U.S. Army Corps of Engineers,
Portland District
(Contract No. W9127N-08-D-0006)
Task Order No. 0026

DRAFT

Brainstorming Meeting Report

The Dalles East Fish Ladder Auxiliary Water System Emergency Operation Backup System Alternatives

Columbia River, Oregon-Washington

Prepared by:

HDR
1001 SW 5th Ave., Suite 1800
Portland, OR 97204-1134
503.423.3700 Phone 503.423.3737 Fax
HDR Project No. 147341
HDR Project Manager: Ron Mason

December 22, 2010

A-E CONTRACTOR STATEMENT OF TECHNICAL REVIEW
COMPLETION OF INDEPENDENT TECHNICAL REVIEW

The A-E Contractor, HDR Engineering, has completed The Dalles East Fish Ladder Auxiliary Water System Emergency Operation Backup System Alternatives Report**.** 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 USACE policy. The independent technical review was accomplished by an independent HDR team. All comments resulting from independent technical review have been resolved.

_______________________________________ _______________________
Mike McGowan, Technical Review Team Leader Date
(Signature)

_______________________________________ _______________________
Ronald C. Mason, Project Manager, HDR Engineering, Inc. Date
(Signature)

CERTIFICATION OF INDEPENDENT TECHNICAL REVIEW

Significant concerns and the explanation of the resolution are as follows:

(Describe the major technical concerns, possible impact, and resolution)

As noted above, all concerns resulting from independent technical review of the project have been fully resolved.

_______________________________________ _______________________
Amy Dammarell, Principal, HDR Engineering, Inc. Date
(Signature)

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Executive Summary

HDR, under contract to the U.S. Army Corps of Engineers (USACE), Portland District (CENWP) completed a report, "*Brainstorming Meeting Report for The Dalles East Fish Ladder Auxiliary Water Backup System*" (December 2010). This report presents the result of a brainstorming session conducted on December 8, 2010. A total of 15 alternatives for the backup water supply for The Dalles East Fish Ladder (EFL) auxiliary water system (AWS) were identified and evaluated. This report presents a conceptual level evaluation of the identified alternatives based on a set of eight criteria. Alternatives were scored and ranked for further detailed analysis and evaluation by USACE. The evaluation matrix contained in this report displays all of the considerations and rankings generated in this effort. The top four or five ranked alternatives appear to have sufficient potential that further evaluation by the USACE is warranted. If CENWP decides to adopt and implement any of the ranked alternatives included in the matrix, additional analysis will be required including refined investigations of the hydraulic, structural, electrical, and mechanical features as well as operational, costs, and the biological considerations associated with each alternative.

Previously prepared construction cost estimates for Alternatives A and B that were contained in a September 1997 report prepared by INCA titled "*The Dalles Dam Auxiliary Water System Upgrade Alternative Evaluation*" were updated to present day costs. Alternative A was titled "Forebay Intake with Screen Structure." Alternative B was titled "Tailrace Pump Station at East Fishway." The updated costs for alternatives A and B are $ 45,409,916 and $ 40,626,834, respectively.

Pertinent Data

PERTINENT PROJECT DATA THE DALLES LOCK AND DAM – LAKE CELILO		
GENERAL		
Location	Columbia River, Oregon and Washington, River Mile 192	
Drainage area	Square miles	237,000
RESERVOIR – LAKE CELILO		
Normal minimum pool elevation	Feet mean sea level (msl)	155
Normal maximum pool elevation	Feet msl	160
Maximum pool elevation	Feet msl	188.1
Minimum tailwater elevation	Feet msl	76.4
Maximum tailwater elevation	Feet msl	133.4
Reservoir length (to John Day Dam)	Miles	23.5
Reservoir surface area – normal maximum power pool (EL 160.0)	Acres	9,400
Storage capacity (EL. 160.0)	Acre-feet	332,500
Power drawdown pool (EL. 155)	Acre-feet	53,500
Length of shoreline	Miles	55
FLOOD CONDITIONS		
Probable maximum flood (unregulated)	ft^3/s	2,660,000
Probable maximum flood (regulated)	ft^3/s	2,060,000
Standard project flood (unregulated)	ft^3/s	1,580,000
Standard project flood (regulated)	ft^3/s	840,000
100-year flood event (regulated)	ft^3/s	680,000
SPILLWAY		
Type	Gate-controlled gravity overflow	
Length	Feet	1,447
Elevation of crest	Feet msl	121
Number of gates		23
Height (apron to spillway deck)	Feet	130
NAVIGATION LOCK		
Type	Single lift	
Lift – normal	Feet	87.5
Lift – maximum	Feet	90
Net clear length	Feet	650
Net clear width	Feet	86
Normal depth over upper sill	Feet	20
Minimum depth over upstream sill	Feet	15
Minimum depth over downstream sill	Feet	15

PERTINENT PROJECT DATA THE DALLES LOCK AND DAM – LAKE CELILO		
POWER PLANT		
Powerhouse type	Conventional (indoor)	
Powerhouse width	Feet	239
Powerhouse length	Feet	2,089
Number of Main Generating Units		*22*
Installed power capacity	Kilowatts	1,806,800
Peak generating efficiency flow	ft^3/s	260,000
Maximum flow capacity	ft^3/s	320,000
Fishway Units (Not Included Above)		*2*
Installed power capacity	Kilowatts	28,000
Peak generating efficiency flow	ft^3/s	2,500
Maximum flow capacity	ft^3/s	2,500
Station Service Units (Not Included Above)		*2*
Installed power capacity	Kilowatts	6,000
Peak generating efficiency flow	ft^3/s	300
Maximum flow capacity	ft^3/s	300
FISH FACILITIES		
Adult ladders		2
Ladder designations		North and East
North ladder width	Feet	24
East ladder width	Feet	30
Ladder slope (typical)		1v:16h
Ladder elevation change (typical)	Feet	84
WASCO PUD POWER PLANT (OPERATING AT THE NORTH FISH LADDER AWS)		
Powerhouse type	Conventional (indoor)	
Powerhouse width	Feet	44
Powerhouse length	Feet	48
Intake Structure width	Feet	25
Intake Structure length	Feet	125
Number of Main Generating Units		*1*
Installed power capacity	Kilowatts	5,000
Peak generating efficiency flow	ft^3/s	800
Maximum flow capacity	ft^3/s	800

Acronyms and Abbreviations

AWC	auxiliary water conduit
AWS	Auxiliary Water System
BPA	Bonneville Power Administration
CENWP	USACE Portland District
cfs	cubic feet per second
DART	Data Access in Real Time
EFL	East Fish Ladder
FCC	fish collection channel
FERC	Federal Energy Regulatory Commission
FTC	fish transportation channel
HDC	Hydroelectric Design Center
msl	mean sea level
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
SNL	speed no-load
USACE	U.S. Army Corps of Engineers

1.0 INTRODUCTION

1.1 General

This report has been developed to aide USACE in developing cost effective alternatives for providing a backup supply for the auxiliary water system for The Dalles Dam East Fish Ladder (EFL). Alternatives presented and discussed in this report were developed during a brainstorming meeting held on December 8, 2010. The brainstorming meeting was attended by USACE staff, regional fish agencies, and HDR product development team members. Alternatives were ranked and scored based on criteria developed by participants. Results of this process are presented in this report. Engineering judgment and limited computations were used to support conclusions.

1.2 Purpose and Problem Description

Operation of the EFL is a critical component of successful adult passage at The Dalles Dam. The backup water supply system being considered in this memorandum allows for operation of the EFL even when the two fish turbines are not operational. Approximately 80 percent of the returning adult salmon use the EFL as a passage route to upper parts of the Columbia watershed. The EFL AWS is supplied by two fish unit turbines and reliability of these turbines is critical. USACE, through the Hydroelectric Design Center (HDC) has investigated the reliability of the fish unit turbines. Investigations by USACE and other engineering firms have been used to demonstrate the viability of the alternatives presented in this report.

The purpose of this report is to review the technical aspects, operational assumptions, constructability, costs, and identify fatal flaws, if any, of past EFL AWS backup alternatives and put them on comparable terms with the backup AWS alternative recommended in the 2009 HDR report. Two alternatives (A and B) from the 1994 EBASCO report were selected by CENWP to have the original construction cost estimates updated and include in this report.

To ensure an equal treatment of each alternative identified in the Brainstorming session, a consistent set of assumptions, constraints, and criteria were developed at the outset of this study. This criteria is presented in later sections of this report.

1.3 Scope

Having a backup system to provide continuous operation of the EFL is an important component of the overall success of upstream adult fish passage at The Dalles Dam. This report examines 15 potential alternatives that were identified and discussed during a brainstorming meeting on December 8, 2010. The alternatives under evaluation have the design discharge requirement to provide 1,200 to 1,400 cubic feet per second (cfs). Presently, water for the AWS is supplied from a single source: the two fish unit turbines. The reliability of these turbines is critical.

1.4 Authorization

The 1995 Energy and Water Development Appropriation Bill directed the USACE to use additional appropriations to aggressively improve effectiveness and efficiency of the bypass systems, reduce mortality by predators, and enhance passage conditions.

1.5 Existing Fishway Facilities

The adult fish passage facilities at The Dalles Dam consist of a collection of fish ladders. The ladders are identified as the North, South, West, and East Fish Ladders (Appendix C, Sheets 01 and 02). Attraction and transportation flow for the South, West, and East Ladders is provided by two fish units located on the west end of the powerhouse. Water discharged (5,000 cfs) from the fish turbines enters the auxiliary water conduit (AWC) and is released into the transportation and collection channels through diffusers located in the junction pool at the EFL entrance. Fish enter the South and West Fish Ladders and travel through the transportation and collection channels, respectively, to the East Fishway Ladder (Figure 1 through Figure 3).

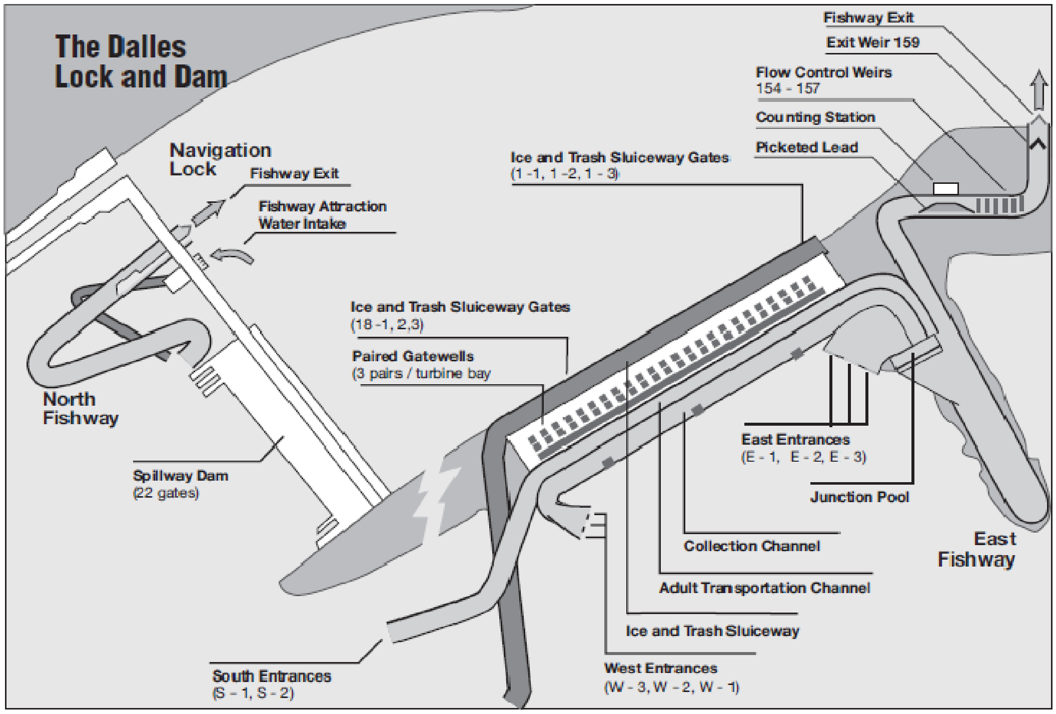


Figure 1. The Dalles Dam Fish Ladder System
(Illustration from the 2008 Fish Passage Plan, USACE)

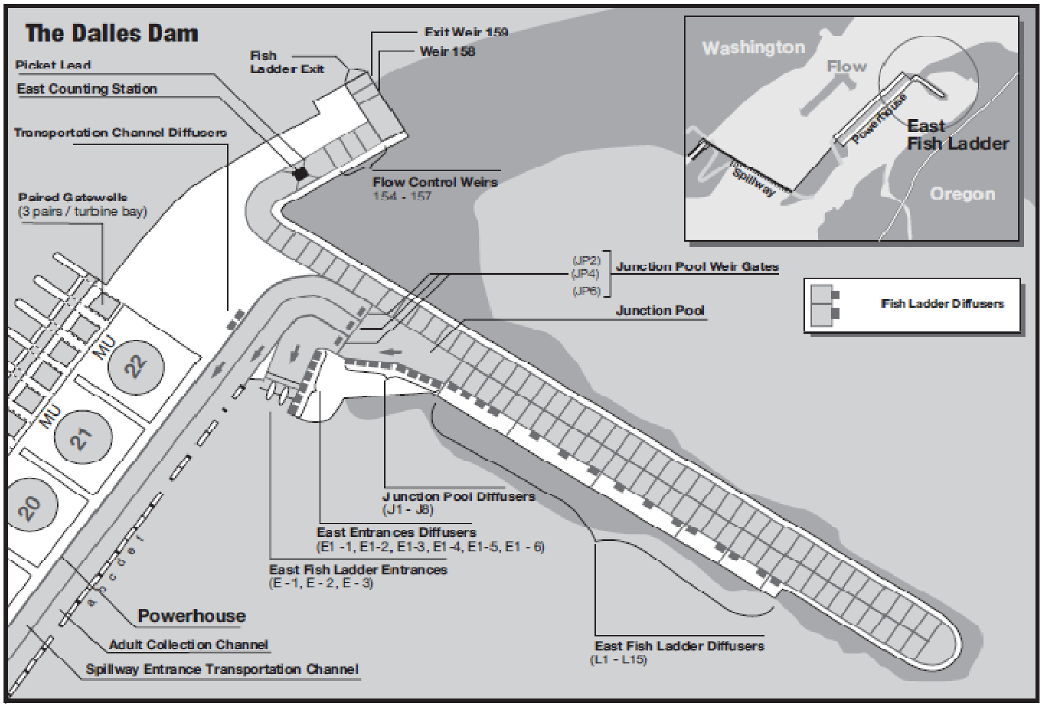


Figure 2. The Dalles Dam East Fish Ladder
(Illustration from the 2008 Fish Passage Plan, USACE)

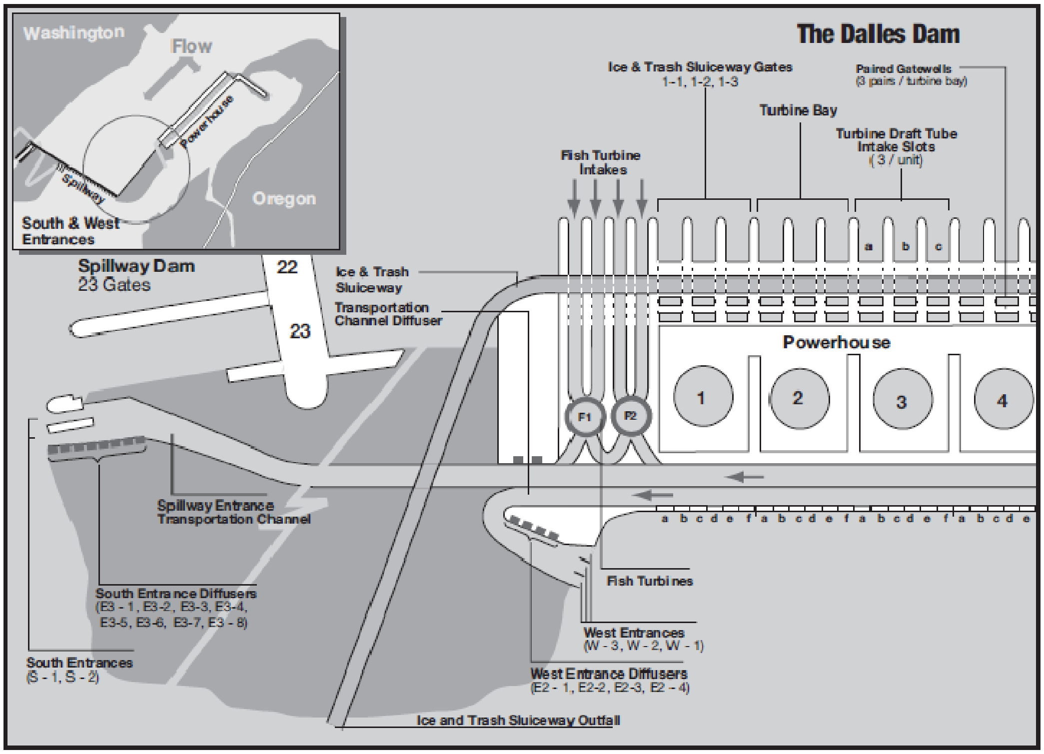


Figure 3. The Dalles Dam West and South Fish Ladders
(Illustration from the 2008 Fish Passage Plan, USACE)

1.5.1 Fish Unit Turbines

Two fish turbine units (F1 and F2) are located at the west end of the powerhouse. The turbine units have a combined power capacity of 28,000 kilowatts and a maximum capacity of 2,500 cfs each. Water (5,000 cfs) is discharged from the fish units into the AWC. Trash racks spaced one inch apart are installed in the fish unit turbine intakes.

