-Mar-10				
1-0	Evaluation **Concurred** This operation was confirmed by Dave Griffith of USACE. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10			
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Jeff Ament ((503) 808-4950) Submitted On: 29-Apr-10			
	Current Comment Status: **Comment Closed**			

3134131	Biology-Ecology	n/a'	n/a	n/a

Somewhere in the requirements we need a discussion of the passage effeciencies (% of fish that use the passage device), survival (juvenile system, project total...) so that a determination can be made if we need to gather 100% of the fish (floor to ceiling screening) or if a somewhat lower standard is acceptable. I initially heard that we would not have to meet the same high standards as on the Columbia, since there are not multiple dams for the fish to pass on the Willamette, but now what I hear sounds more like 100% effeciency - even higher than what we have on the Columbia.

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 16-Mar-10

1-0	Evaluation **Concurred** A new section on biological goals will be added to Chapter 3. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Jeff Ament ((503) 808-4950) Submitted On: 29-Apr-10
	Current Comment Status: **Comment Closed**

3135954	Hydraulics	1.1	1-1	n/a

Second line references U.S. Army Corps of Engineers (USACE) but later in the document the abbreviation CENWP is used. Global change to use one abbreviation is requested.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** USACE will be used throughout the report. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3135957	Hydraulics	1.1, para 3	1-1	n/a

"Determining feasibility of, and designing for, downstream fish passage at the priority Willamette Project dams...". Suggest removing "priority" from this sentence as this study is intended to provide relevant background information for a range of studies in the Willamette basin, not just the initial priority sites.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** The statement will be revised to refer to "high head" rather than "priority" projects. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3135958	Hydraulics	1.1, para 3	1-1	n/a

"pool range (a maximum of 115 to 183 ft)". Provide reference for these numbers or leave them out. It isn't clear what the maximum indicates as it is a range of numbers.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** Project references will be added and the statement revised for greater clarity. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3135959	Hydraulics	Fig 1-1	1-2	n/a

Enlarge fig to full page. We should be able to provide a clearer graphic for this figure if needed for clarity when bigger.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** A new USACE provided graphic will be substituted. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3135960	Hydraulics	n/a'	2-1	n/a

Not clear what the intent of Section 2.0 will be. Section 1.3 says it is the basis for organizing the reference projects. If so, perhaps consider this conceptual framework section as an introduction to the Reference Project section rather than a standalone section. Also see comment about Section 3.0.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** This chapter will be move to become the introductory section to the chapter on reference projects. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3135961	Hydraulics	Section 3.0 Design Req	3-1	n/a

Section 3.0 seems to split the content of Sections 2 and 4 and as a suggestion, may be better placed as the first major section, followed by the conceptual framework/reference projects to show how these reference projects met their design requirements, followed by the data gap analysis that is more specific to two of our projects' design requirements.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred**

	The suggested change will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3135962	Hydraulics	Section 3.0, footnote	3-1	n/a

Place references in References section (currently in footnotes).

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** The suggested change will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3135964	Hydraulics	3.2, First bullet	3-3	n/a

Suggest "...target species, predatory species, resident species, and others".

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** The suggested change will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3135965	Hydraulics	3.3, Second bullet	3-3	n/a

Sentence has a word missing, maybe should be "The project hydrologic analysis must include flow exceedence during the ..."??

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** The missing word "include" will be added. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3135966	Hydraulics	3.3, Third bullet	3-3	n/a

First sentence has an extra "expected". Second sentence reference to "flow structures" may be confusing and could read "flow patterns" or similar if that captures the intent. Computational fluid dynamic is missing "s" at end of dynamics. Not clear what is meant by "Fish passage facility specific influences"

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

Revised 17-Mar-10.

1-0	Evaluation **Concurred** The changes will be made and the "hydraulic setting" description will be clarified. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3135980	Hydraulics	3.3, Third bullet	3-3	n/a

Defining the flow patterns over the "full range" of expected operations is difficult and likely not pracical. We might soften that to indicate that we need flow patterns during "critical" or "at operations over the full range".

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** The statement will be edited to reference "critical operations." Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3135987	Hydraulics	3.3, Fifth bullet	3-4	n/a

"Complete as built drawings of all existing structures..." suggest adding "and an understanding of their operations and limitations" This may be better covered under the operations.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** The referenced bullet will be re-worded to include an operations description. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3135991	Hydraulics	3.4, Second bullet	3-4	n/a

Add "Rate of draft and refill must be considered." or similar

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** The bullet will be modified to add the "and rate" of reservoir drafting and filling. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3136000	Hydraulics	3.4, Third bullet	3-4	n/a

May want to group these last two bullets together and add something like "Operations for authorized purposes must be taken into consideration. Operations for temperature control, water quality, and minimum instream flow requirements need to be considered."

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** Minimum in-stream flow requirements are already specified under the first bullet in the referenced section. Operations for temperature and water quality control will be added in response to Ament comment # 3132897. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3136002	Hydraulics	3.4, Fourth bullet	3-4	n/a

Add a reference to consideration for the capacity of the regulating outlets.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** A bullet will be added concerning regulating outlet capacity considerations. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3136004	Hydraulics	4.0	4-1	n/a

Second bullet - will the history include a rough timeline of project development (# yrs design, construct, test)? Third bullet - Guidance: Suggest Guidance/Exclusion for this topic so that projects with exclusionary structures can have these components described.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** The second bullet will include rough durations of the design, construction, and testing elements where available. Exclusion will be added to the third bullet.

	Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3136006	Hydraulics	4.3.9	4-4	n/a

Is the North Fork reference project mentioned the new collector? Or the existing system? I thought the new system was still in design and assume we will include some reference to it.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** The North Fork reference is to the existing system. The new system is only at a concept level, but will be mentioned. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3136007	Hydraulics	n/a'	4-4	n/a

What about including the in-reservoir collector for Swift?

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** The in-reservoir collector at Swift is essentially a duplication of the Upper Baker design. The differing conveyance system at Swift and the modifications under consideration for Lower Baker will be mentioned. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3136008	Hydraulics	5.2	5-1	n/a

Transportability could also be addressed in each reference project description with a sentence or two about the potentially applicable/compatible components of the reference project (to pool fluctuation, temp control, conveyance, etc.)

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** The reason why each reference project was chosen, i.e. transportability of the system or applicable components to other projects, will be added in the introductory synopsis of the project. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment**

	Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3137130	Hydraulics	1.1, First Para	1-1	n/a

Last sentence, propose replacing with something like, "The RPA includes short- and long-term measures for fish passage, water quality, flows, water contracts, habitat, and hatcheries, as well as related coordination, studies, and monitoring." We are not limited to improving passage at only three dams and temperature control at another as written.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

Revised 17-Mar-10.

1-0	Evaluation **Concurred** The statement will be modified accordingly. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3137199	Hydraulics	1.1, Second Para	1-1	n/a

If the intent of this paragraph is to describe the priority shorter term measures for Cougar and Lookout Point, the RPAs should be referenced to make it clear. It should also be clear that we have additional projects to move on to after these initial priority projects, as mentioned in RPA 4.12.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** The specific RPA measures will be referenced. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3137283	Hydraulics	4.0	4-1	n/a

In list of items to be included in the reference project table, it is not clear where a couple items discussed in our kickoff meeting will be covered. Please confirm whether the following will be included, where possible, in the report: 1. Information used as a design basis 2. Design criteria (covering this in performance requirments?) 3. O&M requirements

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** The requested items will be added as readily available. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10

	Current Comment Status: **Comment Closed**

3138867	Biology-Ecology	n/a'	n/a	n/a

FROM Mike Langeslay: Defining success is a large challenge for us - we do not know what we need to achieve self sustaing naturally produced populatoins of ESA listed fish above our dams. Collection efficiency and survival requirements will have a huge effect on feasibilty and cost for these systems. Will AECOM & BioAnalysts summarize this info for the referenc projects (i.e. what the project owners & agencies used)? Will they suggest criteria or an approach to get to success metrics?

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **Concurred** The biological performance goals will be added to the reference project profiles along with their source, i.e. BiOp or settlement agreement. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3138870	Biology-Ecology	fig 3-1	n/a	n/a

FROM Mike Langeslay: I like figure 3-1, but when I get out to prototype, its not really clear what's in the risk boxes and why there are two of them (one after concept design and one before prototype design).