1.5.2 Auxiliary Water System

As shown on Figure 1 through Figure 3, the AWS consists of a large AWC, a fish transport channel, fish collection channel, junction pool, weir gates, and a series of diffusers along the AWC that conveys water to the South, West, and East Fish Ladder entrances. Water is supplied to the AWC from the two fish unit turbines. This system is complex to operate, but an integral part of the overall operation of the EFL system. Based on a numerical model developed by USACE, CENWP-EC-HD, the hydraulic head within the AWS conduit is approximately 9 feet greater than the tailrace water surface elevation. Water discharged at the EFL entrance is sent through a series of diffusers in the junction pool. The junction pool provides water to the fish transportation channel (FTC), which supplies the South Fish Ladder, and the fish collection channel (FCC), which feeds the West Fish Ladder. The AWS normally operates with a total flow of up to 5,000 cfs, but can be effectively operated at 3,400 cfs with some minor operational constraints.

2.0 GENERAL DESIGN AND OPERATIONAL REQUIREMENTS

2.1 General Discussion

Based on previous reports, alternatives evaluated to date provide a discharge of 5,000 cfs, have costs considered to be unacceptably high as well as the potential to be somewhat unreliable. For this brainstorming report, USACE and regional fishery agencies have recently re-evaluated the flow and operational requirements for the backup system to provide greater flexibility in the range of options which could be considered to be acceptable. This new discharge and operational criteria are contained in Appendix B of this report.

2.2 Operational and Flow Criteria for AWS Backup System

The new detailed operational and flow requirements are described in a USACE technical memorandum dated December 20, 2010. The primary requirements for system operation identified in the memorandum are as follows:

- The west fish entrance will be closed during times the backup flow will be used.
- The south fish entrance will be closed during times the backup flow will be used.
- At the east fish ladder entrance, only two of the three weirs will remain operational.
- The total discharge requirement for the backup system will be in the range of 1,200-1,400 cfs.

2.3 Biological Criteria

2.3.1 In-Water Work Period

The in-water work period for annual maintenance of fish facilities is scheduled from December 1 through February 29. Work during this period is to be conducted such that impacts on upstream migrants are minimized.

2.3.2 Adult Passage Period

Upstream migrants are present at The Dalles Dam throughout the year and adult passage facilities are operated year-round. Adult fish (salmon, steelhead, shad, and lamprey) are normally counted from February 20 through December 7. Adult Salmonids are generally present between late March and early November as illustrated in Figure 4 on the following page.

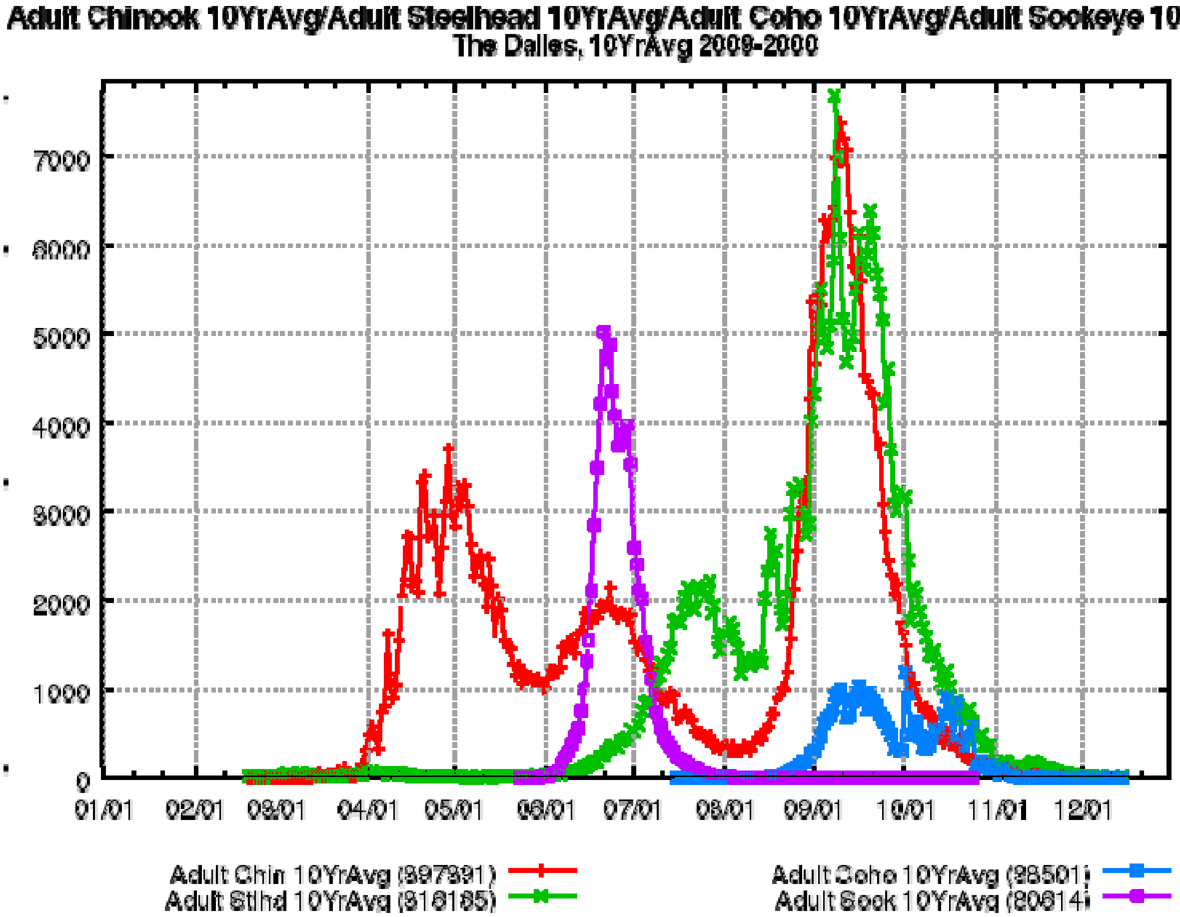


Figure 4. Ten Year Average (2000-2009) of Adult Migrating Salmonids at The Dalles Dam (Data Access in Real Time [DART] 2010).

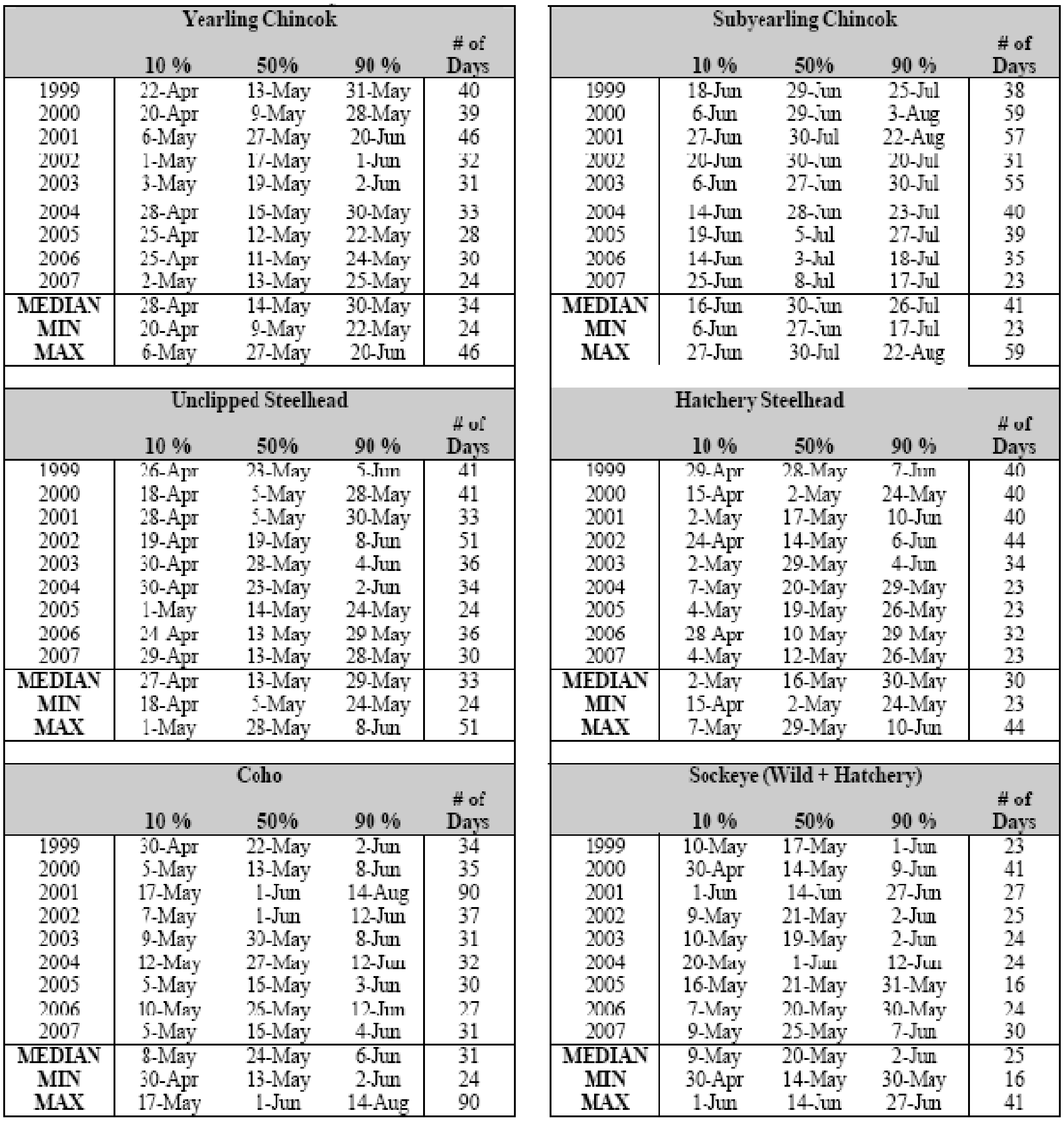
2.3.3 Adult Passage Criteria

The criteria for adult passage during use of the backup supply for the AWS were determined by the USACE and NMFS. It was determined that only the EFL would be in use when the backup supply is operational and that only two weirs at the east entrance of the east ladder would remain open, with an operating head of 1.5 feet.

2.3.4 Juvenile Passage Period

The primary juvenile fish passage period is April through November. Because juvenile monitoring is not performed at The Dalles Dam, results from John Day Dam are used. Table 1 shows passage time at John Day Dam and for purposes of estimating timing, it is common practice to add approximately one day to the dates shown in the table to estimate timing of juvenile fish passage at The Dalles Dam.

Table 1. Juvenile Fish Migration Dates for John Day Dam



Yearling Chincok

	10 %	50%	90 %	# of Days
1999	22-Apr	13-May	31-May	40
2000	20-Apr	9-May	28-May	39
2001	6-May	27-May	20-Jun	46
2002	1-May	17-May	1-Jun	32
2003	3-May	19-May	2-Jun	31
2004	28-Apr	15-May	30-May	33
2005	25-Apr	12-May	22-May	28
2006	25-Apr	11-May	24-May	30
2007	2-May	13-May	25-May	24
MEDIAN	28-Apr	14-May	30-May	34
MIN	20-Apr	9-May	22-May	24
MAX	6-May	27-May	20-Jun	46

Subyearling Chincok

	10 %	50%	90 %	# of Days
1999	18-Jun	29-Jun	25-Jul	38
2000	6-Jun	29-Jun	3-Aug	59
2001	27-Jun	30-Jul	22-Aug	57
2002	20-Jun	30-Jun	20-Jul	31
2003	6-Jun	27-Jun	30-Jul	55
2004	14-Jun	28-Jun	23-Jul	40
2005	19-Jun	5-Jul	27-Jul	39
2006	14-Jun	3-Jul	18-Jul	35
2007	25-Jun	8-Jul	17-Jul	23
MEDIAN	16-Jun	30-Jun	26-Jul	41
MIN	6-Jun	27-Jun	17-Jul	23
MAX	27-Jun	30-Jul	22-Aug	59

Unclipped Steelhead

	10 %	50%	90 %	# of Days
1999	26-Apr	23-May	5-Jun	41
2000	18-Apr	5-May	28-May	41
2001	28-Apr	5-May	30-May	33
2002	19-Apr	19-May	8-Jun	51
2003	30-Apr	28-May	4-Jun	36
2004	30-Apr	23-May	2-Jun	34
2005	1-May	14-May	24-May	24
2006	24 Apr	13 May	29 May	36
2007	29-Apr	13-May	28-May	30
MEDIAN	27-Apr	13-May	29-May	33
MIN	18-Apr	5-May	24-May	24
MAX	1-May	28-May	8-Jun	51

Hatchery Steelhead

	10 %	50%	90 %	# of Days
1999	29-Apr	28-May	7-Jun	40
2000	15-Apr	2-May	24-May	40
2001	2-May	17-May	10-Jun	40
2002	24-Apr	14-May	6-Jun	44
2003	2-May	29-May	4-Jun	34
2004	7-May	20-May	29-May	23
2005	4-May	19-May	26-May	23
2006	28 Apr	10 May	29 May	32
2007	4-May	12-May	26-May	23
MEDIAN	2-May	16-May	30-May	30
MIN	15-Apr	2-May	24-May	23
MAX	7-May	29-May	10-Jun	44

Coho

	10 %	50%	90 %	# of Days
1999	30-Apr	22-May	2-Jun	34
2000	5-May	13-May	8-Jun	35
2001	17-May	1-Jun	14-Aug	90
2002	7-May	1-Jun	12-Jun	37
2003	9-May	30-May	8-Jun	31
2004	12-May	27-May	12-Jun	32
2005	5-May	15-May	3-Jun	30
2006	10-May	25-May	12-Jun	27
2007	5-May	15-May	4-Jun	31
MEDIAN	8-May	24-May	6-Jun	31
MIN	30-Apr	13-May	2-Jun	24
MAX	17-May	1-Jun	14-Aug	90

Sockeye (Wild + Hatchery)

	10 %	50%	90 %	# of Days
1999	10-May	17-May	1-Jun	23
2000	30-Apr	14-May	9-Jun	41
2001	1-Jun	14-Jun	27-Jun	27
2002	9-May	21-May	2-Jun	25
2003	10-May	19-May	2-Jun	24
2004	20-May	1-Jun	12-Jun	24
2005	16-May	21-May	31-May	16
2006	7-May	20-May	30-May	24
2007	9-May	25-May	7-Jun	30
MEDIAN	9-May	20-May	2-Jun	25
MIN	30-Apr	14-May	30-May	16
MAX	1-Jun	14-Jun	27-Jun	41

2.4 Fish Screening

The alternatives evaluated during the brainstorming meeting included a variety of methods to draw water from the forebay or tailrace of The Dalles Dam for use as a backup supply for the AWS. Key within the considerations of the overall effectiveness of an alternative was the agency identified biological concerns and requirements related to fish passage. One of the most consistent considerations for water withdrawals included its potential effect on juvenile outmigrants. The consideration or requirement for screening was considered on a case-by-case basis during the evaluation of alternatives utilizing a withdrawal source requiring screening. In all cases, it was assumed that if screening was necessary, the installed screens would be in compliance with the Juvenile Fish Screening Criteria, National Marine Fisheries Service (NMFS), Northwest Region, February 2008.

3.0 BRAINSTORMING ALTERNATIVES

3.1 Introduction

Previous studies (1991-2009) conducted by USACE and other engineering companies (A/E firms) identified a wide array of alternatives that were costly and most of these had characteristics that raised concerns with USACE management, but the need for a reliable backup system for the AWS of the EFL still remained. To define a feasible backup system, a brainstorming session was conducted that included staff from the organizations: USACE District Office, The Dalles Dam Project Operations, National Oceanic and Atmospheric Administration (NOAA), Bonneville Power Administration (BPA), and HDR Engineering. This session led to the identification of 15 alternatives that were considered to be worth a cursory evaluation. To prepare this report, these alternatives were evaluated, scored, ranked, and displayed in an evaluation matrix. The alternatives identified in the brainstorming meeting are discussed below.

3.2 Discussion of Alternatives

3.2.1 Alternative 1: Siphon for Additional Water to the Fish Lock

Alternative 1 consists of constructing a large siphon structure, connecting the forebay with the fish lock caisson. Determining the exact size and location of the siphon piping is beyond the scope of this effort, but it would have to operate on the maximum head differential between the forebay and the crest of the siphon estimated to be 15-20 feet. Potential alignments of the siphon could include trenching through the upper 10-15 feet of the embankment dam, passing through existing openings at/around the fishway exit or boring through the monolith itself.

The position of the siphon intake would also need to be evaluated to minimize impacts to fish passage. Screening will likely be required regardless of where the intake is located in the water column. A shallow intake may adversely impact juvenile salmonids, while a deep intake may impact lamprey.

The preferred location for the outlet of the siphon is within the existing fish lock caisson and it is assumed this would operate as a free discharge allowing energy dissipation to be achieved through created turbulence within the pool at the bottom of the fish lock caisson.

Operationally, the siphon would first need to be primed. This would likely entail filling the lower (downstream) portion of the conduit using a small pump, then releasing that volume of water via an outlet valve, creating the siphoning effect and drawing the full design flow up and over/through the dam.

From a maintenance perspective, key issues would be ensuring the priming pump and valve were functional and that no pressure leaks were present in the system. If everything is working properly a siphon is a relatively simple system to maintain.

This alternative could function with or without flows from the existing fish lock piping system depending on what diameter siphon was ultimately selected. Additionally, this alternative may need to be combined with improvements to the downstream fish lock fishway to ultimately deliver flows to the east ladder and junction pool diffuser system.

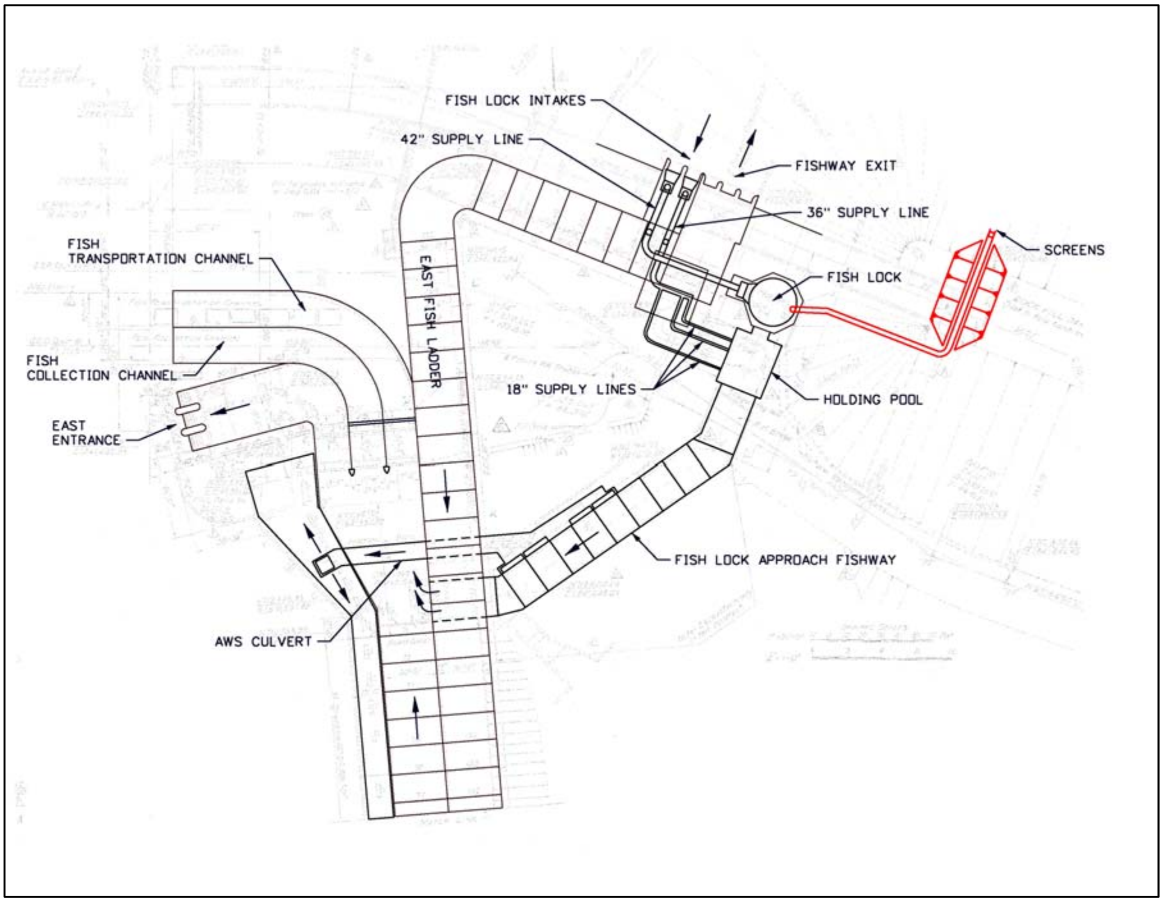


Figure 5. Concept for Alternative 1, Siphon for Additional Water to the Fish Lock

3.2.2 Alternative 2: River Wet Tap

Alternative 2 involves installing a pipe under the non-overflow structure from the base of the fish lock or a sump constructed adjacent to the fish lock extending to a point in the reservoir. The intake would daylight in the reservoir at an elevation of about 58 feet. That portion of the pipe located under the existing non-overflow structure would be double cased with the outer casing being pressure grouted in place to prevent seepage between the pipe and the existing rock. Following installation of the outer pipe, an inner pipe would be installed and grouted in place. This installation would require boring a hole about 490 feet long using directional boring procedures. A control valve and an energy dissipation system would be required in the fish lock. The pipe would be sized to provide the required flow. See Figure 6 below for location and a typical section.

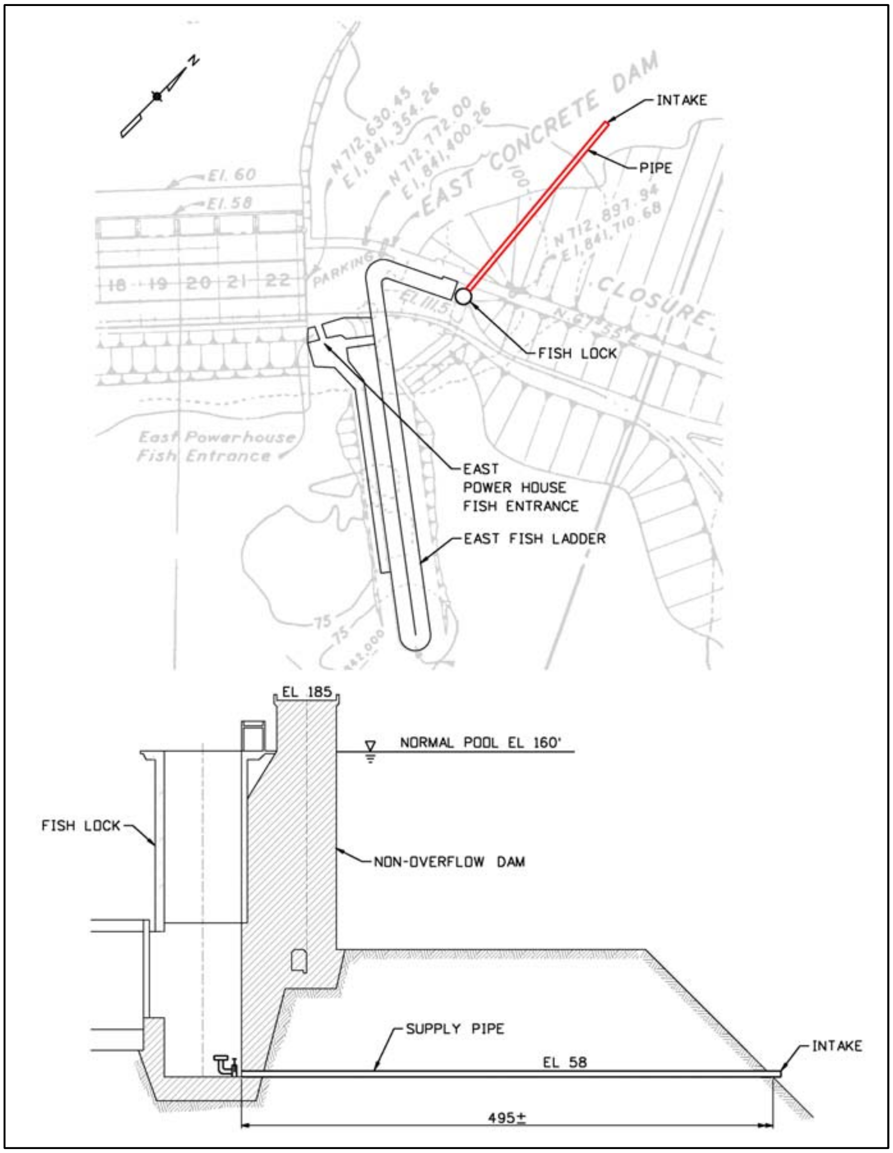


Figure 6. Concept for Alternative 2, River Wet Tap

3.2.3 Alternative 3: Ice Trash Sluice Water Tap

Alternative 3 consists of the construction of fish screens along the side or the bottom of the ice and trash sluiceway in close proximity to the downstream end of the sluiceway. The goal of this alternative would be to take screened water and route it to the AWS conduit. To reduce the length of the screens and associated structure, this feature would be located as close to the powerhouse as possible and in a location before flows in the sluiceway channel accelerate to supercritical conditions. Figure 7 shows the general location of this alternative and one of several possible routes to convey water in one or more conduits to the AWS conduit. The exact route of the conduit would be determined in the next phase of evaluation.

The use of fish screens is an important feature of this alternative. During normal operations, the ice and trash sluiceway is considered by the region to be a “fish passage” route at The Dalles Dam. Therefore, any changes to the ice and trash sluiceway cannot impact fish passage. Maintenance of the screens and associated equipment to ensure reliability could be intensive depending on the trash loads carried in the sluiceway that would be passing the screening system.

Field observations show that the discharge chute/channel has very high velocities (est. 25-50 ft/sec) that might preclude this being used as a source of water for a reliable backup system. Further hydraulic investigations would be needed to assess this concern.

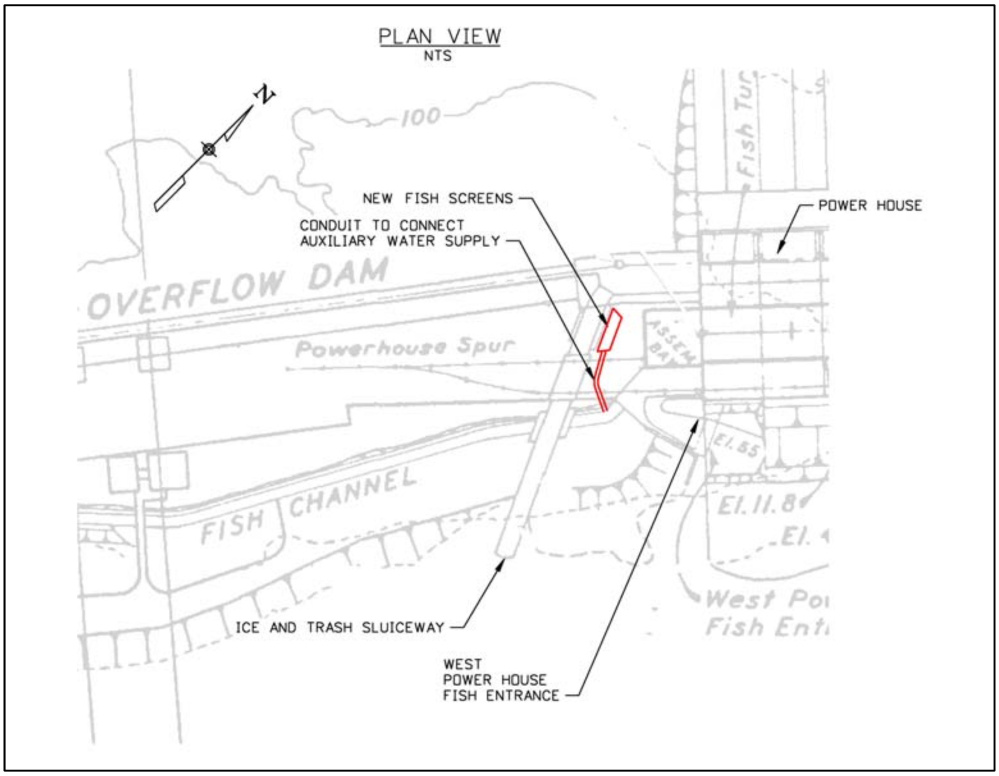


Figure 7. Concept for Alternative 3, Ice Trash Sluice Water Tap

3.2.4 Alternative 4: Fish Lock Direct Tap to Reservoir Forebay

Alternative 4 is similar to Alternative 1 except the siphon is replaced with a direct penetration of the dam, connecting the forebay with the fish lock caisson. The location of the penetration would need to be evaluated to minimize impacts to fish passage and as with the siphon will likely require screening regardless of position and configuration.

The outlet of the penetration would preferably occur within the existing fish lock caisson as a free discharge. Depending on the elevation of the outlet and the net energy head, energy dissipation would likely be achieved through turbulence within the pool at the bottom of the fish lock caisson. A deflection plate system might also be required to minimize erosional impacts to the concrete caisson.

Operationally, this system could be activated by simply opening a head gate and/or valve(s), thus allowing water to pass directly into the fish lock. Total discharge could also be controlled by throttling valves. Figure 8 shows the general location of this alternative.

From a maintenance perspective, key issues would be maintaining the valves. Otherwise, like the siphon alternative, if everything is working, this system is a relatively simple system to maintain.

This alternative could function with or without flows from the existing fish lock piping system depending on what diameter penetration was ultimately selected. Additionally, this alternative may need to be combined with improvements to the downstream fish lock fishway to ultimately deliver flows to the east ladder and junction pool diffuser system.

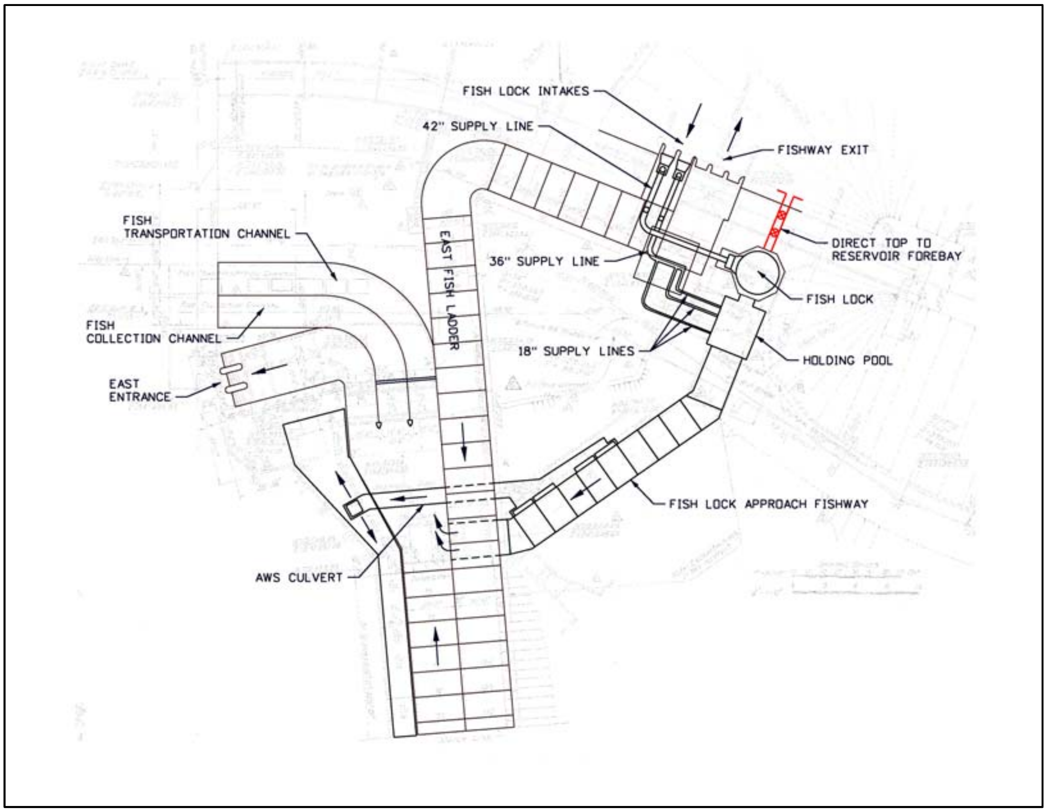


Figure 8. Concept for Alternative 4, Fish Lock Direct Tap to Reservoir Forebay

3.2.5 Alternative 5: Install Concrete Lid on Open Channel Fishway

Alternative 5 targets improvements to the downstream fishway portion of the existing fish lock system. The improvements would involve capping and sealing the existing fishway up to the fish lock caisson, thus allowing for pressurization and an increase in the available operating head of the fishway conveyance system. If pressurized, the existing fishway and AWS culvert could provide higher total discharges into the AWS conduit and subsequently into the east ladder diffuser system. This alternative would need to be combined with other alternatives (such as piping and valve improvements; new pipes) to deliver the minimum AWS backup flow rate (approximately 1,400 cfs).