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

1-0	Evaluation **For Information Only** At the end of conceptual design, the risk analysis asks whether there is enough information to proceed with either a production or prototype system. The risk analysis at the beginning of prototype or production design asks the same question of the next iteration of modification of the prototype or production system if modification is required as a result of monitoring and evaluation of performance. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10
	Current Comment Status: **Comment Closed**

3138871	Biology-Ecology	n/a'	n/a	n/a

FROM Mike Langeslay: Maybe it's a sensitive issue with the owners of the reference projects we are looking at, but if possible, it would be helpful to see the costs of these systems.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10

Revised 17-Mar-10.

1-0	Evaluation **Concurred** Rough cost information will be supplied when it is readily available. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment.

	Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10			
	Current Comment Status: **Comment Closed**			
3138874	Biology-Ecology	n/a'	n/a	n/a
FROM Mike Langeslay: Required information - Reservoir Survival - This is another complicated and difficult to address issue: if the intent is to determine which stategy provides the most benefits (head of reservoir, in-reservoir, or at dam collection/passage) then reservoir survival should be veiwed along with reservoir rearing and its benefit toward survival to adult returns. What we are seeing at these projects is mostly fry entering the reservoirs in spring, and age 1+ smolts passsing the dams. Dam passage peaks during fall drawdown. So even though fewer large fish may pass the dams, they may have much higher SARS fry that are transported around the reservoir and dam (due to either their size, timing, or combo). Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 17-Mar-10				
1-0	Evaluation **For Information Only** The comment is acknowledged. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10			
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 26-Apr-10			
	Current Comment Status: **Comment Closed**			
3151781	General	n/a'	n/a	n/a
figure 3-1. Recommend changing box "hydraulic modeling" to; "Collection of physical science data and modeling of hydraulic conditions" I feel that the collection of temperature and hydrology data is important. As written itonly highlights modeling flows... Submitted By: David Griffith (503-808-4773). Submitted On: 23-Mar-10				
1-0	Evaluation **Concurred** The box will be changed to "Field Data Collection and Hydraulic Modeling." Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10			
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 13-May-10			
	Current Comment Status: **Comment Closed**			
3151787	General	n/a'	n/a	n/a
Section 3.2: Need to be very specific with our passage data. Fish passage timing seems to be heavily influenced by reservior elevations and might not reflect natural conditions or conditions under volitional/year round passage. Submitted By: David Griffith (503-808-4773). Submitted On: 23-Mar-10				
1-0	Evaluation **Concurred** A clarifying statement will be added to the "Timing" bullet noting that passage timing should consider when fish naturally arrive in the reservoir, rather than when they pass, as the latter may be operationally-driven behavior. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10			
1-1	Backcheck Recommendation **Close Comment** Closed by EWR for DWG per discussions of comment resolution in 30% Checkpoint Meeting			

	Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 13-May-10
	Current Comment Status: **Comment Closed**

3151789	General	n/a'	n/a	n/a

Section 3.2. Add bullet for fish presence in forebay timing (related to previous comment).

Submitted By: David Griffith (503-808-4773). Submitted On: 23-Mar-10

1-0	Evaluation **Concurred** See the response to comment # 3151787. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed by EWR for DWG per discussions of comment resolution in 30% Checkpoint Meeting Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 13-May-10
	Current Comment Status: **Comment Closed**

3151798	General	n/a'	n/a	n/a

Section 3.2: Need to add the importance of target species abundance and non-target species. Based on screwtrap data we can expect LOTSA crappie at Lookout Point (not likely at head of reservior but for any at dam alt.). Are these going to clog up the screens and holding facilities? Do we need to remove and not allow to pass? All of this needs to feed into a design.

Submitted By: David Griffith (503-808-4773). Submitted On: 23-Mar-10

1-0	Evaluation **Concurred** The abundance bullet will be modified to indicate that the abundance of non-target species that may encounter the collector must be considered. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed by EWR for DWG per discussions of comment resolution in 30% Checkpoint Meeting Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 13-May-10
	Current Comment Status: **Comment Closed**

3151814	General	n/a'	n/a	n/a

3.3 Suggest adding a citation for the extensive modeling that took place at Pelton Round Butte project. I googled this report but I think there is some peer reviewed stuff out there...
http://www.fwc.com/publications/tech_papers/env/pdfs/3dchinoo.pdf

Submitted By: David Griffith (503-808-4773). Submitted On: 23-Mar-10

1-0	Evaluation **For Information Only** The extensive modeling performed for the PRB design will be cited in the project profile for this project. The AECOM task manager is very familiar with this as he was the program manager for the hydraulic modeling and design of the PRB Selective Water Withdrawal and Fish Collection facility. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed by EWR for DWG per discussions of comment resolution in 30% Checkpoint Meeting Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 13-May-10

	Current Comment Status: **Comment Closed**

3151824	General	n/a'	n/a	n/a

Add a bullet for temperature information, i.e. if the reservoir epilimnion is too warm we will need to have a deep pump to provide adequate WQ.

Submitted By: David Griffith (503-808-4773). Submitted On: 23-Mar-10

1-0	Evaluation **Concurred** A bullet will be added for Water Quality and Temperature. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed by EWR for DWG per discussions of comment resolution in 30% Checkpoint Meeting Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 13-May-10
	Current Comment Status: **Comment Closed**

3151838	General	n/a'	n/a	n/a

Section 3.4 Water level ranges: Need info on daily fluctuations too. Sometimes we can have a pol go up by 10-15 feet in a day. And again be specific about run timing, when fish are present or when they pass under current ops could be different...

Submitted By: David Griffith (503-808-4773). Submitted On: 23-Mar-10

1-0	Evaluation **Concurred** The "rate" of reservoir drafting and filling will be added to the appropriate bullet. This information will be examined in conjunction with run timing. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 26-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed by EWR for DWG per discussions of comment resolution in 30% Checkpoint Meeting Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 13-May-10
	Current Comment Status: **Comment Closed**

3151849	General	n/a'	n/a	n/a

Section 3.4 FLOOD DAMAGE REDUCTION!! This definitely needs it's own bullet. This is the paramount purpose of the project and trumps fish passage. There for any design needs to be compatible with FDR Ops. These OPs also affect our discharge rates and pool elevations which is important. We can change operations to stay below the "rule curve" though...

Submitted By: David Griffith (503-808-4773). Submitted On: 23-Mar-10

1-0	Evaluation **Concurred** Flood control ooperations have been separated out under a separate bullet. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 31-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed by EWR for DWG per discussions of comment resolution in 30% Checkpoint Meeting Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 13-May-10
	Current Comment Status: **Comment Closed**

3151850	General	n/a'	n/a	n/a

Section 3.4 FLOOD DAMAGE REDUCTION!! This definitely needs it's own bullet. This is the paramount purpose of the

project and trumps fish passage. There for any design needs to be compatible with FDR Ops. These OPs also affect our discharge rates and pool elevations which is important. We can change operations to stay below the "rule curve" though...

Submitted By: David Griffith (503-808-4773). Submitted On: 23-Mar-10

1-0	Evaluation **Concurred** This is a duplicate of previous comment. See evaluation to previous comment. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 31-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed by EWR for DWG per discussions of comment resolution in 30% Checkpoint Meeting Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 13-May-10
	Current Comment Status: **Comment Closed**

3151852	General	n/a'	n/a	n/a

4.1.1 Leaburg has a flume and outfall not a pipe.

Submitted By: David Griffith (503-808-4773). Submitted On: 23-Mar-10

1-0	Evaluation **Concurred** This has been corrected. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 31-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed by EWR for DWG per discussions of comment resolution in 30% Checkpoint Meeting Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 13-May-10
	Current Comment Status: **Comment Closed**

3151854	General	n/a'	n/a	n/a

4.1.3 By inflatable dam did they mean an obermier weir?

Submitted By: David Griffith (503-808-4773). Submitted On: 23-Mar-10

1-0	Evaluation **For Information Only** Obermeyer is one manufacturer of inflatable dams or weirs. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 31-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed by EWR for DWG per discussions of comment resolution in 30% Checkpoint Meeting Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 13-May-10
	Current Comment Status: **Comment Closed**

3151859	General	n/a'	n/a	n/a

4.2.1 Need to add language so that it is clear that a surface collector could be located many places within a project. Head of reservoir, mid-reservoir or at the dam. This could be difficult with how Section 4.1 is organized.