From a constructability perspective, this alternative would involve casting concrete caps atop the existing fish lock approach fishway. A new set of stop logs, or an altogether new wall may also need to be constructed at the confluence of the fish lock approach fishway and the junction pool.

Operationally, the system would not require any specific actions, although stop logs need to be installed at the downstream terminus of the fish lock approach fishway. Maintenance would also be minimal; testing for leaks, etc.

Further hydraulic analysis is required to determine if this alternative could deliver the full AWS backup discharge without further enlargements of the fish lock approach fishway, or more likely, the existing 8' x 8' AWS culvert.

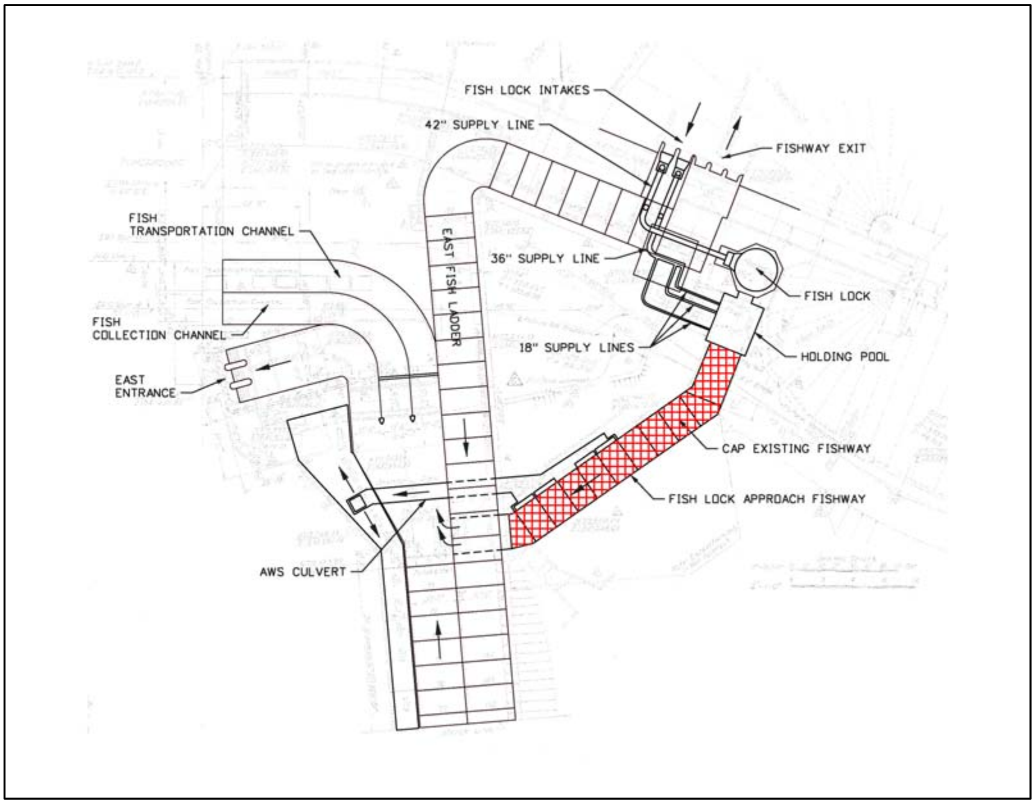


Figure 9. Concept for Alternative 5, Install Concrete Lid on Open Channel Fishway

3.2.6 Alternative 6: Stop Log Modifications at Tainter Gate No. 23

Alternative 6 consists of the modification or construction of new stop logs for spillway bay No. 23. Currently, stop logs are used to dewater the spillway bay and allow for inspection and repair of the tainter gate, if necessary. For this alternative the tainter gate would be taken out of service during the time use of the backup water supply is required. Figure 10 displays the major features of this alternative. The bottom stop log that is seated on the spillway sill would be constructed or modified to allow water to pass through fish screens that are attached to the upstream face of the stop log. Water would then flow into a slot along the face of the stop log and enter a conduit(s) that are attached to the downstream face of the stop log. This conduit would then be routed along or in the existing fish channel or directly to the AWS conduit. The capacity of the system could be 1,200-1,400 cfs, although it could be increased easily.

Normal upstream pool elevations would provide the head (energy) required for this alternative. As displayed in Figure 10, the tainter gate in spillway bay 23 would need to be in the open position when this alternative is in use.

USACE only needs to install these when the backup water supply is needed, otherwise they can be removed and operations returned to normal. Then if the back up system is in operation and maximum flow conditions start to approach the probable maximum flood, stop logs would be removed for flood control operations and dam safety considerations. Removal of some concrete or mining of concrete would most likely be required depending on the final route and sizing of the conduit or conduits. Deployment of this alternative as a backup system could take 5-7 days or longer. Large cranes would be needed for deployment. Under normal operational conditions the reliability of this alternative should be very good.

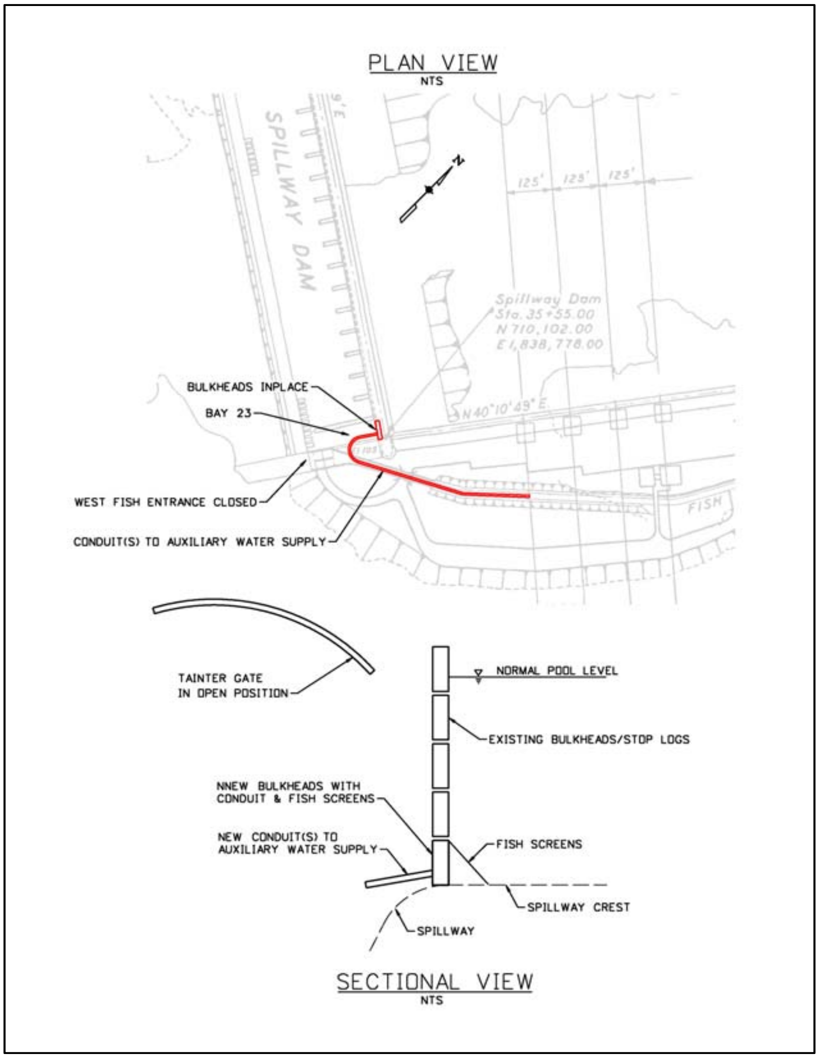


Figure 10. Concept for Alternative 6, Stop Log Modifications at Tainter Gate No. 23

3.2.7 Alternative 7: New Third Fish Turbine

Alternative 7 involved building an additional generating turbine bay that would have a maximum flow of 5,000 cfs and would continually operate so switchover time would be minimal. The location of this new third turbine bay would be at the east end of the powerhouse adjacent to generation bay No. 22. This location, as shown on Figure 11, would be above or at the site of the current visitor center, which could be located at a more secure area east of the powerhouse. A discharge pipeline would exit this new turbine bay to either the east or south directly into either the AWS conduit, the junction pool or the diffuser pool. Construction time for this addition to the powerhouse would probably exceed 24 months and be quite costly, but there may be additional benefits to the agencies involved for generating additional power. Federal Energy Regulatory Commission (FERC) permitting is not required for this federal project, but funding the project may take more than 10 years.

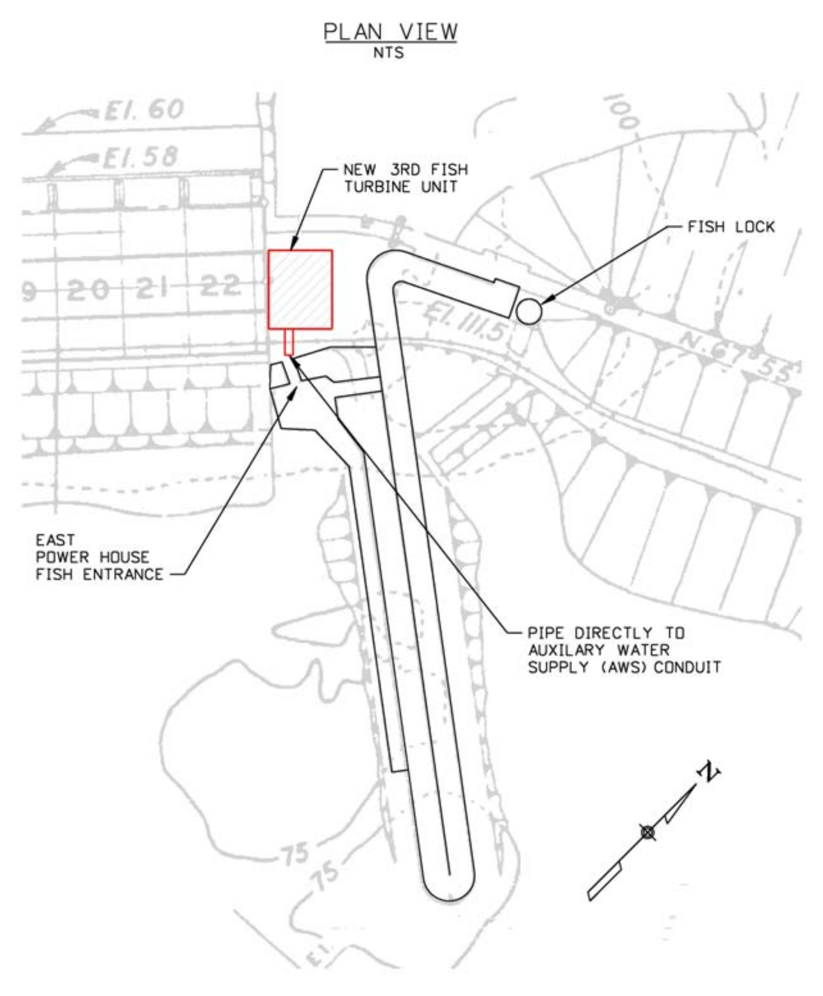


Figure 11. Concept for Alternative 7, New Third Fish Turbine

3.2.8 Alternative 8: Pipe(s) to AWS Culvert

Alternative 8 involves constructing a new large diameter (likely 48" to 72" in diameter) pipe system that would connect the existing fish lock supply intake, consisting of two vertical 8' x 8' square shafts, directly with the AWS culvert.

Connecting into the fish lock supply shafts would likely require 10 to 15 feet of horizontal concrete boring from within the fish lock valve room. A pipe (or pipes) would then be constructed from the fish lock valve room to the AWS culvert, where they could be connected directly into the culvert allowing for a pressurized system. The specific alignment of the new pipe will need to be evaluated, but one possible alignment would involve attaching it to the side of the fish lock approach fishway.

From a maintenance perspective, the system would require routine inspection and testing of intake gates and valves.

As with Alternative 5, further hydraulic analysis is required to determine if this alternative could deliver the full AWS backup discharge without further hydraulic analysis or further enlargements of the existing 8' x 8' AWS culvert.

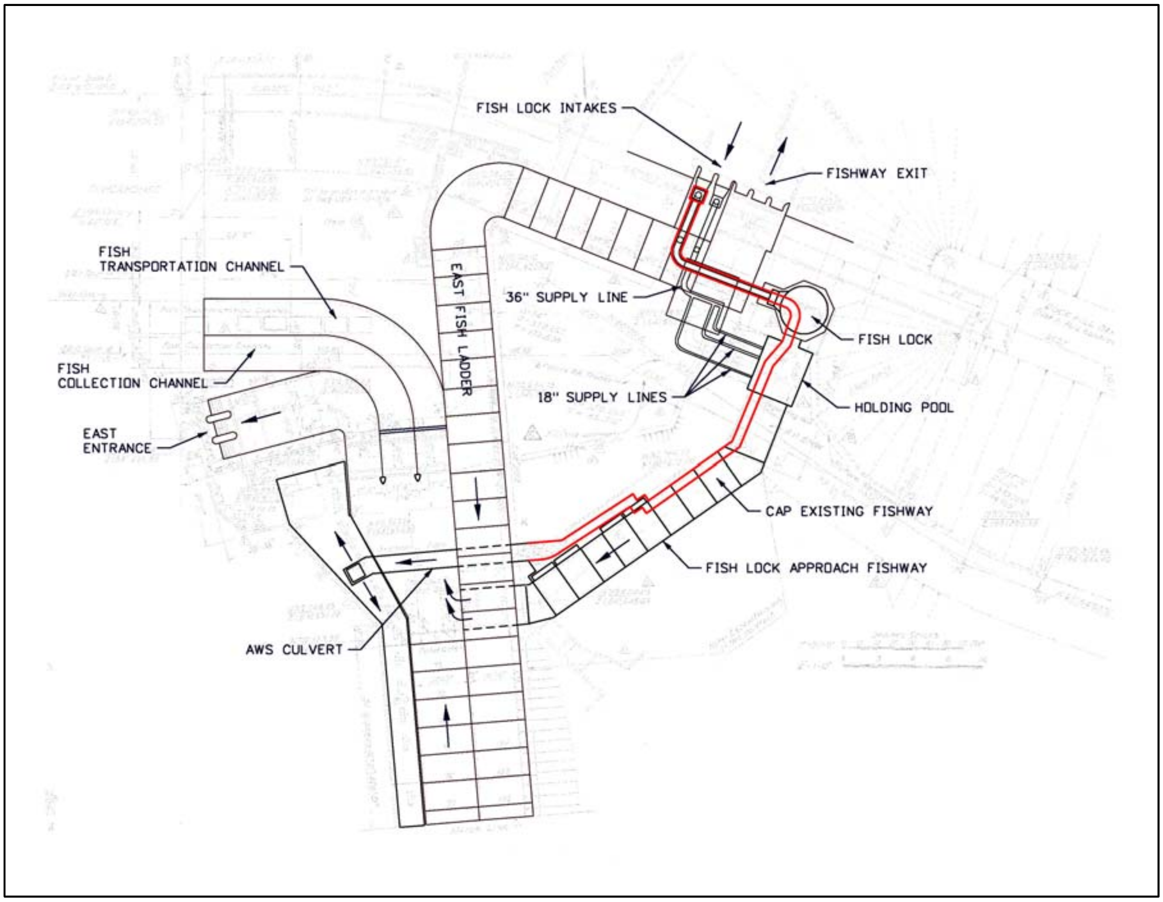


Figure 12. Concept for Alternative 8, Pipe(s) to AWS Culvert

3.2.9 Alternative 9: Remove Flow Restrictions on Current System

Alternative 9, while not likely to provide the minimum 1,400 cfs of AWS backup flow, would maximize the delivery capacity of the existing fish lock system. Construction elements could include bypassing the energy dissipation chamber in the 42-inch filling line or reconsolidating the three 18-inch lines back to the 36-inch conduit.