Submitted By: David Griffith (503-808-4773). Submitted On: 23-Mar-10

1-0	Evaluation **Concurred** This will be clarified in definitions of locations in Section 2. At-dam indicates "connnected to"

	the dam; in-reservoir means anywhere in the reservoir: head of-, mid-, and lower-. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 31-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed by EWR for DWG per discussions of comment resolution in 30% Checkpoint Meeting Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 13-May-10
	Current Comment Status: **Comment Closed**

3151862	General	n/a'	n/a	n/a

4.3.7 Clarify the application of the B2CC to 400+ft high dams.

Submitted By: David Griffith (503-808-4773). Submitted On: 23-Mar-10

1-0	Evaluation **Concurred** The application of the B2CC concept to a 400 ft high dam is the location in the forebay relative to flow patterns and fish concentration. This will be clarified in the project profile. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 31-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed by EWR for DWG per discussions of comment resolution in 30% Checkpoint Meeting Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 13-May-10
	Current Comment Status: **Comment Closed**

3151867	General	n/a'	n/a	n/a

Section 6 is an important and likely time consuming section of the report. It is critical that the quality of the data/information is identified!

Submitted By: David Griffith (503-808-4773). Submitted On: 23-Mar-10

1-0	Evaluation **Concurred** The information availability column in the tables will characterized the quality of the information using a key list of descriptors, i.e. unavailable, abysmal, inadequate, adequate, good, and excellent. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 31-Mar-10
1-1	Backcheck Recommendation **Close Comment** Closed by EWR for DWG per discussions of comment resolution in 30% Checkpoint Meeting Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 13-May-10
	Current Comment Status: **Comment Closed**

3175225	General	1.1	1-1	n/a

1st paragraph: missing period betw. 1st & 2nd paragraphs

Submitted By: Joseph Orlins (425-881-7700 x200). Submitted On: 01-Apr-10

1-0	Evaluation **Concurred** Correction will be made Submitted By: Charles Sweeney (425-881-7700) Submitted On: 20-Apr-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 29-Apr-10

	Current Comment Status: **Comment Closed**

3175228	General	1.3	1-3	n/a

3rd paragraph, last sentence - suggest rephrasing from "....inquiries of vendors and subs)" to "....inquiries of potential vendors and subcontractors)"

Submitted By: Joseph Orlins (425-881-7700 x200). Submitted On: 01-Apr-10

1-0	Evaluation **Concurred** The suggested change will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 20-Apr-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 29-Apr-10
	Current Comment Status: **Comment Closed**

3175238	General	Fig 3-1	n/a	n/a

(a) Diagrammatic flow arrows overlap functional blocks in figure - need to revise graphic to minimize overlap of lines. (b) Between Prototype & Production - box for Hydraulic Modeling. This would be the action step if the risk analysis indicated there was not enough information to proceed with either a prototype or production system. It seems prudent to feed the modeling back into the "Risk?" evaluation decision point, rather than directly to Prototype or Production Design.

Submitted By: Joseph Orlins (425-881-7700 x200). Submitted On: 01-Apr-10

1-0	Evaluation **Concurred** (a) The flow arrows will be corected. (b) Risk analysis following conceptual design decides prototype or production; risk analysis prior to either design decides if there is enough information to proceed with design; if not modeling is performed to develop the information and the model results feed into the design. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 20-Apr-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 29-Apr-10
	Current Comment Status: **Comment Closed**

3175247	General	4.1.3	4-2	n/a

confusing phrasing: "...off-channel primary and secondary V-screens fish screens from which..." Perhaps simplify to "...secondary V-screens from which..."

Submitted By: Joseph Orlins (425-881-7700 x200). Submitted On: 01-Apr-10

1-0	Evaluation **Concurred** Suggested change will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 20-Apr-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 29-Apr-10
	Current Comment Status: **Comment Closed**

There are currently a total of 375 users online as of 05:24 PM 13-May-10.

Comment Report: All Comments
Project: Willamette Design Requirements Report
Review: 90%
Displaying 117 comments for the criteria specified in this report.

2531 ms to run this page

Id	Discipline	DocType	Spec	Sheet	Detail
3293763	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: Figure 2-2)

This schedule doesn't seem to line up with the names of our reports and may not allow for enough time for all the processes that need to be gone through - Feasibility Report, DDR, P&S then Construction. Prototype seems to have the process repeated twice, not sure why? Also, 6 months to biologically evaluate a prototype is not nearly long enough, this has typically taken 2 years worth of data collection, and additional time for analysis of the data.

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **Concurred** We will change the schedule to make it consistent with USACE nomenclature. We also concur that 6 months to evaluate a prototype is short; that is why we have included two annual cycles of prototype development, monitoring, and evaluation./ Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

Id	Discipline	DocType	Spec	Sheet	Detail
3293774	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: 3.2.2 Cowlitz)

This facility is located in the tailrace of the dam, this seems odd to me, and there is little explanation of why this is not located in the forebay, would be helpful to better explain this.

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **Concurred** An explanation will be added to the text. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

Id	Discipline	DocType	Spec	Sheet	Detail
3293783	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: 3.2.3 Cougar In-Trib... and throughout)

"..concerns for not allowing reservoir rearing." This seems to be a point of much discussion and disagreement throughout all the bios within the region. Not sure this is a valid thing to say, need to have bios weigh in on this

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **For Information Only** No changes made to text as no change requested. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3293792	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: 3.2.6 Willamette Falls)

Don't see the louvered trash rack on the drawings. Also, maybe everyone else is familiar with an Eicher screen, but I am not, would like a little more information on what this is.

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **Concurred** The plane of the trashrack will be called out on Figure 3-13; Figure 3-14 will have call-outs labeling the various components. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3293801	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: 3.3 In-Reservoir Systems)

General Comment - this scares me, with nets and debris. Would be nice to have additional discussion on how the debris issues were handled, if there were issues with debris at these other dams.

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **Concurred** Debris discussion will be added in this section and Section 3.1.1. Upper Baker is the only operational project example and debris has not been an issue. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3293833	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: 3.4.3 Cougar Dam Abandoned...)

Was there control on which entrances were open? Did the pipe that discharged into the RO act like a lock with ocassional discharges, or continuous flow and the fish had to dive to depths to exit.

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **Concurred** There were butterfly valves on each entrance; the pipe had continous flow; explanation will be added to the text. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3293839	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: 3.5.1 B2CC)

The last sentence of this paragraph seems to be a repeat of earlier discussion, not necessary.

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **Concurred** The sentence will be revisited/re-written. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3293846	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: 3.5.1 Round Butte Abandoned..)

Third paragraph appears to be a repeat. - Delete?

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **Concurred** This sentence will be revisited and possibly deleted. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3293852	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: Figures)

The red arrows, vs blue arrows are nice, but It would be nicer to show the volumes of flow with and without the fish as it goes through the system, to indicate an amount of dewatering...

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **Concurred** The figures will be modified with call-outs providing the collection and bypass flows. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3293855	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: Figure 3-2)

It is really hard to tell what is going on in the Juvenile fish release channel, too messy with all the contours I think to tell.

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **Concurred** We did not have the source drawing, only a pdf, so cannot modify it. We will add an arrow indicating the location of the outfall discharge. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3293859	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: Figure 3-4)

Where do the juvenile fish go after the facility, might be nice to add a note to the drawing.

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **Concurred** A note will be added. This is a concept that was never built. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3293862	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: Figures)

It might be good to have a different color arrow for dewatered fish water.

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **For Information Only** With the addition of the collection and bypass flow call-outs, another color of arrow will be redundant. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3293886	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: Figure 3-10)

Fish water goes to a juvenile collection facility, but there is no indication of what all is happening here, or what happens to the fish after this facility

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **Concurred** This is a concept that was never built. This is described in the text. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3293895	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: Figure 3-14)

Label Louvers, Eicher Screens, and all other screens/gates/weirs.

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **Concurred** Call-outs will be added to the figure. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
2-0	Evaluation **Concurred** Agreed - same comment applies for Figure 3-13. Labeling components (louvers, Eicher Screens, etc) will help clarify. Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10

	Backcheck not conducted				
	Current Comment Status: **Comment Closed**				
3293910	Design Team Leader	Planning Report	n/a'	n/a	n/a
(Document Reference: Figure 3-15) Since this structure is "In-Reservoir" is would be nice to see a view that actually shows it's location within the reservoir and the other features of the reservoir (Intake Tower, spillway, shape of the banks of the reservoir in this area...) This could then show the net arrangement. Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10					
1-0	Evaluation **Concurred** A site plan will be inset in the figure. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10				
	Current Comment Status: **Comment Closed**				
3293914	Design Team Leader	Planning Report	n/a'	n/a	n/a
(Document Reference: Figure 3-36) Impossible to read with all the horizontal lines on this page... Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10					
1-0	Evaluation **For Information Only** We confirmed that the pdf file is okay and prints fine using our printers. We suspect this is a printing problem on the CENWP end. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10				
	Current Comment Status: **Comment Closed**				
3293933	Design Team Leader	Planning Report	n/a'	n/a	n/a
(Document Reference: 4.2) 2nd paragraph indicates that only 5 of the 12 "types" are reflected here. I guess I don't think there area 12 totally different types, there may be 12 different ways that the 3 different types were implemented. To me the types are In trib, in reservioir and at dam. Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10					
1-0	Evaluation **Concurred** The text will be changed to call them 12 different combinations of location and technology.				

	Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3293940	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: 4.2)

End of 3rd paragraph - Merwin, scoop/dipper, or screw traps. Provide info on these.

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **For Information Only** There are descriptions of the technologies used for research included in the Lookout Point Alternatives study report under development, as this report focuses on prototype facilities. Descriptions of these types of facilities are beyond the scope of this study report. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3293948	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: 4.3.1.1)

2nd Paragraph - What about debris on the nets? Seems like a big concern to me, with little discussion here.

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **Concurred** A description of debris handling will be added to the text. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3293961	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: 4.3.3)

Seems like Round Butte also has a distance issue from the collection point to the release point.

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **Concurred** Round Butte will be added to the text discussion.

	Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3293974	Design Team Leader	Planning Report	n/a'	n/a	n/a

(Document Reference: 4.3.4)

May want to state what the upper limit is about 100 ft of forebay change. Cougar alone has almost 200' of forebay elevation change, not sure if this is the highest or not?

Submitted By: Jeff Ament ((503) 808-4950). Submitted On: 26-May-10

1-0	Evaluation **For Information Only** The report text indicates that 100 ft is the lower end of the range for the Willamette Projects. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3301972	Hydraulics	Project Information Reports	Exec Summary - Process Section	n/a	n/a

First Sentence, suggest rewording to "The literature search focused on downstream passage systems at high-head dams in the Northwest but did not exclude lower head facilities or those located outside of the identified region..." or similar.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** The change will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3301973	Hydraulics	Project Information Reports	Exec Summary - p. ES-2	n/a	n/a

Analysis of Collection Strategies... Section, 1st sentence needs to be split into more than one sentence and clarified. It does not make.sense.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** The change will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10

1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
2-0	Evaluation **Concurred** Concur - section is confusing as written Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10
	Backcheck not conducted
	Current Comment Status: **Comment Closed**

3301974	Hydraulics	Project Information Reports	Global Comment	n/a	n/a

Choose consistent notation for Willamette System and use throughout report (other uses are Willamette, Willamette Projects, Willamette basin, Willamette Valley, etc.) As this is a USACE report, perhaps the Willamette Project reference would be most applicable?

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** The Willamette Project reference will be used throughout. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3301975	Hydraulics	Project Information Reports	Exec Summary page ES-3	n/a	n/a

1. 1st bullet could be broken into two sentences for clarity 2. 2nd and 3rd bullets recommend "impacts of range and rate of reservoir elevation change..." 3. last para, last sentence, suggest "...define biological goal prior to the design process"

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** The change will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3301976	Hydraulics	Project Information Reports	Exec Summary page ES-4	n/a	n/a

In reservoir bullets: 1st bulllet, What about partial or no-net situations, like N. Fork or cougar alternative? Do we mention that here along with the full-exclusion?

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** The partial net solutions will be added.

	Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
2-0	Evaluation **Concurred** Agreed - need to add partial net solutions, esp. since they are discussed elswehere in report. Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10
	Backcheck not conducted
	Current Comment Status: **Comment Closed**

3301977	Hydraulics	Project Information Reports	Section 1.3	n/a	n/a

2nd para, last sentence suggest "and presenting the timeframe typically required for development, with supporting timelines from profiled projects."

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** The change will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3301978	Hydraulics	Project Information Reports	Section 2.1	n/a	n/a

1. Suggest "... process flowchart in which there are intermediate decision points" rather than "many"... 2. 1st para, next to last sentence, suggest making reference to USACE design phases (Alts or Feas. Study, DDR, P&S) where applicable. 3. For schedule, instead of 1st para last sentence, suggest Introducing Table 2-1 as a summary of past project development schedules, with a generic accelerated schedule included in the 1st column. Then lead into Fig 2-2 as being based on the timelines from Table 2-1. Shows the supporting info first, then the resulting generic schedule.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** The change will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
2-0	Evaluation **Concurred** Agreed - revising the order of presentation will clarify and provide better understanding of project development timelines Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10
	Backcheck not conducted
	Current Comment Status: **Comment Closed**

		Project Information			

3301979	Hydraulics	Reports	Fig 2-2	n/a	n/a
Can we make the dates generic? Year 1, year 2... that might be a pain in Project... Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10					
1-0	Evaluation **Concurred** The date columns will be hidden and only months included on the time axis. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10				
	Current Comment Status: **Comment Closed**				
3301982	Hydraulics	Project Information Reports	Section 2,2,	n/a	n/a
page 2-2, last sentence. clarify the reference to higher rates of natural mortality within the project boundaries... the "within the project boundaries part is confusing". Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10					
1-0	Evaluation **Concurred** The phrase, "within the project boundaries" will be removed. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10				
	Current Comment Status: **Comment Closed**				
3301984	Hydraulics	Project Information Reports	Section 2,3	n/a	n/a
It seems like the reference to Roy, et.al, should be an AECOM report or memorandum reference, since it was an AECOM deliverable to USACE and all authors were from AECOM. Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10					
1-0	Evaluation **Concurred** The reference will be changed. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10				
2-0	Evaluation **Concurred** Agreed - references should be consistent. Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10				
	Backcheck not conducted				
	Current Comment Status: **Comment Closed**				
3301985	Hydraulics	Project Information	Section 2,4	n/a	n/a

		Reports			
Water quality bullet: discusses an issue with water quality, not information that is required to identify the issue. Temperature data would be required to identify stratification. Density driven currents may require hydrodynamic modeling of the forebay flow patterns. Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10					
1-0	Evaluation **Concurred** The bullet will be re-writtten as suggested. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10				
	Current Comment Status: **Comment Closed**				
3301986	Hydraulics	Project Information Reports	Section 3.1	n/a	n/a
1st para, 1. 1st sentence suggest " selected as appropriate examples of fish collection and passage designs that may be adapted to the Willamette Project dams or that demonstrate relevant lessons learned." 2. Suggest moving up the next to last sentence "We also present some..." to be the second sentence. Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10					
1-0	Evaluation **Concurred** The suggested changes will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10				
	Current Comment Status: **Comment Closed**				
3301989	Hydraulics	Project Information Reports	Section 3.2.5/6	n/a	n/a
3.2.5, 1st para, next to last sentence, clarify that the "impact large flood flows" would have is debris related... may be in the profile, but could be mentioned here. 3.2.6 6th sentence "allows" should be "allow". In next sentence, suggest "In the Unit 13 penstock" for clarity. 3.2.6, inflatable dam is mentioned as relevant, but there is very little description of its operation, size, flows, etc. Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10					
1-0	Evaluation **Concurred** The suggested editorial changes and clarification will be made, plus further description of the inflatable dam added. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10				
	Current Comment Status: **Comment Closed**				
3302000	Hydraulics	Project Information	Section 3.3.2	n/a	n/a

		Reports			

One of the Cougar In-res options made it throught the previous alts study as one of two final alternatives. None were designed and constructed. We should confirm the reference to the concept being "rejected as an alternative as part of the review process".