Other enhancements to improve flow conditions could include modifying, replacing, or eliminating some of the horizontal structural struts of weirs in the fish lock approach fishway, thus making it more hydraulically efficient.

Further hydraulic analysis is required to determine if this alternative could deliver the full AWS backup discharge without additional improvements being made elsewhere.

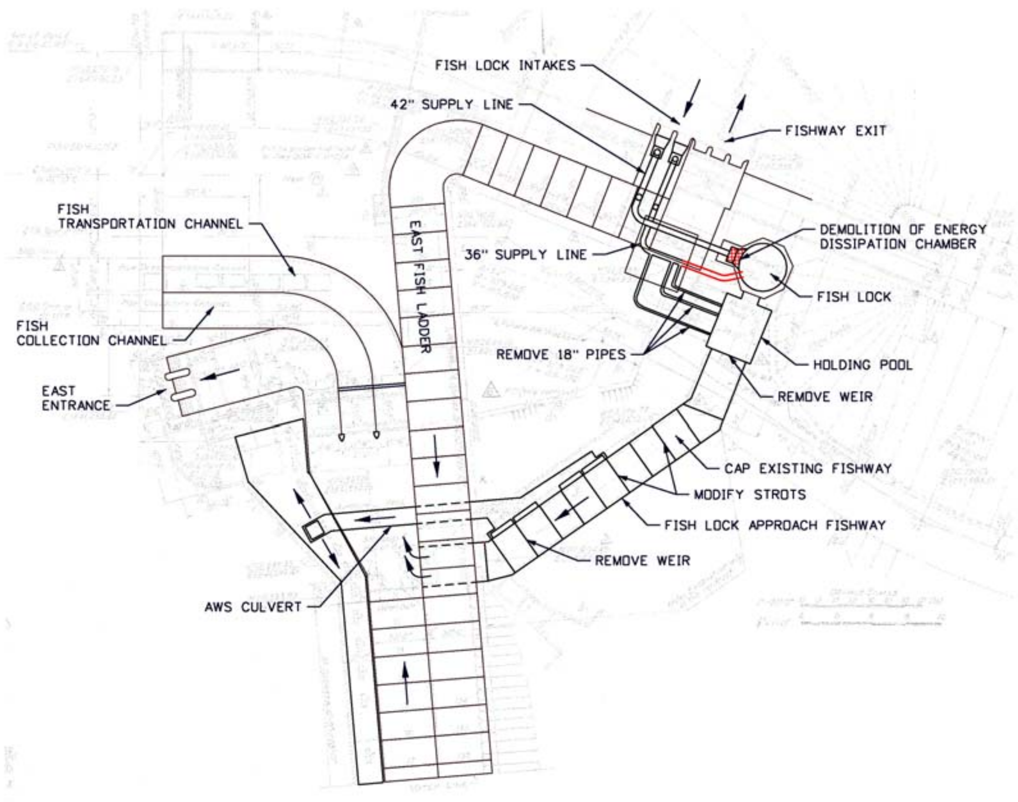


Figure 13. Concept for Alternative 9, Remove Flow Restrictions on Current System

3.2.10 Alternative 10: Single Pump/Pumphouse on East Side

Alternative 10 consists of the construction of a pump station in the cul-de-sac area with a discharge pipeline terminating at either the junction pool or the diffuser pool. The pump station would consist of a single pump with a minimum capacity of 600 cfs (assuming other fish lock piping improvements are made), the appropriate support equipment, and a suction line that could be deployed to the deep water in the cul-de-sac. This alternative could also be sized to deliver up to 1,400 cfs. It is assumed that the suction line would require screening. The discharge pipeline would be relatively short; being only a few hundred feet in length and the pipeline could be laid on the bottom of the tailwater pool. As presented here, the assumption has been made that the 42" and 36" existing pipes are fully functioning and provide water as part of the backup system.

The pump station structure would be cast-in-place concrete and would require the construction of a coffer dam. The pump driver could be either an electric motor or a diesel engine; however, because this installation is for emergency use only, maintenance is likely to be less than optimal. Therefore, the use of a diesel driver is discouraged.

Normal pump station equipment should be installed to include bridge cranes, office areas, instrumentation and control systems, switchgear and motor starters, and appropriate maintenance equipment.

The routine maintenance requirements include maintaining power to the heaters in the motor, routine rotation of all rotating components, and providing heat, as required, to the gear reducers.

The construction of this facility would be routine, with tasks familiar to the general contractor within the geographical area. However, delivery time for the large pump is likely to take 72 weeks from the receipt of approved submittals to arrive at the jobsite. The construction of the coffer dam could be complicated by the site geology.

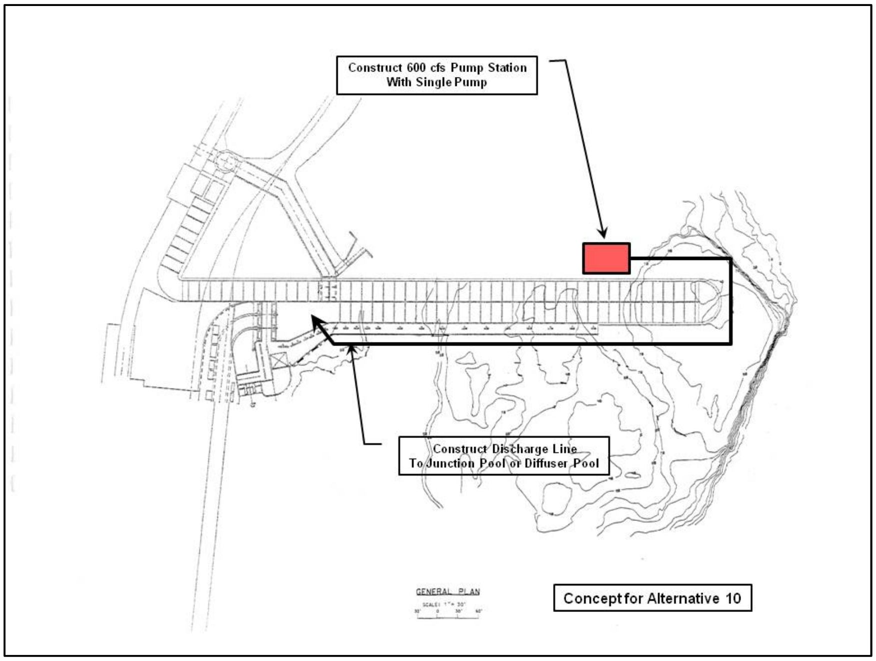


Figure 14. Concept for Alternative 10, Single Pump/Pumphouse on East Side

3.2.11 Alternative 11: Upstream Intake Tower with Siphon

Alternative 11 consists of the construction of a relatively deep water intake tower and a siphon to deliver water for the attraction water system. An intake caisson, or structure, would be built in relatively deep water to avoid the need for fish screens. The discharge from the intake tower would then be delivered to the attraction water system via a siphon system. Appropriate valves and/or gates would need to be installed for both isolation and flow control purposes. The capacity of the system would be 600 cfs, although it could be increased easily to convey 1,200 cfs. This assumes improvements to the existing piping system in the fish lock have been completed.

Construction should be relatively simple, and local contractors have experience with this type of construction in the Portland area. Maintenance of the system would consist of exercising the valves on a predetermined schedule.

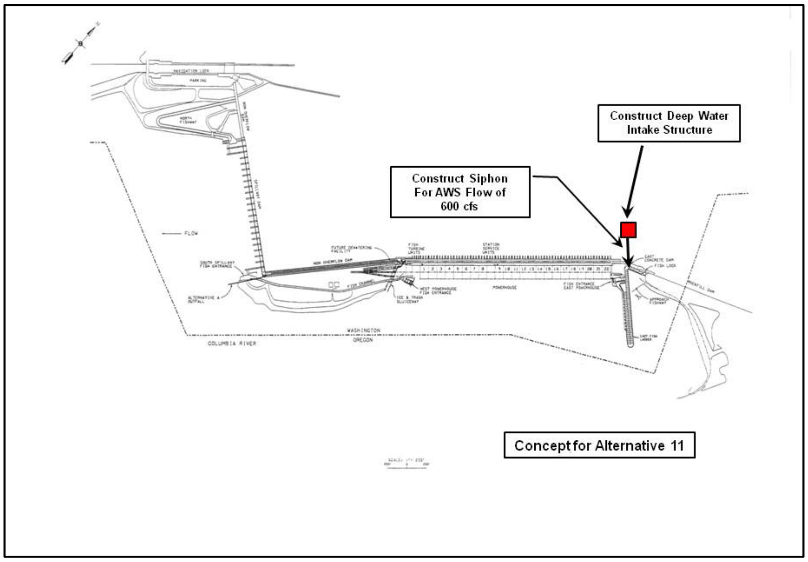


Figure 15. Concept for Alternative 11, Upstream Intake Tower with Siphon

3.2.12 Alternative 12: Floating Plant Pump Station

Alternative 12 consists of the construction of a floating pump station in the cul-de-sac or area near the existing EFL entrance with a discharge pipeline terminating at either the junction pool or the diffuser pool. The pump station would consist of a single pump with a minimum capacity of 600 cfs or larger, the appropriate support equipment, and a suction line that could be deployed to the deep water in the cul-de-sac. It is assumed that the suction line would require screening. The discharge pipeline would be relatively short; being only a few hundred feet in length and the pipeline could be laid on the bottom of the tailwater pool.

The pump station structure would be a floating unit consisting of pontoons, a superstructure, and appropriate appurtenances. The project would require the placement of at least four piles, or drilled shafts, to hold the pump station in place. The pump driver could be either an electric motor or a diesel engine; however, the fact that this installation is for emergency use only indicates that maintenance is likely to be less than optimal. Therefore, the use of a diesel driver is discouraged.

Normal pump station equipment will need to be installed to include bridge cranes, office areas, instrumentation and control systems, switchgear and motor starters, and appropriate maintenance equipment.

The routine maintenance requirements include maintaining power to the heaters in the motor, routine rotation of all of the rotating components, and providing heat, as required, to the gear reducers. The maintenance of the pontoons that are in the water would be a continuing issue with respect to the corrosion protection coating. Periodic operation of a diesel driver would be absolutely necessary.

The construction of this facility would be routine, with tasks familiar to the general contractor within the geographical area. However, delivery time for the large pump is likely to take 72 weeks from the receipt of approved submittals to arrive at the jobsite.

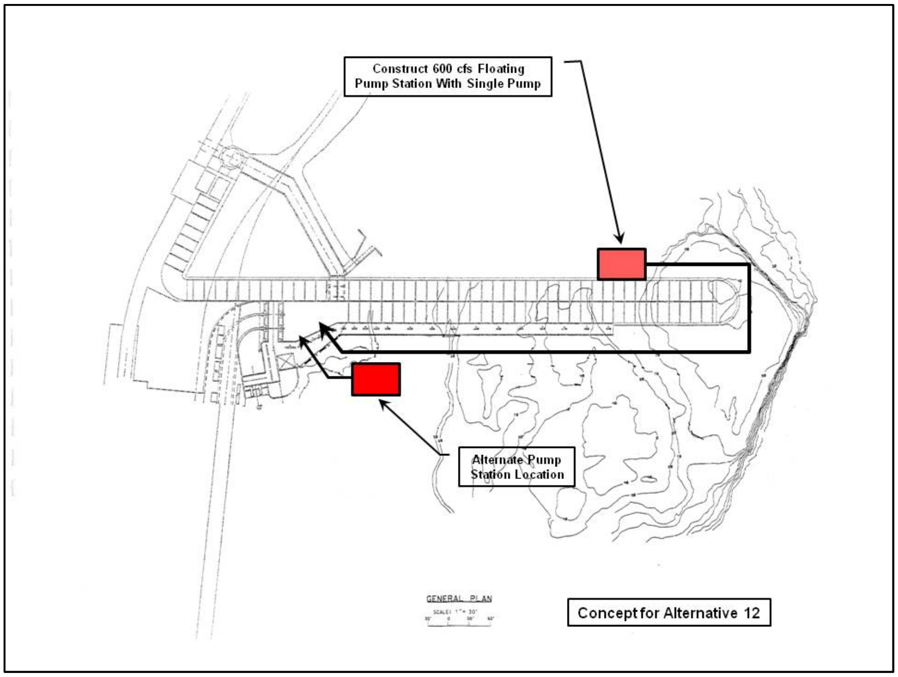


Figure 16. Concept for Alternative 12, Floating Plant Pump Station

3.2.13 Alternative 13: Fish Turbine Speed No Load

Alternative 13 is an option to run one of the existing 2,500 cfs fish turbines at speed no-load (SNL) while the adjacent fish turbine generating unit is off-line for maintenance or rebuilding. The amount of flow that the fish turbine generator at SNL can supply is assumed to be approximately 10 to 20 percent of operational flow, which is a maximum of 500 cfs. This flow rate would need to be verified to include this alternative for further study. In order to meet the assumed minimum requirements of 1,400 cfs for the AWS backup system, the fish lock improvements as discussed elsewhere would be needed. The fish lock improvements are assumed to contribute an additional 600 cfs, which would provide somewhat less than the minimum 1,400 cfs, but may be acceptable by the agencies for a short duration. The length of an allowable outage is currently being determined by the agencies. This alternative could also be used in conjunction with many of the other options of providing additional flow to the fish lock. The constructability factor associated with this option is rated highly (in the matrix) as there is minimal labor to implement the system and the switchover time is very quick. Unknowns for this alternative are the possibility of a runaway turbine and how the heat that may be produced would be dissipated.

3.2.14 Alternative 14: Ice and Trash Sluice Intake Channel Water Tap and Diversion

Alternative 14 consists of the construction of a bulkhead across the ice and trash sluiceway between units 19 and 20 and modification of the sluiceway channel above unit 22 to direct flow into a conduit or conduits that would be routed to AWS conduit or perhaps the existing fish lock (after modifications have been made). Flow entering the sluiceway from the upstream reservoir would be diverted in the opposite direction of the normal flow pattern for this structure. Figure 17 displays the location of this proposed alternative and one possible routing of the discharge conduit(s).

In this alternative, the existing gates for the sluiceway could be used to control flows entering the diversion. One large diameter conduit or several smaller pipes, 4-5 feet in diameter, could be used to convey water to the AWS conduit.

Screening would most likely be required just upstream of where flow would enter the ice and trash sluiceway. Debris handling might be of concern for this alternative, but the overall reliability would be considered excellent.

The construction of this alternative would be fairly routine, with tasks familiar to the general contractor within the geographical area. The most difficult construction component would be the modification of existing concrete to accept the new large discharge conduit (s).

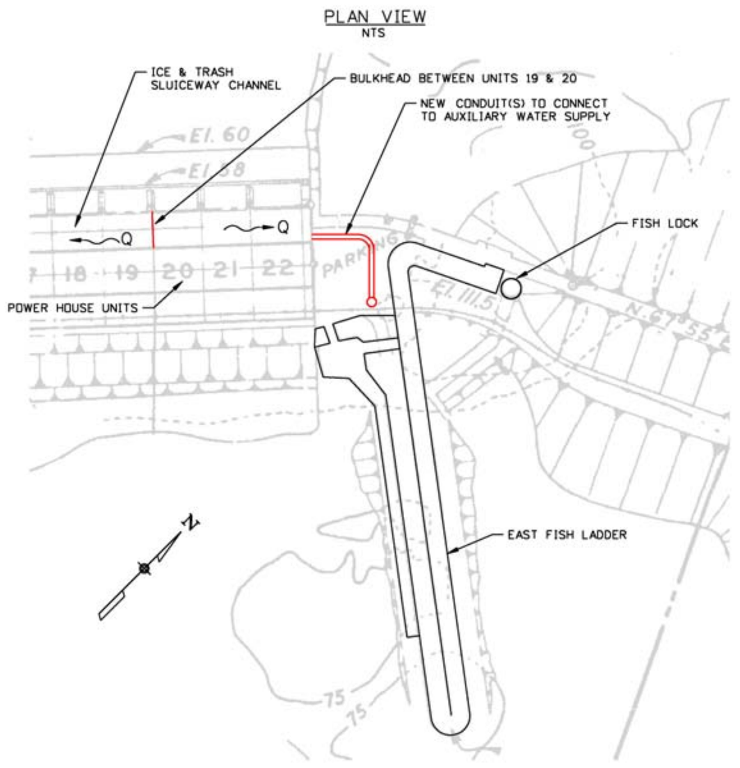


Figure 17. Concept for Alternative 14, Ice and Trash Sluice Intake Channel Water Tap and Diversion

3.2.15 Alternative 15: Siphon with Entrance at Fish Ladder Exit to AWS Conduit

Alternative 15 is similar to the siphon described in Alternative 1; however, instead of discharging into the fish lock caisson, the siphon piping would be directly connected to the AWS conduit. The exact size and location of the siphon piping would need to be determined by a more detailed analysis, but it would have to operate within the maximum of 15 to 20 foot head differential available between the forebay and the crest of the siphon. Potential alignments of the siphon penetration could again include trenching through the upper 10-15 feet of the embankment dam, passing through existing openings at/around the fishway exit or boring through the monolith itself. The continuation of the siphon piping might follow the east fishway itself down to where it meets the AWS conduit.