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** The status of the Cougar concepts in the alternatives report will be confirmed. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
2-0	Evaluation **Concurred** In addition, it would be helpful to include reasoning for why / on what basis the alternative(s) were rejected Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10
	Backcheck not conducted
	Current Comment Status: **Comment Closed**

3302003	Hydraulics	Project Information Reports	Section 3.4.1	n/a	n/a

1. 5th sentence "The bypass water..." is confusing. Please clarify and reword. 2. Can we add the vertical drop to the bypass pipe sentence? 3. Relevant feature... also long bypass pipe?

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** The text will be clarified, vertical drop of the bypass pipe added, and the long bypass pipe feature added. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3302005	Hydraulics	Project Information Reports	Section 3.4.2, 1st para	n/a	n/a

1. "...though a screened intake structure"... instead of "screen intake" ? 2. ..."sides of the structure which provide"... rather than "provides"

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** The wording changes will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10

	Current Comment Status: **Comment Closed**

3302007	Hydraulics	Project Information Reports	Section 3.4.4	n/a	n/a

1. flexible hose attached manually as reservoir changed? Or was there some automatic system? 2. Bio Performance: Any info on the bypass system survival?

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** 1 - Confirmed that the control was manual. 2. Mortality through the bypass pipes were 30%, however total mortality from handling/bypass was less than 5%. This info added to text. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3302008	Hydraulics	Project Information Reports	Section 3.4.6	n/a	n/a

Not clear how the fish are "removed from the fish well via a basket"... are they crowded into the basket or? Any info on how often? This may be in the profile.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** The description will be expanded. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3302009	Hydraulics	Project Information Reports	Section 3.5.2	n/a	n/a

1. 2nd sentence, suggest "The feature of interest is the simple valve-controlled pipe elevator system used in the historic system to transport and release fish below the dam." 2. 2nd para., "Once the fish were added to the fish transport pipe"... suggest indicated that it was full or mostly full of water

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** The suggested changes will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3302011	Hydraulics	Project Information	Section 3.5.3	n/a	n/a

		Reports			

1. Suggest "Once the new pipeline is added, flows will be increased to 7 cfs." 2. Last sentence... move up earlier in paragraph.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** The suggested changes will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3302012	Hydraulics	Project Information Reports	Section 4.1	n/a	n/a

Consider moving the definitions in Section 4.1 up to Section 1.4? They are good definitions and helpful to the reader, but would be more useful at the start. Maybe 1.4 Collector Terminology, 1.4.1 Location, 1.4.2 Components. This would not require significant renumbering of figures.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** The collector terminology section will be moved to Section 1.4 as suggested. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
2-0	Evaluation **Concurred** Agreed - this will aid the overall clarity of the report. Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10
	Backcheck not conducted
	Current Comment Status: **Comment Closed**

3302013	Hydraulics	Project Information Reports	Section 4.2	n/a	n/a

1st para last sentence, needs "functioning" rather than "funtion".

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** The change will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3302014	Hydraulics	Project Information Reports	Section 4.3	n/a	n/a
1. 1st bullet... suggest "must primarily deal with the flow, debris, and sediment load issues associated with a flashy..." 2. "Due to these varying levels of complexity, it is little wonder",,, this sentence seems out of place. Suggest deleting it. Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10					
1-0	Evaluation **Concurred** Item 1 will be changed as suggested and item 2 will be re-worded. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10				
2-0	Evaluation **Concurred** Also: 1st paragraph, 2nd sentence. Suggest "...must be designed that will deliver the deisred physical performance for fish collection and safe..." Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10				
	Backcheck not conducted				
	Current Comment Status: **Comment Closed**				
3302016	Hydraulics	Project Information Reports	Section 4.3.4.2	n/a	n/a
1st sentence, suggest "only operational precedent for accomodation of reservoir elevation change by an in-reservoir system." Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10					
1-0	Evaluation **Concurred** The change will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10				
	Current Comment Status: **Comment Closed**				
3302017	Hydraulics	Project Information Reports	Section 4.3.4.3	n/a	n/a
1. 1st sentence... "fish must be lifted to the same conveyance elevation when the reservoir elevation is lowered" What about is at-dam and using a bypass w multiple outlets? Need to mention this in the text and examples... Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10					
1-0	Evaluation **Concurred** The abandoned systems at Cougar and Green Peter will be mentioned, with why they were unsuccessful, plus a hybrid of the Howard Hanson and abandoned Round Butte approach will be suggested. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment** Closed without comment.				

	Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
2-0	Evaluation **Concurred** In addition: the entire first sentence is confusing. Suggest rephrasing to add clarity. Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10
	Backcheck not conducted
	Current Comment Status: **Comment Closed**

3302018	Hydraulics	Project Information Reports	Section 4.3.5.1	n/a	n/a

1. Total Project Head... is this supposed to be a level III heading, 4.3.6? Headings in this section are confusing. 2. 1st bullet "meat" should be "meet" 3. rusty Green Peter pipes... my understanding was that they remedied the survival issues by lining the pipes and survival through the pipe was reasonably good. Like to see this double checked. I could be remembering incorrectly. Also the last sentence of the Green Peter bullet is not a sentence. 4. Third bullet, I like the reference to previous project Section and the bullet so we don't rehash info. 5. Suggest moving the technical info in the HH bullet up to the HH synopsis and referring to it in this bullet.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** 1 - The referenced heading level will be corrected; 2 - The correction will be made; 3 -The pipes may have been fixed but the information does not change conclusions about the facility or its applicability to Cougar and Lookout Point. The incomplete sentence was edited. 4/5 - The approach used on bullet 4 will also be used on bullet 5. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
2-0	Evaluation **Concurred** Agreed - discussion of physical model study does not belong in this portion of the report Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10
	Backcheck not conducted
	Current Comment Status: **Comment Closed**

3302019	Hydraulics	Project Information Reports	Section 5.1	n/a	n/a

1. 1st para, Last sentence "The following descriptors were applied based on the authors' experience with similar past projects and current understanding of the available data." 2. In bullets, suggest "considered" to replace "judged" for all bullets.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10

1-0	Evaluation **Concurred** The suggested changes will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3302021	Hydraulics	Project Information Reports	Table 5-1	n/a	n/a

1. Species... "longnose" rather than "longnoze" 2. Global: check formatting on tables for consistent alignment, spacing, etc. Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10					
1-0	Evaluation **Concurred** The spelling will be corrected and table formatting made consisitent. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10				
2-0	Evaluation **Concurred** Also: 3. Under 'Physical - Bathymetric & Topographic Mapping ' Reference is made to "GIS is checking on the survey information" Can this be clarified? I assume that this refers to CENWP's GIS group...(?) Has information been found? 4. Water quality: Is reference available for TDG study info? 5. General comment: Repeat column headings when tables span multiple pages Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10				
	Backcheck not conducted				
	Current Comment Status: **Comment Closed**				
3302022	Hydraulics	Project Information Reports	Table 5-2	n/a	n/a
1. Hydraulic Setting: "May" should be "may" 2. Water level ranges: "Note that these reservoir levels are measured at-dam" Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 31-May-10					
1-0	Evaluation **Concurred** The wording correction will be made and the requested note added to the table. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10				
	Current Comment Status: **Comment Closed**				
3302026	Hydraulics	Project Information Reports	Section 5.2	n/a	n/a
1. 1st sentence, suggest "The studies that are recommended to fill in data gaps to support design ....Dams... are described in Sections 5.2.1 and 5.2.2, and summarized in Tables 5-3 and 5-4, respectively." or similar to make it clear that there is a description of the studies, not just the table. 2. 4th para, suggest "The two primary benefits are..." 3. 6th para, 1st sentence suggest "The physical study recommendations are similar for Cougar and Lookout Point dams. 4. 6th para, 2nd sentence, "different" how? due to RPA measure priorities for head of reservoir focus for RPA 4.9. Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 01-Jun-10					
1-0	Evaluation **Concurred** The suggested changes will be made and the reason for the differences in the Cougar and Lookout Point study recommendations clarified. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment**				

	Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
2-0	Evaluation **Concurred** Agreed - this will aid clairity of report. Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10
	Backcheck not conducted
	Current Comment Status: **Comment Closed**

3302027	Hydraulics	Project Information Reports	Table 5-3	n/a	n/a

1. Spell out CWT to define 2. Reservoir modeling/CFD modeling timelines seem short. If this is time to set up model to begin design process, specify.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** 1 - CWT will be defined; 2 - The text will clarify that this is based on the "optimistic generic schedule in Section 2 and assumes the level of interaction between design and modeling efforts will not delay the latter. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
2-0	Evaluation **Concurred** Also: 3. Adjust formatting so that long words are not broken (e.g., Photogrammetry, bathymetric in last row on page 5-9) Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10
	Backcheck not conducted
	Current Comment Status: **Comment Closed**

3302036	Hydraulics	Project Information Reports	Section 5.2	n/a	n/a

1.Global: check formatting for section headings/sections... some have different format (Bio studies bullets, In-tributary bathymetric Cross Sections for example) 2. Biological Studies, 3rd para, "over time" instead of "overtime" 3. Juvenile Chinook Migratory Behavior and Survival Rate... In this section, what information on spring Chinook migratory behavior is recommended. Also what data for reservoir survival is recommended? Section says USACE will begin collecting data, but doesn't really describe it or define extent/quality of data needed. Will our study meet these needs?

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** 1 & 2 corrections will be made; 3 - The study recommendations will be clarified. We have not reviewed the proposed Corps study plans as they were unavailable. Based on comments by others we have expanded the discusssion of what is needed and can be collected from each study. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3302038	Hydraulics	Project Information Reports	Section 5.2	n/a	n/a

Forebay CFD Model - Priority (moderate) 1st sentence, suggest "It will be necessary to evaluate the hydraulic conditions of the forebay and tower ..."

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The wording change will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3302039	Hydraulics	Project Information Reports	Section 5.2	n/a	n/a

In-tributary Bathymetric Cross-Section... page 5-14, suggest "... this study would be needed for an in-tributary facility."

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The wording change will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3302040	Hydraulics	Project Information Reports	Table 5-4	n/a	n/a

River Hyd Modeling: timeline seems adequate for model setup, but maybe not for evaluation of alternatives.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The time duration and cost will be increased. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3302044	Hydraulics	Project Information Reports	Section 5-2	n/a	n/a

LOP Biological Studies and Physical Studies (start on p. 5-18) Can we combine the text for Cougar and LOP recommended studies to shorten up the text and eliminate all the re-hashing? Maybe a section for each study, but a quick sentence about what is recommended for Cougar and LOP.?? It seems like the studies are similar, but slightly different priority or application.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 01-Jun-10

1-0	Evaluation **For Information Only** We have considered this revision, but feel the present organization enhances use of the report by those who only want to read about the study recommendations for either project, but not the other. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3302050	Hydraulics	Project Information Reports	Figures	n/a	n/a

1. Global, check scale applied to figures... some seem incorrect (3-3, 3-4, 3-7...) 2. 3-11 has vertical lines down middle...not sure what they are. 3. 3-26 indicate that pipe from the fish pump goes to the FTF for clarity 4. Global check font on figures... some have weird font (see Fig 3-33, 3-36 for example) 5. 3-1 Site locations Cowlitz has In-tributary listed two times. 6. 3-15 Baker figure would benefit from an overall site plan showing location of FSC, orientation, nets, in reservoir. It could be a small inset in the current figure...

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** 1, 3, 5, & 6 - The suggested changes and corrections will be made. Information 2 & 4 - We have confirmed that the pdf file is okay and prints without the problems noted by the reviewer. This suggests either corruption of the file when transferred electronically or a printer interface problem on the reviewers end. This problem will be troubleshot as the final report is transmitted. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3302052	Hydraulics	Project Information Reports	Appendix A	n/a	n/a

Profiles look great and provide good info, but would benefit from the following: 1. Check all for formatting consistency, typos 2. Project Ops/O&M section could be shortened by eliminating the items that are not filled in or listed with n/a. 3. Bio Baseline info: this item was intended (from our point of view) to summarize the biological studies used by the owner/designer as the biological baseline for the design. The profile seems to be filled out describing the studies AECOM/BioAnalysts used to review the profiled projects. 4. There is some repitition through the collection, dewatering, bypass sections.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** 1, 2, & 4 - The formatting, headings without information, and repetitiveness will be addressed. 3 - We have included studies that show results and those used to set design criteria etc. Many of the project examined were simply concepts, others such as Upper Baker were built on a best guess etc. Examples of the project profiles were reviewed twice by the Corps and we followed the direction received. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment.

	Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3302056	Hydraulics	Project Information Reports	Appendix A	n/a	n/a

Willamette Falls: 1. system is located "just in front of the dam"... clarify with a better description. 2. Facility performance standards...: typo in "votices". Also, suggest "which formed along the inner intake screens during early testing." 3. Please include more information on the FCS and operation of the rubber dam, flows, etc. for this structure.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The typo will be corrected and the suggested text clarifications made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3302057	Hydraulics	Project Information Reports	Appendix A	n/a	n/a

Upper Baker: Collection: suggest "500 cfs pumped collection flow with designed capacity to increase to 1000 cfs with modification of the structure" or similar to make it clear that it isn't just a turn of a switch. Also in Project operations section: Water Quality: may want to add change in design to side discharging pumps to reduce potential for downward discharging pumps in early design resuspending bottom sediments.

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The description of expansion to 1,000 cfs will be clarified and the point on the pump discharge direction change added. Note that the system is designed to be and has been tested at 1,000 cfs by only turning on additional pumps. It is possible that the system may be operated in this manner in the future, without expanding screen area, since biological evaluations have shown no fish injury despite screen approach velocity components exceeding criteria. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3302062	Hydraulics	Project Information Reports	Appendix A	n/a	n/a

Carmen-Smith: Collection: power generating flow of 2000 cfs... or "up to 2000 cfs" Do they intend to typically operate at 2000 or will the flows vary seasonally to min instream flows? Screen baffles are 3 feet behind the primary and secondary screen panels? Is that right? Did they include any considerations for Pacific lamprey?

Submitted By: Elizabeth Roy (503-808-4849). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The intended operation will be clarified; The design concept is as presented, though this distance between screen and baffle will probably not work; this statement will be added. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10

1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3304989	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: ES-1)

"... designs never made it PAST a conceptual..."

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Concur - The word correction will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
2-0	Evaluation **Concurred** Also: 4th paragraph - no apostrophe in "...that the authors felt..." Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10
	Backcheck not conducted
	Current Comment Status: **Comment Closed**

3304991	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: ES-2)

"... effective at collecting two juvenile life stages,..." Which 2?

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Text changed to define life stages. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305005	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: ES-2)

"... smaller fish have lower SARS than larger fish AT OCEAN ENTRY." Add capitalized text. This is for size at ocean entry based on studies at Bonneville correct (need citation, nowhere to be found in whole document)? For fish that pass downstream as fry, parr, and subs we do not know size at ocean entry, however I agree that this is likely the case for res. type juv.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **For Information Only** The statement in the text is meant to account for freshwater residence as well. Generally, we do not put citations in executive summary. Will include citations in main body. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Open Comment** Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
1-2	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 14-Jun-10
	Current Comment Status: **Comment Closed**

3305014	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: ES-2)

Last paragraph. The principal idea behind any head of reservoir concept is that you avoid unfavorable reservoir conditions (i.e. predation, fish losing their way etc.). This is suspected at some of the WV dams but has never been confirmed and is based on only professional opinion with little to no hard data. The report should mention that the RPA is founded upon this belief.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Change made to text. Did not include reference to RPA as not sure exactly what NMFS thinking is on this issue. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305026	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: ES-3 first paraqgraph last two sentences)

There is no information on fish sizes at the dam face during times when fry/parr maybe present. Data on fish size in tailrace DOES NOT apply to forebay during early spring through mid summer. Our operations preclude/severely discourage fish passage. Suggest striking last sentence and rewording second to last sentence. Would suggest language about how a year round (if feasible) dam facility will allow for fish to express a more diverse life history. This was observed historically and is still seen at Leaburg.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Deleted the first line in text. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Open Comment**

	This did not seem to get changed consistently with comment # 3305234 on similar item in Section 5.2. There is another instance of this on p 5-12, Biological Studies, Juvenile to Adult Surv Studies, 1st para, last sentence Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
1-2	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 14-Jun-10
2-0	Evaluation **For Information Only** Also - 1st paragraph, 2nd sentence... is not a sentence. Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10
	Backcheck not conducted
	Current Comment Status: **Comment Closed**

3305033	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: ES-3 first bullet)

First bullet is a run-on and very confusing. Please reword.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Bullet will be rewritten. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
2-0	Evaluation **Concurred** Also: 1st paragraph, 2nd sentence - is not a sentence. Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10
	Backcheck not conducted
	Current Comment Status: **Comment Closed**

3305037	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: ES-3 third bullet)

A bypass for mid-reservoir? Seems very unlikely. I suggest rewording to include transport only. The fact that a direct bypass is unlikely could be a strike against this location as well...