The position of the siphon intake would need to be evaluated to minimize impacts to fish passage. Screening may be required regardless of where the intake is located in the water column as a shallow intake may adversely impact juvenile salmonids, while a deep intake may impact lamprey.

If energy dissipation is required at the connection point of the siphon piping and AWS conduit, a dissipation chamber or Howell Bunger-type valve may be viable options.

Operationally, the siphon would first need to be primed. This would likely entail filling the lower (downstream) portion of the conduit using a small pump, then releasing that volume of water via an outlet valve, thus creating the siphoning effect and drawing the full design flow up and over/through the dam.

From a maintenance perspective, key issues would be ensuring the priming pump and valves were functional and that no pressure leaks were present in the system. Otherwise, the siphon is a relatively simple system to maintain.

This alternative could function with or without flows from the existing fish lock piping system depending on what diameter siphon was ultimately selected.

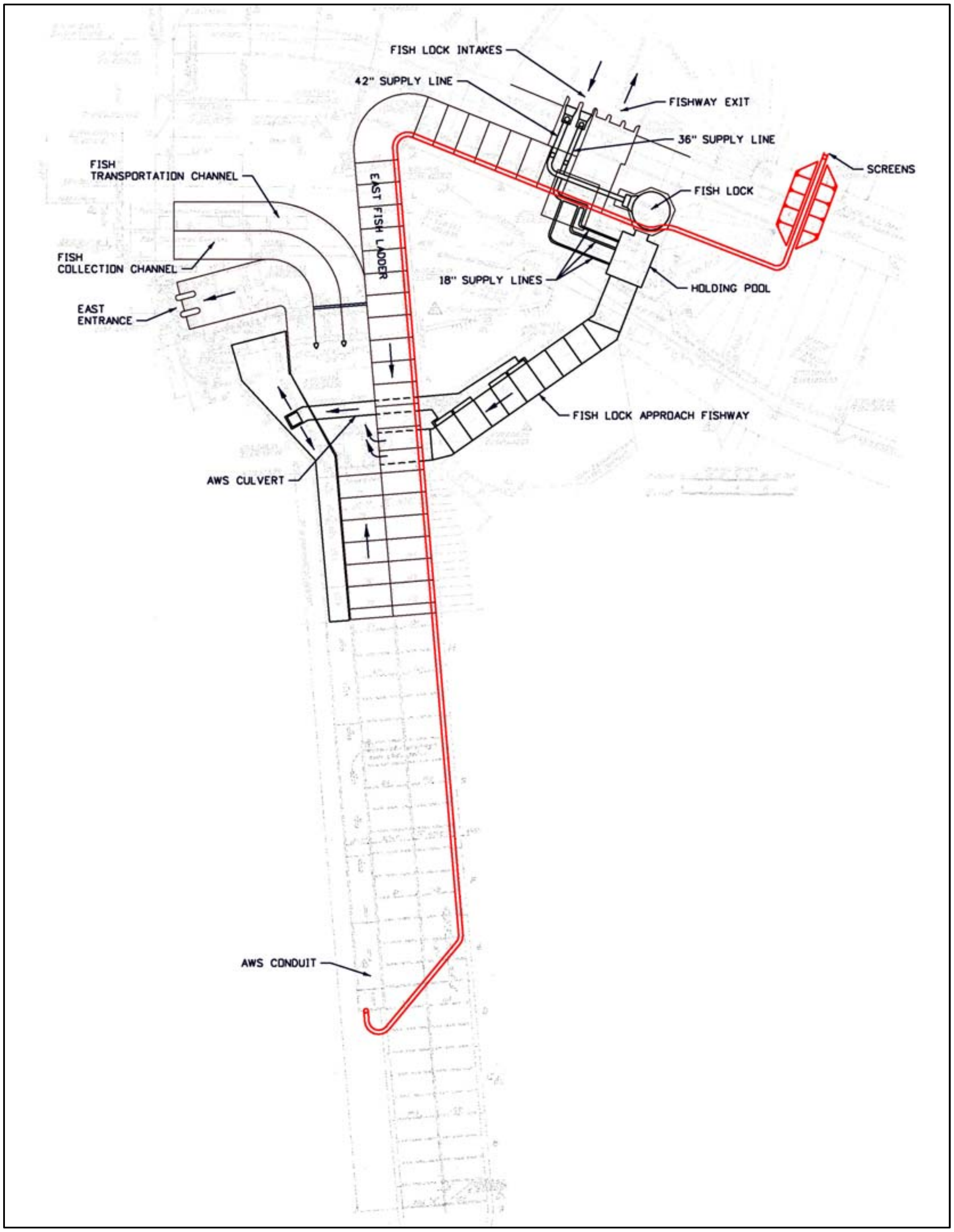


Figure 18. Concept for Alternative 15, Siphon with Entrance at Fish Ladder Exit to AWS Conduit

4.0 Evaluation of Alternatives

4.1 Introduction

Per guidance from the USACE, all alternatives developed as a result of the brainstorming session were to be ranked and compared with each other. The alternatives that appear to have the most merit and highest ranking scores could be further evaluated and studied in the next phase of the project. Evaluation factors consisted of the following:

- Constructability
- Estimated construction time
- Reliability
- Maintenance aspects
- Biological and fish agency concerns
- Fish passage requirements
- Impacts to hydropower production
- Time to implement backup system
- Disruption to project operations to implement backup system
- Construction cost

With the exception of construction cost and lost power revenues, all evaluation factors were given a ranking score between 1 and 4, with 1 being an unfavorable score and 4 being a highly favorable score. The maximum score for any alternative could be 32 points. The composite scores displayed in Table 2 represent the average score of HDR's and USACE's product development teams. A total of 15 team members participated in the evaluation and scoring process. Table 2 displays the results of the ranking and scoring evaluation.

4.2 Matrix Evaluation Factors

This section describes the evaluation factors that were used to score the alternatives that were developed during the brainstorming session. Table 2 shows the evaluation matrix results.

> ***Fish Passage Requirements*** evaluation factors were based on the ability of the alternative to keep the EFL system within compliance and meet fish passage criteria while, at the same time, causing no negative environmental impact to fish in the Columbia River. Some of the factors that were considered pertained to main powerhouse units in relationship to smolt locations in the reservoir and water column, the ability of smolts to survive in the diversion system, and overall induced stress to smolt and adults. Consideration for Lamprey passage is also mentioned in some alternatives.

Fish Agency/Biological Concerns evaluation factors were based on the expected concerns that regional fishery agencies would have with the proposed alternative. A low score indicated that it is expected that agencies will have considerable concerns, while a high score indicated little or no concern is expected.

Estimated Construction Time evaluation factors considered the overall difficulty or ease of constructing the alternative. If the total construction time was in excess of 24 months a relatively low score was assigned; whereas, if the total construction time was less than 6 months it was scored highly. Scoring criteria is displayed on the evaluation matrix.

Time to Implement the Backup System considered factors that would allow for the backup system to be fully functional and providing water to the AWS. If the time to implement the alternative was relatively brief (hours) it scored relatively high; whereas, if the alternative took a long time (days) to fully implement, it scored relatively low.

Construction Cost was considered in the evaluation of each alternative. Rating score was based on *high, medium, and low* construction cost. Actual costs were not developed for each alternative rather expected costs considering scope and complexity relative to the expected costs of other alternatives were used to rate the alternatives. For example, the cost of the pumping plant was ranked as “high.”

Constructability evaluation factors considered the overall difficulty or ease of constructing the alternative. If components needed to be fabricated in smaller manageable parts and then assembled in place to make a larger component, and overall construction would be very difficult and highly complex, this received a relatively low score. If the major components of the alternative could be installed or assembled in one or two pieces and construction was relatively straightforward, the alternative received a higher ranking score.

Disruption to Project Operations (Post Construction) was defined as the ability to operate and start up the backup system without major negative impacts to the operations staff at The Dalles Dam. For example, a high score could be applied to a system that was easy to implement, e.g., open a gate or a valve. A low score would indicate several groups of project staff would be required and would take a considerable amount of time to implement.

Reliability evaluation factors were based on the overall ease to operate the backup system. For example, if the alternative had multiple complicated steps, required numerous staff to implement the backup system, and needed to be monitored on a continual basis, it received a low ranking score when compared to an alternative that could be activated in one step by very few USACE staff and require little or no monitoring and adjustments.

Maintenance Aspects evaluation factors considered the overall maintenance of the alternative. For example, if a hydraulic controller system was to be continually submerged or needed to be inspected weekly, it received a low ranking score. But, an alternative that had yearly maintenance or components that were simple to maintain received a high ranking score.

Loss of Power Revenues were considered in the overall evaluation of each alternative but did not receive a ranking score. None of the alternatives resulted in additional power losses.

Table 2. Dalles East Fish Ladder AWS Backup Evaluation Matrix Results

USACE TO #26 - Brainstorming Meeting - December 8, 2010

Criteria for Ranking

[1]Est. Construction Time:	[2]Implement/ Switchover Time:	[3] Cost:
< 6 months = 4	hours = 4	high = 0
6-12 months = 3	days = 3	medium-high = 1
12-18 months = 2	weeks = 2	medium = 2
18-24 months = 1	months = 1	low-medium = 3
24+ months = 0		low = 4

Notes:

1. Scoring Definition: N/A = 0; Poor = 1; Fair = 2; Good = 3; Excellent = 4

2. Total Scores: Poor = 8; Fair = 16; Good = 24; Excellent = 32

Alternatives			Rated Item	Rated Item	Rated Item	Rated Item	Rated Item	Rated Item	Rated Item	Rated Item			
								Post-Construction					
No.	Description	Fish Passage Requirements	Fish Agency/ Biological Concerns	Estimated Construction Time[1]	Implement/ Switchback Time[2]	Cost[3]	Constructability	Disruption to Project Operations	Reliability	Maintenance Aspects	Miscellaneous Concerns	Total Score	Ranking
1	**Siphon for Additional Water to the Fish Lock** (pipe or use existing adit)	Fish screens need to be considered for siphon intakes	3	2	4	4	3	4	3	3	- Rehab fish lock - Priming pump - Exercise valves	26	3
2	**River Wet Tap** (boring tunnels under dam to increase water to Fish Lock)	Fish screens need to be considered for siphon intakes	3	1	4	0	2	4	4	4	- Deep water intake (lamprey) - Construction - mining under dam into water, dam safety	22	8
3	**Ice Trash Sluice Water Tap** (either below or along side)										- Not rated due to biological and physical constraints		
4	**Fish Lock Direct Tap to Reservoir Forebay**	Fish screens required	3	2	4	2	3	4	4	4	- Dam safety - mining through dam - Underwater construction	26	5
5	**Install Concrete Lid on Opern Channel Fishway**										- Not rated - use as a potential component with Alternatives 1, 2, and 4.		
6	**Tainter Gate # 23** (modify stoplogs with a pipe to AWS culvert)	Fish screens required	3	2	2	2	3	2	3	3	- Assumes screen is part of fabricated unit.	20	9
7	**New Third Fish Turbine** (with maximum flow of 5,000 cfs ; federally owned and operated)	Fish screens or mitigation may be required depending on depth of intake	3	0	4	0	0	4	3	1	- Time to construct - Major disruption to overall operations during construction - Buy in from NW Power Council	15	11
8	**Pipe(s) to AWS Culvert** (using existing 8' x 8' opening; full length pipe)	Fish screens	3	1	4	3	3	4	4	4	- Energy dissipation - Isolate east entrance - Exercise valves	26	4
9	**Remove Flow Restrictions on Current System** (at fish lock and downstream)										- Not rated - use as a potential component for Alternatives 1, 2, 4, and 5.		
10	**Single Pump/Pumphouse on East Side** (cul de sac area)	Fish screens will be required based on depth variables	2	0	4	0	3	4	1	0	- Sturgeon in cul de sac (spawning or congregation area?) predator issues - Constructed in the wet -Some minimal power use - High maintenance	14	12

Table 2. Continued.

USACE TO #26 - Brainstorming Meeting - December 8, 2010

Criteria for Ranking

[1]Est. Construction Time:	[2]Implement/ Switchover Time:	[3] Cost:
< 6 months = 4	hours = 4	high = 0
6-12 months = 3	days = 3	medium-high = 1
12-18 months = 2	weeks = 2	medium = 2
18-24 months = 1	months = 1	low-medium = 3
24+ months = 0		low = 4

Notes:
1. Scoring Definition: N/A = 0; Poor = 1; Fair = 2; Good = 3; Excellent = 4
2. Total Scores: Poor = 8; Fair = 16; Good = 24; Excellent = 32

Alternatives			Rated Item	Rated Item	Rated Item	Rated Item	Rated Item	Rated Item	Rated Item	Rated Item			
								Post-Construction					
No.	Description	Fish Passage Requirements	Fish Agency/ Biological Concerns	Estimated Construction Time[1]	Implement/ Switchback Time[2]	Cost[3]	Constructability	Disruption to Project Operations	Reliability	Maintenance Aspects	Miscellaneous Concerns	Total Score	Ranking
11	**Upstream Intake Tower with Siphon**	Assumes no screens needed	2	1	4	2	3	4	3	3	- 'Predator habitat	22	7
12	**Floating Plant Pump Station** (located at either side of EFL)	fish screens will be required	2	0	4	1	3	4	1	0	- Anti-perching needs; predator issues - Pump maintenance is a major issue.	15	10
13	**Fish Turbine Speed No Load** (run one fish turbine SNL while other is being prepared in combination with fish lock improvements)	-no screens required for turbine - Fish lock - screen would apply	3	4	4	4	4	4	2	3	- Surface oriented attraction for fish lock - Turbine runaway condition is possible - Amount of heat produced during long-term operation - Turbine reliability is an issue - Assumes 10-20% normal discharge is possible - Monitor turbine temperature and other parameters - Assumes fish screens are not present at fish intake	28	1
14	**Ice and Trash Sluice Intake Channel Water Tap and Diversion** (uses water from Units 20-22)	- exclusion screens would be needed in front of units 20-22	3	1	4	2	3	4	4	2	- might require multiple pipes - more yearling during summer months - need for trash rack and screen cleaning system - dewatering system?	23	6
15	**Siphon with Entrance at Fish Ladder Exit to AWS Conduit** (Deep Intake)	- Fish screens need to be considered for siphon intakes - Adult fish passage exit considerations	2	3	4	4	4	4	3	3	- Priming pump - Exercise valves	27	2

Matrix Assumptions:
- Alternatives would supplement the existing 36" and 42" diameter supply pipes.
- Power Production Impacts were included in evaluation, but there were no impacts.
- Assumes both units offline.
- If more than one alternative has the same Ranking Score, higher ranking given to alternative with lowest Cost score

5.0 UPDATED CONSTRUCTION COST ESTIMATES

5.1 Introduction

Construction cost estimates were prepared by INCA for the alternatives they presented in their 1997 report. The report was titled "The Dalles Dam Auxiliary Water System Upgrade Alternatives Evaluation." The INCA cost estimates for Alternatives A and B have been indexed to 2010. Their spreadsheet and quantities were used as presented with changes made to the unit prices. New unit price values were developed by indexing the INCA costs to 2010 and then comparing them to costs from other studies related to the AWS that had been indexed to 2010 as well as from current unit costs available from the Oregon Department of Transportation cost database. Alternative A was titled "Forebay Intake with Screen Structure." Alternative B was titled "Tailrace Pump Station at East Fishway."

5.2 Alternative A—Updated Cost Estimate

Alternative A would consist of a gated intake structure in the fish lock monolith with an elevated vertical V-screen dewatering facility downstream of the east non-overflow dam. The intake would be mined through the fish lock monolith and a new bridge deck constructed across the intake channel. A guide wall would extend into the forebay between the fishway exit and the intake. Two large tainter gates would be located just downstream of the bridge control discharge into the intake channels. An elevated dewatering screen facility, at the same elevation as the intake, would be constructed with a large sump under the screen structure with a penstock, which carries 2,500 cfs to the diffusion pool for the fish ladder. The cost sheet below (Table 3) contains updated unit costs and cost totals. The total cost computed by INCA (in 1997 dollars) for Alternative A was $25,494,861. The 2010 cost, as computed by HDR, is $45,409,916. Table 3 displays the current cost information for Alternative A.