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The "/conveyance" was left out of the text. This is the generic terminology used throughout for this system component. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment.

	Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305045	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: ES-3 second to last pp)

Reword first sentence to remove parentheses... "Two full scale facilities at Upper Baker and Round Butte dams,..." This type of word smithing should be considered many other places in the document to improve readability.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Document will be edited to remove parenthetical statements. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
2-0	Evaluation **Concurred** Also: This may be first time term 'FSC' is used. If so, please define. Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10
	Backcheck not conducted
	Current Comment Status: **Comment Closed**

3305047	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: ES-3 second to last pp)

"success of the U B FSC has SPAWNED several..." No pun intended?

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** No pun was intended. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305053	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: ES-4)

Reword "cut and pasted" to "directly applied"

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Suggested change will be made.

	Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
2-0	Evaluation **Concurred** Also: Last bullet under "At-Dam" - what is a braille ? Submitted By: Joseph Orlins (425-881-7700 x200) Submitted On: 09-Jun-10
	Backcheck not conducted
	Current Comment Status: **Comment Closed**

3305059	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: ES-4 Data Gaps for...)

First paragraph last sentence does not make sense. Suggest rewording to "Due to their high priority and short deadlines, Cougar dowstream passage and LOP head of res prototype..."

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The paragraph will be edited to clarify. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305066	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: ES-4 Data Gaps for...)

Second paragraph This is a run-on sentence and confusing. What is the intent of this paragraph? I don't understand how the biological gaps were related to the need to identify at dam or HOR. Were the data needs (not gaps) identified to adress this question?

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The paragraph will be edited to clarify. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305086	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: ES-5 Data Gaps for biological studies and first bullet on page) in general the list seems really short. I am very suprised that fish horizontal and vertical distribution did not make the list for cougar but a hydro model to identify distribution problems did. Seems like a cart before the horse. Why not discern where the fish are and if they aren't in an area that facilitates easy collection then look at current patterns. Cougar is very different than the situation at Billy Chinook and it is premature to assume there is an issue here with surface currents until more is known about where fish are! It seems a more useful study is to look at the currents at the tower and how they might effect any sort of collection. Strongly suggest removing study of "hydro-thermally driven current structure". Maybe just delete "hydro-thermally" from sentence and mention the issues encountered at Billy Chinook in the project description. Again it seems like we're in a much bigger biological hole than physical science hole here...

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Vertical and Horizontal distribution data will be collected as part of the survival studies (Text changed later in section 5.2) Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305093	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: ES-5 Data Gaps for LOP)

Greg Taylor has already collected informatioin for the second bullet on the NFMF Willamette. This will be published in a Corps report due end of September.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **For Information Only** Comment noted. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305100	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: ES-5 Data Gaps for CGR an LOP, SARS)

I agree that SARS data is critical data need for the head of res question (not necessarily applicable to CGR). You also mention later how these studies take 5-10 years, however this is not reflected in your general schedule. Please adress the discrepancy. The schedule needn't change but then we must identify that the data will not be in hand for decision making.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Changes made to text in section 5.2 Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10

1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305119	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 2.2 Bio goals)

Good section but would suggest language pointing out that many times these are established during a negotiation and are often based on policy and precedence. Ideally biological performance goals/criteria should be determined by what makes sense for site specific technical reasons.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Text added. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305126	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 2-2 & 2-3)

Fry to parr have very low survival in a completely natural system not just "within project boundar(ies)". Please reword to reflect this.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The phrase "within project boundaries" will be removed. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305137	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 3.0 Reference Projects)

The information presented here would be much more useful with a little more detail. Specifically when ever survival or collection efficencies are cited we should know where the treatment fish were released. Head of Res.? In the forebay? After the RO gate? More effort on your end but an very important aspect of this report. It saves managers and future staff the time and effort at digging up the old reports again (if they go through the trouble at all, see NMFS 2008c for example).

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **For Information Only** No changes made to text. Appendix A has information for some but not all release sites used for each project (See Wapato Irrigation Diversion). Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305138	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 3.3.1)

C.E from where? Head of Res.? Forebay?

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Head of reservoir added to text . Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305145	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 3.4.1)

The vertical drop (total head) of the bypass would be helpful info. This applies to all bypass systems within this document

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** This information will be added where readily available. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305150	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 3.3.2)

"this concept was rejected as an alternative..." Why? Also why were all of the alternatives for CGR rejected? This seems very important and is not documented in the 2001 alternatives study.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The alternatives were not really rejected; they were just not designed and constructed. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305155	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 3.4 last sentence)

suggest "Fish can be bypassed through the dam directly or directed to a collection facility for truck transport."

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** This change will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305158	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 3.4.4)

Please insert information on the survival estimates that were established for GPR. Also important to note why the system was abandoned.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The data reviewed did not explicitly state why or if the facility was abandoned. Added information on chinook survival to the text. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305180	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 3.4.6)

Any collection efficency goals established? Also, 95% survival for smolts or all life stages/species?

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The cited document in the project profiles simply states juvenile, with no definition. We did not find a collection efficiency standard in the literature reviewed. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305181	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 3.5.2)

Despite difficulties in collection I'm sure there was an evaluation of direct survival through the bypass system. Is that information out there?

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** We have the report on order. Not sure if the data exists. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305186	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: Figure 3-34)

Okay so fish pass point "D" and enter "E", then what? Not explained "well" in section 3.4.6. How are fish dipped out of well? Has NMFS bought off on this apect of the design? Can you continue collection during dipping? How often are they dipped?

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The explanation will be expanded to answer these questions. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305188	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 4.1 glossary)

Move section to front of document and double check all text to make sure it is consistent with your definitions presented here.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** This change was also suggested by Elizabeth Roy and will be implemeted. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305190	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: Table 4-1)

May of the projects listed here have certain aspects that violate NMFS criteria that are not mentioned (i.e. Willamette Falls Sulivan outfall velocities). Also many of these, especially the mothballed facilities were designed before there were criteria. Suggest removing the astix or adding them all.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Removed Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305191	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: Table 4-2)

Issue #3 does not apply to the last column, does it? For a release location isn' this issue already covered by the previous column?

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Issue # 3 will be removed from the final column and the text references. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305194	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 4-8 first para last sent)

"It is worth noting that all of the conceptual... facilities were sized for the 10% exceedence flow." Agree! Most interesting. Why? Was there agency buy in?

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** In each case the concept was developed for the 10 % exceedence flow because of the magnitude of higher flows. None were built, so agency buy-off was never obtained. The text will be revised to reflect this. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305196	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: General info on upper baker)

Somewhere please insert info on the guidance net mesh size. If I missed it my appologies.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **For Information Only** It is in the profile in the appendix. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305200	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 4.3.4.1)

"Partial exclusionary nets utilized for earlier versions... were abandoned..." This was with sockeye that migrate deeper than Chinook. Also more info would be helpful, how deep were these nets? Do we expect a BGS to work better? BGSs have a pretty low batting average don't they?

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Depth of 100 ft. Added to text... Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10

	Current Comment Status: **Comment Closed**

3305205	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 4.3.4.2)

The primary reason downstream passage was abandoned at CGR had to do with difficulty in collecting adults. This combined with lower survival in the downstream facility were a deal killer. Again, more info would be helpful (survival rates?). I know they did tests looking at survival and injury at specific points within the system. As I recall the real trouble was the valve structure immediately behind the fish horns. Better double check!

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Data on survival rates are presented in Appendix A for this project and in section 3.4.3. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305208	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 4.3.4.2)

The term "conveance" should be changed to "bypass" since it is more like a bypass than truck.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The word change will be made. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305210	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 4.3.4.3)

Add GPR bypass

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** GPR bypass, as well as the Howard Hanson and abandoned Round Butte hybrid will be added. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment.

	Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305218	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 5.0)

Suggest section title change to "Information Gap Analysis" or "Required Information Assesment" Are we requiring information gaps? If so we should be good! Ha

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** "Information Gap Analysis" it is. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305224	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: Table 5-1)

Where there is more than one reference in a cell please insert references next two numbers using super script (i.e "trapping in the late 90's indicated less than 20,000 smolts passed the project.1" " Taylor 2000 1." 1s should be in super script. Right now they aren't even in the order that they are presented so it is dificult to tell where the info is coming from.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The comments in each field are presented as broad conclusions from the papers cited. So fish size range for example may be based on data from two papers. Where possible citations were put into text. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305226	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: Table 5-1)

Abundance: Please re-confirm all numbers, especially the HOR fry "aboundance".

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred**

	Numbers corrected. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305230	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: Table 5-1)

Debris loading: I don't think that either DET or FOS are good surrogates for CGR as the land use practices within these basins are totally different. Better double check this assumption.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Change rating to Inadequate and explanation of differing land use practices. Upgrade the need for debris study to Moderate Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305231	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: Table 5-2)

Abundance: How can CGR be inadequate and LOP adequate?!? We have much better trap efficency with our CGR data. The trap efficency for live fish is around 1% for LOP. Please change to inadequate and insert estimates from NFMF screw trap. Where did all of the numbers come from in the last column? This is not cited properly. Were these based on data from the middle fork or outside the basin? Based on 500 adults outplanted so 250 pairs? Our sex ratio can be very skewed especailly after the hatchery brood needs in low run years...

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

Revised 01-Jun-10.

1-0	Evaluation **Concurred** Text changed to reflect comment. The data are meant to provide an example of possible production. The 500 value was selected as it is higher than the 200-300 wild fish reported in the Willamette BiOP. A footnote has been added to the Table. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305232	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: Table 5-2)

Debris Loading: Can Debris at DET dam be used for LOP head of res.? Wouldn't the amount of debris and especially sediment be much higher in the tributary and at the head of res.?

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Change rating to inadequate and recommend sediment study as Moderate importance. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305233	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: Section 5.2)

Again there is a general lack of proper citations for many of the statments made. Please remedy.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Citations have been added to the text. The project profiles have the majority of the citations used in the analysis. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305234	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: Section 5.2)

Please see my comment in the Exec Sum. about how we can not assume the facilities at dam can be designed for larger fish. Screwtrap data in the tailrace DOES NOT apply to the forebay for much of the year. Please correct any other instances in the document.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Sentence edited to account for comment. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305235	General	Project Information Reports	n/a'	n/a	n/a
(Document Reference: All Tables) Please make table formatting consistent. Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10					
1-0	Evaluation **Concurred** Table format will be made consistent. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10				
	Current Comment Status: **Comment Closed**				
3305236	General	Project Information Reports	n/a'	n/a	n/a
(Document Reference: Table 5-3) Juvenile Chinook Migratory Behavior and Survival through res. Minimum fish size should be 95mm. Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10					
1-0	Evaluation **Concurred** Corrected Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10				
	Current Comment Status: **Comment Closed**				
3305237	General	Project Information Reports	n/a'	n/a	n/a
(Document Reference: Table 5-3) Suggest add a study category: "Vertical and horizontal distribution in forebay" Where and when is very important on determining which alternatives will work! Should also be higher priority than hydrodynamic modeling of entire res. as this may not be necessar if fish concentrate where collection is possible. Can use numerous methods like active tags or mobile hydro-acoustics. Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10					
1-0	Evaluation **Concurred** Added objectives to the migratory behavior study. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10				
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10				

	Current Comment Status: **Comment Closed**

3305238	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: Table 5-3)

Juv Chk Migratory behavior and survival through res: Paired release for reservior survival?!? Where is the control released? In general the use of active tags for looking at res survival seems inappropriate since most fish enter as fry. If you do see high mortality for +95mm fish i guess you could assume its really bad for fry?

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Control would be released at the dam or tailrace. Added that a single release approach could also be used. Clarified some points in text Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305239	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: Table 5-3)

Res. Rearing: Suggest rating it low.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Our opinion is that it is moderate until Biological Performance Criteria are developed for the program. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305240	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: Table 5-3)

Reservior Hydrodynamic modeling: This would only be a high priority if studies using fish identified a problem (i.e. similar to rounde butte). Why moveout on this if there is no problem identified? Suggest changing rating to low or moderate.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** The study shoud still be prioritized as Moderate. While there may not be a fish problem identified, by the time fisheries research determines absence or presence of problem, it may be too late to initiate modeling in time for input to concepetual design.

	Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305241	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: Table 5-3)

Forebay modeling: Certainly higher than reservior modeling if you are looking at forebay/at dam passage solutions!

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Raise prority to high and description accordingly. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305242	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 5-11)

Reason #1. Should read: "larger size at ocean entry..." Also need to mention time at ocean entry which could be different for HOR vs. Res. life histories...

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** We intended to account for both freshwater and saltwater survival with this comment. For example, fry released below the dam may require for some time resulting in mortality that is higher than a group of smolts released downstream. Added text to clarify. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305243	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 5-11)

SARS studies in general: This type of study needs to be coupled with a robust life cycle modeling effort. The analysis of SARS under the current project configuration is confounded by the fact that res. fish have to pass the project with its high mortality. A sensitivity analysis needs to be done on dam survival to see if it could drastically bias SAR study results...

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Comment noted. The life-cycle model could be done after the survival and behavior data were collected. As such, it has a low priority at this point. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305244	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 5-12)

See previous comments on Res. Hydro. model studies. Really seems to be over emphasized here.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Change priorities per response to comment #'s 3305240 and 3305241 Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Open Comment** Make sure Exec summary priority studies match those in Section 5 as revised for CGR and LOP. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
1-2	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 14-Jun-10
	Current Comment Status: **Comment Closed**

3305245	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: 6.0)

In general there needs to be more citations in the text where appropriate.

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

1-0	Evaluation **Concurred** Added references to biological sections of text. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

3305246	General	Project Information Reports	n/a'	n/a	n/a

(Document Reference: GENERAL)

One area where the report could have greater applicability and use would be to have more detailed info on how biological performance goals/criteria were set. Pelton Round Butte uses smolt criteria screens instead of fry, why? Can we have a bypass that is out of NMFS design criteria but meets our biological needs? How did these other projects arrive at these goals...yadada Given the short time line I appreciate the level that this report is at already. A little more detailed info in spots would make the document much better though. Especailly putting in to context some of the collection and survival numbers. Though much of this is in the appendicies it would be great to bring it up into the text where appropriate. THANKS!!

Submitted By: David Griffith (503-808-4773). Submitted On: 01-Jun-10

Revised 01-Jun-10.

1-0	Evaluation **Concurred** Because of time constraints we have not moved data from the appendix to the body of the report. We added text to section 2.2 to illustrate the point. Submitted By: Charles Sweeney (425-881-7700) Submitted On: 09-Jun-10
1-1	Backcheck Recommendation **Close Comment** Closed without comment. Submitted By: Elizabeth Roy (503-808-4849) Submitted On: 12-Jun-10
	Current Comment Status: **Comment Closed**

A-E CONTRACTOR STATEMENT OF TECHNICAL REVIEW

COMPLETION OF INDEPENDENT TECHNICAL REVIEW

The A-E Contractor **AECOM Technical Services Inc. (AECOM)** has completed the final report of **Willamette Downstream Fish Passage Design Requirements Report (Doc No. 60148335.401).** Notice is hereby given that an independent technical review, that is appropriate to the level of risk and complexity inherent in the project, has been conducted as defined in the Quality Control Plan. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of: assumptions; methods, procedures, and material used in analyses; alternatives evaluated; the appropriateness of data used and level obtained; and reasonableness of the result, including whether the product meets the customer's needs consistent with law and existing Corps policy. The independent technical review was accomplished by **Dr. Joseph Orlins**. All comments resulting from ITR have been resolved.

______________________________ _6/17/2010_______

Joseph Orlins, P.E., Ph.D., D.WRE Date
Technical Review Team Leader

______________________________ _6/17/2010__ ____

Charles E. "Chick" Sweeney, P.E. Date
Project Manager, A-E Contractor

CERTIFICATION OF INDEPENDENT TECHNICAL REVIEW

Significant concerns and the explanation of the resolution are as follows:

No significant concerns.

As noted above, all concerns resulting from independent technical review of the project have been fully resolved.

______________________________ _6/17/2010______

Charles E. "Chick" Sweeney, P.E. Date
Principal, A-E Contractor