Table 3. Alternative A (2010 Costs)

The following is an estimate of contstruction cost, including contingency to account for uncertainty in the development fo the design and the unit prices. Costs for operation and maintenance have been included.

Item	Description	Unit	Unit Price	Qty	Contingency	Total
	Intake					
1	Concrete Demolition - Fish Lock	CY	**$3,272**	1,550	30%	$ 6,593,080
2	Reinforced Concrete - Channel, Interior	CY	**$668**	1,350	30%	$ 1,172,340
3	Reinforced Concrete - Aerial Span	CY	**$437**	490	30%	$ 278,369
4	Reinforced Concrete - Beams & Columns	CY	**$426**	46	30%	$ 25,475
5	Structural Steel - Aerial Span	LBS	**$2.00**	63,000	30%	$ 163,800
6	Aerial Span - Hoist	LS	**$696,000**	1	30%	$ 904,800
7	Trashrack & Trashrack Support	EA	**$104,000**	1	30%	$ 135,200
8	Trashrake/Gantry Crane	EA	**$348,000**	1	30%	$ 452,400
9	Stoplogs & Guides	EA	**$174,000**	2	30%	$ 452,400
10	Tainter Gates	EA	**$244,000**	2	30%	$ 634,400
11	Guidewall	LS	**$418,000**	1	50%	$ 627,000
					Subtotal	**$ 11,439,264**
	Screen Structure					
12	Soil Excavation & Pavement Removal	CY	**$30**	2,910	30%	$ 113,490
13	Rock Excavation	CY	**$110**	3,841	30%	$ 549,263
14	Concrete Backfill (2500 psi)	CY	**$110**	250	30%	$ 35,750
15	Reinforced Concrete - Mat/Slab	CY	**$185**	1,766	30%	$ 424,723
16	Reinforced Concrete - Exterior Walls & Columns	CY	**$426**	3,984	30%	$ 2,206,339
17	Reinforced Concrete - Roof Deck	CY	**$426**	1,552	30%	$ 859,498
18	Reinforced Concrete - Channel, Interior	CY	**$520**	2,628	30%	$ 1,776,528
19	Steel Walkways and Stairways	LBS	**$1.70**	131,144	30%	$ 289,828
20	5-Ton Bridge Crane & Hoist	LS	**$77,000**	1	30%	$ 100,100
21	Support Track, Beams, & Rails	LS	**$34,000**	1	30%	$ 44,200
22	Installation	LS	**$149,000**	1	30%	$ 193,700
23	Screen Maintenance Crane	LS	**$70,000**	1	30%	$ 91,000
24	Access Elevator	LS	**$209,000**	1	30%	$ 271,700
25	Primary Control Weirs	EA	**$29,000**	30	30%	$ 1,131,000
26	Secondary Control Weirs	EA	**$29,000**	12	30%	$ 452,400
27	Juvenile Fish Flushing System	LS	**$271,000**	1	30%	$ 352,300
28	Vertical Stainless Steel Screens	SF	**$139**	4,848	30%	$ 876,034
29	Vertical Aluminum Perforated Plate	SF	**$21.00**	4,848	30%	$ 132,350
30	Vertical Screen Cleaner System	LS	**$536,000**	1	30%	$ 696,800
31	Lighting Fixtures	LS	**$31,000**	1	30%	$ 40,300

Table 3. Continued

Item	Description	Unit	Unit Price	Qty	Contingency	Total
	Intake					
32	Conduit & Wire	LS	**$72,000**	1	30%	$ 93,600
33	Equipment Connections	LS	**$111,700**	1	30%	$ 145,210
34	Devices	LS	**$11,000**	1	30%	$ 14,300
35	Miscellaneous Material	LS	**$32,000**	1	30%	$ 41,600
					Subtotal	**$ 10,932,013**
	Penstock					
36	Pipe - 15 ft Diameter	LF	**$4,000**	105	30%	$ 546,000
37	90 Degree Elbow - 15 ft Diameter	EA	**$31,500**	2	30%	$ 81,900
38	Transition - 15 ft Diameter to 8 ft x 7 ft Rectangle	EA	**$33,400**	1	30%	$ 43,420
39	Conduit Liner - 8 ft x 7 ft Rectangle	LF	**$2,100**	96	30%	$ 262,080
40	Concrete Encasement	CY	**$426**	250	30%	$ 138,450
					Subtotal	**$ 1,071,850**
	Diffusion Chamber					
41	Steel Fabrication	LBS	**$1.70**	101,300	30%	$ 223,873
42	Rock Excavation	CY	**$110**	660	40%	$ 101,640
43	Concrete Backfill	CY	**$110**	160	20%	$ 21,120
44	Concrete Demolition - Junction Pool	CY	**$760**	100	30%	$ 98,800
45	Reinforced Concrete - Channel, Interior	CY	**$520**	700	30%	$ 473,200
46	Closure Gates & Guides	EA	**$278,000**	4	30%	$ 1,445,600
					Subtotal	**$ 2,364,233**
	Juvenile Bypass					
47	Juvenile Bypass Flume and Supports	LF	**$1,100**	5,680	40%	$ 8,747,200
48	Flume Outfall	LF	**$2,200**	150	30%	$ 429,000
					Subtotal	**$ 9,176,200**
				Subtotal (Capital Cost)		**$ 34,983,560**
49	**Mobilization / Demobilization**	LS	$ 3,498,356	10%		$ 3,498,356
					Subtotal	**$ 3,498,356**
				Total (Capital Cost)		**$ 38,481,916**
	Operations and Maintenance (NPV)					
	Discount Rate	4.125%				
	Life in Years (service life)	30				
50	Operation		$ 244,028	$/yr		$ 4,157,000
51	Maintenance		$ 162,685	$/yr		$ 2,771,000
					Subtotal	**$ 6,928,000**
					Total	**$ 45,409,916**

5.3 Alternative B—Updated Cost Estimate

Alternative B would consist of a pumphouse next to the East Fishway, adjacent to the existing junction pool. The pump house would include a lower-level intake conduit, intake channel, forebay, pump house, and afterbay. The intake would be located at a depth of 60 feet below minimum tailwater and no fish screen would be required. A channel would convey the water to the pump house. The pump house forebay would contain a trash rack for debris and intake stop logs. An outdoor gantry crane would be provided for stop log handling. An indoor crane would provide for handling and loading inside the pump house. The pump house would contain three vertical propeller pumps with a capacity of about 375,000 gpm (833 cfs) each. The pumps would discharge into an afterbay, then to the auxiliary water conduit through gated openings. The cost sheet below (Table 4) contains updated unit costs and cost totals. The total cost computed by INCA (in 1997 dollars) for Alternative B was $26,267,258. The 2010 cost, as computed by HDR, is $40,626,834. Table 4 displays the current cost information for Alternative B.

Table 4. Alternative B (2010 Costs)

The following is an estimate of contstruction cost, including contingency to account for uncertainty in the development of the design and the unit prices.

Item	Description	Unit	Unit Price	Qty	Contingency	Total
	Intake					
1	Intake Channel Rock Excavation	CY	**$110**	15,400	30%	$ 2,202,200
2	Intake Walls - Concrete	CY	**$426**	1,225	30%	$ 678,405
3	Intake Conduit	TN	**$3,500**	158	30%	$ 718,900
					Subtotal	**$ 3,599,505**
	Pumphouse					
4	Cofferdam Construction and Removal	LS	**$3,149,000**	1	30%	$ 4,093,700
5	Pumphouse Rock Excavation	CY	**$110**	2,667	30%	$ 381,381
6	Pumphouse - Structure Concrete	CY	**$426**	9,218	30%	$ 5,104,928
7	Pumphouse - Building Concrete	CY	**$426**	1,200	30%	$ 664,560
8	Diffuser Pool - Concrete	CY	**$185**	1,040	30%	$ 250,120
9	Pumphouse Piping	LF	**$542**	150	30%	$ 105,690
10	Pumphouse Misc. Building Costs	SF	**$43.30**	4,800	30%	$ 270,192
11	Pumps / Motors	EA	**$3,750,000**	3	30%	$ 14,625,000
12	Check Valves	EA	**$167,000**	3	30%	$ 651,300
13	Bridge Crane	EA	**$70,000**	1	30%	$ 91,000
14	Trackrack	EA	**$505,000**	1	30%	$ 656,500
15	Trashrake	EA	**$139,000**	1	30%	$ 180,700
16	Stoplogs	EA	**$258,000**	1	30%	$ 335,400
17	Stoplog Guides	EA	**$100,000**	3	30%	$ 390,000
18	Closure Bulkheads & Guides	EA	**$209,000**	4	30%	$ 1,086,800
19	Electrical Power Supply	LS	**$1,183,000**	1	30%	$ 1,537,900
20	Gantry Crane	EA	**$174,000**	1	30%	$ 226,200
21	Station Auxiliary System	LS	**$209,000**	1	30%	$ 271,700
					Subtotal	**$ 30,923,071**
					Subtotal (Capital Cost)	**$ 34,522,576**

Table 4. Continued.

Item	Description	Unit	Unit Price	Qty	Contingency	Total
22	**Mobilization / Demobilization**	LS	$3,452,258	1	10%	$ 3,452,258
				Total (Capital Cost)		**$ 37,974,834**
	Operations and Maintenance (NPV)					
	Discount Rate	4.125%				
	Life in Years (service life)	30				
23	Operation		$83,290	$/yr		$ 1,419,000
24	Maintenance		$72,380	$/yr		$ 1,233,000
					Subtotal	**$ 2,652,000**
					Total	**$ 40,626,834**

5.4 Basis of Estimate

Techniques used to update the cost estimates for Alternatives A and B from the 1997 INCA Report were identical. Initially all of the INCA unit prices were indexed to 2010 using an inflation factor of 1.3919. Cost from the 1004 EBASCO *Study of AFA Auxiliary Water Supply, The Dalles Project Improvements for Endangered Species*, were indexed to 2010 along with the costs from the HDR, 2009 Letter Report, *The Dalles East Fish Ladder Auxiliary Water Backup System*, which was reviewed and unit costs applicable to the current cost estimate were included for evaluation and use. Costs from the 2009 State of Oregon, Oregon Department of Transportation, *Average Bid Item Prices Database* was used to evaluate cost for concrete and steel. Costs from the references above were compared to the INCA-indexed costs and the unit costs were adjusted to reflect what appeared to be the best available information. Those items with quantities available were evaluated and selected unit cost generally differed from the indexed INCA unit cost. Lump sum cost from the INCA estimate were indexed and generally used without additional evaluation due to the lack of information related to quantity and configuration of the individual items. An exception being the pump for which an estimate for a 370,000 gpm pump, motor, and gear was supplied by Flowserve Corp. at $3,750,000, which was used instead of the three pump system assumed by INCA. The INCA unit costs were updated with the new unit costs. Unit cost contingencies were adjusted based on the level of comfort for each unit cost, and an item cost was computed. Mobilization and demobilization was assumed to be 10% of the subtotal (capital cost). Mobilization and demobilization was added to obtain the total (capital cost).

6.0 CONCLUSIONS

All of the alternatives evaluated in this report are the results of the Brainstorming Meeting that was conducted on December 8, 2010. Based on the input of experienced engineers from USACE and HDR, the alternatives appear to be capable of providing a reliable backup system for the EFL AWS. All alternatives presented in this report will require additional engineering and biological evaluations. Retrofitting a backup water system into The Dalles Dam presents unique challenges to USACE.

Improvements to the existing fish lock piping and valves should be considered.

Conceptual alternatives that consider modification to the fish lock and its fishway and the potential use of a large siphon appear to have merit at a relatively low cost.

Based on the evaluation matrix presented in this report, further technical evaluation of the top 4 or 5 alternatives is warranted. Of a maximum possible score of 32 points, Alternative 13 was the highest scored alternative with 28 points; the fifth ranked alternative had a score of 26 points.

If USACE Portland District decides to adopt and implement any of the ranked alternatives that were included in the matrix, additional analysis will be required. This should include refined investigations of the hydraulic, structural, electrical, and mechanical features as well as operational, costs, and biological considerations of the alternative.

Appendix A:
Brainstorming Meeting Minutes

ONE COMPANY
Many Solutions℠

Brainstorming Meeting Minutes

Subject:	Minutes for Brainstorming Meeting		
Client:	U.S. Army Corps of Engineers		
Project:	The Dalles East Fish Ladder Auxiliary Water System Backup, Brainstorming Meeting	Project No:	000000000147341
Meeting Date:	December 8, 2010	Meeting Location:	HDR, Mountain Rooms
Notes by:	Jennifer Switzer/Ron Mason		

Attendees:

Ron Mason, HDR
Jeff Blank, HDR
Rich Hannan, HDR
Matt Bleich, HDR
Pete Gaby, HDR
Al Petrasek, HDR
Jennifer Switzer, HDR
Randy Lee, USACE
Karen Kuhn, USACE
Sean Tackley, USACE
Jeff Ament, USACE
Rick Reiner, USACE
Paul Keller, USACE
Bob Cordie, USACE
Gary Fredricks, NOAA
Eric Volkman, BPA

Topics Discussed:

✓ Introductions by USACE/Agency/ HDR team Members	Randy Lee/Ron Mason/All
✓ Purpose of the Meeting/Project Goal	Randy/Ron
✓ Discussion of Rules and Project Limits	Ron
✓ Project Background	Randy/Ron
✓ Previous Reports	Ron
✓ Design Discharges & Other Operational Criteria	Randy
✓ Discussion of Cost Estimates (Alt. A.& Alt. B. from INCA 1997 Report)	Rich Hannan
✓ Discussion of Fish Lock	Jeff Blank
✓ Brainstorming of alternatives	All
✓ Summary of overall discussions	Ron/Randy

Action/Notes:

Introductions

Randy Lee and Ron Mason began the meeting and requested that everyone introduced themselves, their agency/firm, their role, and what they hope to achieve in the brainstorming meeting.

Purpose of Meeting/Goal

Ron Mason began the brainstorming meeting with a review of the agenda explaining the goal of the morning session (9:00 am to 10:30 am) would be to cover agenda items through "Discussion of Fish Lock". The remaining agenda topics would be discussed prior to and following lunch break. The meeting was originally scheduled as an 8-hour meeting per the scope requirements but due to various agency schedules, the meeting was reduced to 4 hours with HDR and a number of USACE employees continuing to brainstorm beyond the initial 4 hours. He welcomed all to stay for the afternoon session and to continue to work through lunch.

Discussion of Rules and Project Limits

HDR's major items for Task Order 26 are as follows:

1. Review the INCA report cost estimates for Alternatives A & B and update them to current day costs.
2. Conduct a Brainstorming Meeting between HDR, USACE, and other invited agencies.
3. Prepare meeting minutes for the Brainstorming Meeting and include as an appendix in the final report
4. Develop both a draft and final Brainstorming Report that includes a matrix describing the various alternatives discussed, and updated cost estimates for INCA Alternatives A & B, including explanatory figures.

Engineering is not required for this task order, but it is expected that a contract modification will be issued in the future to further analyze the higher ranking alternatives through the engineering and preliminary design phases.

Brainstorming Meeting Expectations:

- As a group, discussed concepts/ideas to help solve the need for a backup system if fish turbines 1 & 2 fail. Old ideas/alternatives from previous reports may still be valid, but many were too costly to consider and were based on the requirements of providing 5,000 cfs to the Auxiliary Water System (AWS). The current task order requires an updated construction cost estimate based on the 5,000 cfs flow requirements.
- There was a discussion that the cost estimates should be revised to reflect the reduced flow requirements once this is established by USACE, but during the meeting, it was agreed that this additional out-of-scope effort would require an HDR contract modification.
- All alternatives discussed whether good or bad during the meeting will be included in the evaluation Alternative Matrix.
- Develop/populate the Alternatives Matrix with ideas that could achieve the reduced flow requirement.

Design Discharges and Other Operational Criteria

The reduced flow requirement for the discussed alternatives has not been formally established at this meeting time, but is expected to be in the range of 1,200 cfs to less than 1,500 cfs. USACE was preparing a technical memorandum to address this topic.

Ron reviewed the project schedule:

	Completion Date
Brainstorm meeting	12/8/2010
Draft Report	12/23/2010
Comments from USACE	1/10/2011
Draft Report mtg	1/12/2011
Final Report	1/26/2011
TO Completed.	2/26/2011

Gary Fredricks, Senior Biologist with the National Marine Fisheries Service, expressed some concern regarding the tight timeframe for the NMFS to comment on any alternatives, Randy Lee said given the Task Order completion date being one month after the final report submittal date, there was some room for an extension during the review period.

Ron gave the report expectations and stated it would be a fairly short report containing: the Alternatives Matrix from today's brainstorming meeting, a brief discussion of the alternatives, the brainstorming meeting minutes, and operational criteria.

Project Overview

Although undocumented, it is Ron's understanding the south and west fish entrances are to be closed during an outage, the east fish entrance will be open with two (2) of the three (3) weirs at the entrance operational. He again stressed that this is undocumented information, but something to consider during today's meeting. Bob Cordie had also heard the same information, but was unclear as to which weirs would remain open and which were to be closed.

Project History

Ron Mason provided an overview of several reports (1991-present) that have been prepared for the back-up system of the AWS for the East Fish ladder at The Dalles Dam:

1991, The Dalles Emergency Fish Attraction Water System, HDC, USACE
1994, Study of Auxiliary Water Supply (AWS) The Dalles Project Improvements for Endangered Species, USACE
1997, The Dalles Dam Auxiliary Water System Upgrade Alternatives Evaluation, INCA
The Dalles Fish Water Units Failure Analysis, HDC
2007, The Dalles Dam East Fish Ladder Inspection Report, Washington Group International
2009, The Dalles East Fish Ladder Auxiliary Water Backup System Letter Report, HDR

Randy Lee showed a few slides from a PowerPoint presentation he had used approximately 1 ½ months ago at an internal USACE meeting regarding criteria for the operation and flow requirements of the back-up system. Slides that Randy presented displayed information on flow and weir settings at fish entrances and a table of tail water exceedance at The Dalles dam:

East or West Single Weir and Tailwater - 73.6 ft

- 460 cfs 1ft head/8 ft submergence
- 570 cfs 1.5 ft head/8 ft submergence

South Entrance for single weir and Tailwater - 73.6 ft

- 1040 cfs 1ft head/8 ft submergence
- 1290 cfs 1.5 ft head/8 ft submergence

An exerpt from the second slide showed:

Percent Exceedance and Recurrence Interval for Range of Tailwaters:

Tailwater Elevation	% Exceedance	Recurrence Level
73.6 ft	99%	1.01
86.0 ft	1%	100

It was recommended the table include a column for adult fish passage movements in the Columbia River. Blank/Fredricks/Cordie discussed the level of flows where fish migration would stop. 400,000 cfs was discussed as flow where migration would stop. Gary stressed that duration of high flows is an important factor when reviewing high spill levels and fish passage.

USACE agreed they need to conduct the analysis to determine what the flow requirements are for this project.

Ron Mason shared with the group the question: "Is there an upper dollar limit that USACE has for this project?", but HDR and the team have yet to receive a concrete answer. USACE staff explained the onus is on them to work to find the best alternative with the least amount of cost. They do not know the cutoff line for projects to make the "list"of approved regional projects. If the dollar amount is too high, it won't make the list, if the price is “right”, then it will make the budgeting list and possibly move forward toward construction.

Other discussion points:

- Alternatives should be easy to operate and maintain
- According to Gary Fredricks, the time it takes to bring the back-up system online can be days, but a week would be too long
- Some of the diffusers in the AWS system cannot be opened (Bob Cordie). USACE Dalles Dam engineering staff currently maintain diffuser valves and motor, but vanes don’t move.

Discussion of Cost Estimates

Rich Hannan provided an overview of the cost estimates being prepared:

- INCA cost estimate is 13 years old
- This cost estimate in the report was used as is (unit quantities stay the same and update pricing)
- -3.4% to +10% inflation variation
- Rich Hannan stated that the inflation rate used for cost of living is not the same as that used for construction and cited various reasons. Therefore straight line inflation was not used because of fluctuations in market prices for materials These adjustment factors would be applied to the 1997 report.
- The updated cost estimate will be based on information from two sources:
  - The Dalles Cost Estimate in 2009 prepared by HDR
  - ODOT Construction Database showing unit cost by contract for varying areas in Oregon
- Also referred to EBASCO, HDC, and INCA reports for additional background
- Yellow highlighted areas on Rich’s slides indicate straight line inflation from INCA cost estimate
- Detailed Cost estimates make it easy to identify large costly items
- Alternative B - Pump/motor cost = pretty good number.

It was also reiterated that these cost estimates were prepared for Alternatives A and B which was designed for 5,000 cfs.

It was recommended by Gary Fredericks and Randy Lee that these values be updated for the assumed reduced flow requirements.

Discussion of Fish Lock

Jeff Blank provided an overview of the fish lock: and how it was intended to operate. The fish lock was only used by USACE for a couple of years after it was constructed.

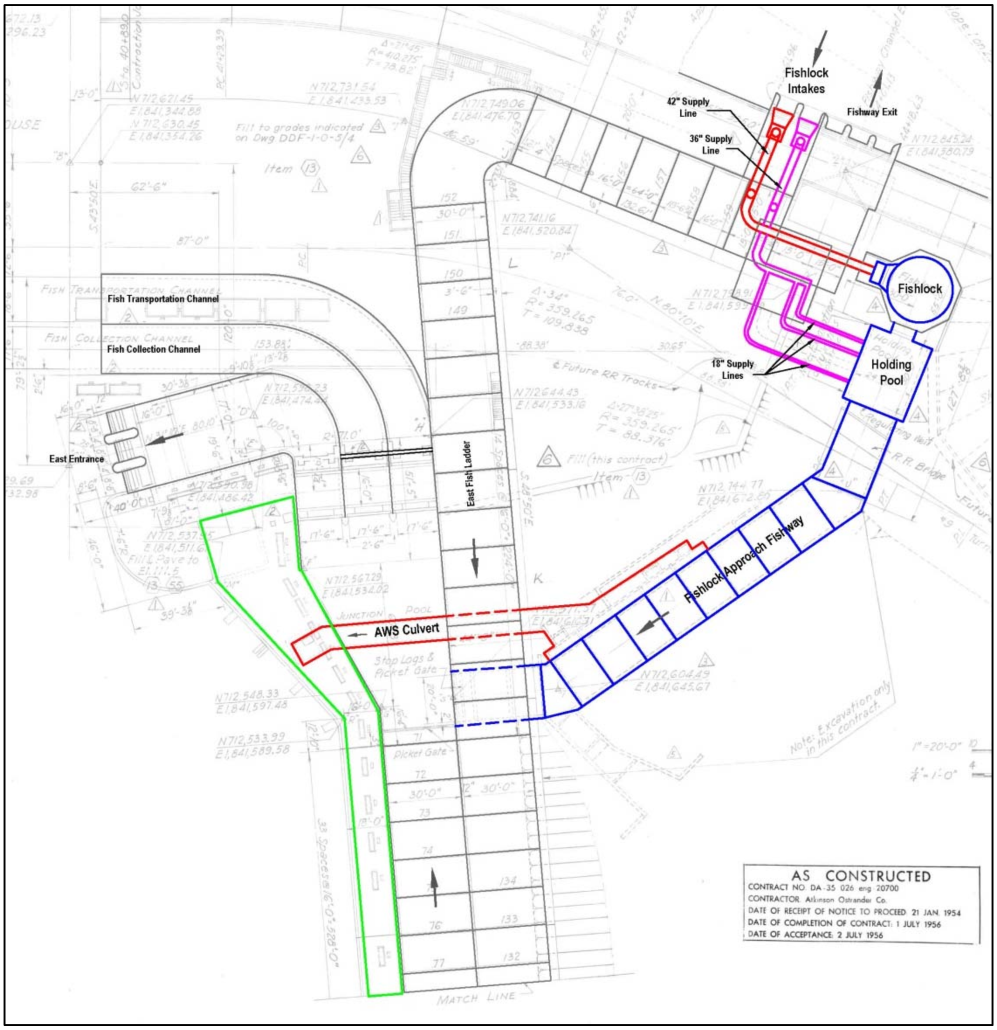
Jeff’s presentation and discussion lasted about 10-15 minutes.

Essentially, Jeff described that the fish lock piping system could be used to provide AWS water to the east entrance junction pool. This would occur via an existing 42” pipe, which discharges directly to the fish lock caisson as well as a 36” (which bifurcates to 3 x 18” pipes) that discharges to the fish lock holding pool.

Estimated flow capacities for each system are listed below:

- 42" pipe = approx. 400 cfs
- 36" pipe = 250cfs (currently blocked, possibly with sediment)

To further increase the capacity of the existing piping system, much of the existing system would require some modification, but in general the group thought that improvements to the fish lock system should be fully evaluated and has merit at this stage of the project. Improvements to the actual piping include removing valves, replacing bends, eliminating energy dissipation chambers … could all increase the systems total capacity.



(In the excerpt figure above, red = filling pipe and pink = attraction flow.)

Gary Fredericks brought up a concern of fish being attracted to the entrance of the location of the pipe entrances.

Bob Cordie would like to see ½ ft/sec. through diffusion grating/racks.

If you want to push water through the culvert, you have to build up head. 1200 cfs at the fish lock is easier, 1200 cfs down to channel is harder.

USACE performed a flush/clean out of the 42" line which was filled with silt, clams, and rock. The water level in silo/fish lock increased by 8 ft compared to the water level at the beginning of the operation.

Regardless of configuration, screens might be required.

Generating Alternative Ideas

Ron Mason randomly chose individuals in the room asking them to share their concepts of alternatives to be considered. These ideas were added to a matrix to be used to rate each alternative. About 15 alternatives were provided and input into the matrix (attached). A summary of the major features is listed below:

- Several of the alternatives dealt with improvements and changes to the existing fish lock and fishway channel
- Addition of a 3rd fish turbine (keep both fish units and add a 3rd fish turbine)
- Siphons at various locations that would provide water to the AWS conduit or the fish lock
- Modification of bulkheads for Spillway Bay #23
- A Single pump/pump station at several locations; a floating plant was also discussed
- A Speed no load alternative for one of the existing fish turbines

Gary Fredericks and Eric Volkman stated that lamprey and salmon species were a sensitive issue for the region to deal with and if the chosen alternative made it worse in terms of conveyance, the alternative would need to be screened up to current standards and/or mitigation may be required.

Also noted was if an alternative gave a PUD more hydropower capacity (i.e., non-federally operated), FERC licensure would be required thus extending the implementation of the alternative (upwards of 10+ years).

The following also was discussed:

Pump systems - O&M pose reliability issues

Gravity flow systems with gates and simple valves are generally considered to be more reliable

Prior to the conclusion of the brainstorming of alternatives portion of the meeting, Gary Fredricks needed to leave the meeting. Before he left, he stated the next step was risk assessment and wanted to know when other interested parties would be involved (tribes, state, USFWS, others) in the process. It was confirmed by USACE that interested/stakeholder parties would be involved prior to alternatives being taken too far into the development phase of the project.

Brainstorming of Alternatives

The attached matrix was partially completed with discussion and consensus on rating values input. The USACE was sent a copy of the matrix and provided further input after the meeting via email.

The sign–in sheet and matrix are attached to these notes.

The Dalles East Fish Ladder Auxiliary Water System Backup
Brainstorming Meeting Sign-In

Please print clearly

Name	Agency/Firm	Email	Phone
Al Petrasek	HDR	Al.Petrasek@HDRInc.com	972-964-4421
PETE GABY	HDR	Peter.gaby@hdrinc.com	503-720-6102
Jeff Ament	USACE	Jeffrey.M.Ament.usace.army.mil	503 808 4950
Karen Kuhn	USACE	Karen.A.Kuhn@usacearmy.mil	503-808 4897
Sean Tackley	USACE	sean.c.tackley@usace.army.mil	503-808-4751
Eric Volkman	BPA	efvolkman@bpa.gov	503-230-3182
Matt Bleich	HDR	Matthew.Bleich@hdrinc.com	253-858-5610
Jeff Blank	HDR	jblank@hdrinc.com	503-830-9259
Rich Hannan	HDR	Richard.hannan@hdrinc.com	503-423-3751
Randy Lee	USACE	Randall.T.Lee@usace.army.mil	503 808-4976
Bob Cordie	USACE	robert.p.cordie@usace.army.mil	541 506 7800
PAUL KELLER	USACE	paul.s.keller@usace.army.mil	" " "
Rick Reiner	USACE	Richard.L.reiner@usace.army.mil	541 506 7805
Gary Fredricks	NOAA	gary.fredricks@noaa.gov	503 231 6855
Jennifer Switzer	HDR	jennifer.switzer@hdrinc.com	503-727-3923
Ron Mason	HDR	ronald.mason@hdrinc.com	503-423-3802

Dalles EFL AWS Backup Alternatives Summary Matrix
USACE Task Order 0026
Brainstorming Meeting - December 8, 2010

			Rated Item	Rated Item	Rated Item	Rated Item		Rated Item	Rated Item	Rated Item	Rated Item				
Alternatives		Fish Passage Requirements	Fish Agency/ Biological Concerns	Estimated Construction Time[1]	Implement/ Switchback Time[2]	Cost (H/M/L)	Power Production Impacts	Disruption to Project Operations	Constructability	Reliability	Maintenance Aspects	Miscellaneous Concerns	Total Score		Ranking
No.	Description														
1	Add a siphon (pipe or use existing adit) for additional water to the Fishlock - supplement with existing 36" and 42" diameter supply pipes				Hrs / Days / Wks / Months								0		
2	River wet tap - boring tunnels under dam to increase water to Fishlock				Hrs / Days / Wks / Months								0		
3	Ice Trash Sluice Water Tap-either below or along side				Hrs / Days / Wks / Months							- not rated due to biological and physical constraints	0		
4	Fishlock direct tap to reservoir forebay	Fish screens may be required			Hrs / Days / Wks / Months								0		
5	Install concrete lid on open channel fishway				Hrs / Days / Wks / Months								0		
6	Tainter Gate # 23 - modify stoplogs with a pipe to AWS culvert				Hrs / Days / Wks / Months								0		
7	New third fish turbine - with maximum flow of 5000 cfs (Federally owned)	Fish screens will be required depending on depth of intake	4	1	Hrs / Days / Wks / Months 4		N/A	4	1	3	1	- Time to construct - Major disruption to overall operations - Buy in from NW Power Council	14		
8	Pipe to AWS culvert (full length)				Hrs / Days / Wks / Months							Isolate east entrance	0		
9	Remove flow restrictions on current system at fish lock and downstream				Hrs / Days / Wks / Months								0		
10	Single pump / pumphouse (cul de sac area)	Fish screens will be required based on depth variables	2	1	Hrs / Days / Wks / Months 4	0	N/A	4	3	1	0	- sturgeon in cul de sac (spawning or congregation area?) predator issues - constructed in the wet -Some minimal power use - high maintenance	13		

Dalles EFL AWS Backup Alternatives Summary Matrix
USACE Task Order 0026
Brainstorming Meeting - December 8, 2010

Alternatives		Fish Passage Requirements	**Rated Item**	**Rated Item**	**Rated Item**	**Rated Item**	Power Production Impacts	**Rated Item**	**Rated Item**	**Rated Item**	**Rated Item**	Miscellaneous Concerns	Total Score		Ranking
No.	Description		Fish Agency/ Biological Concerns	Estimated Construction Time[1]	Implement/ Switchback Time[2]	Cost (H/M/L)		Disruption to Project Operations	Constructability	Reliability	Maintenance Aspects				
11	U/S Cassion Intake with siphon				Hrs / Days / Wks / Months								0		
12	Floating Plant Pump Station - located at either side of EFL	fish screens will be required	2	1	Hrs / Days / Wks / Months 4	2	N/A	4	3	1	0	- anti-perching needs; predator issues	13		
13	Run SNL on one fish turbine while other is being prepared in combination with fish lock improvements	-no screens required for turbine - Fish lock - screen would apply	3	4	Hrs / Days / Wks / Months 4		N/A	4	4	1	3	- Surface oriented attraction for fish lock - Runaway turbines - Amount of heat produced - Turbine reliability	20		
14	Ice and Trash Sluice Water Tap - Use water from Units 20-22	- exclusion screens would be needed in front of units 20-22	3	1	Hrs / Days / Wks / Months 4		N/A	4	2.5	4	2	- might require multiple pipes - more yearling during summer months - need for trash rack and screen cleaning system	17.5		

Criteria for Ranking

[1]Est. Construction Time:
< 6 months = 4
6-12 months = 3
12-18 months = 2
18-24 months = 1

[2]Implement/Switchback Time:
hours = 4
days = 3
weeks = 2
months = 1

Notes:
1. Scoring Definition: N/A = 0; Poor = 1; Fair = 2; Good = 3; Excellent = 4
2. Total Scores: Poor = 7; Fair = 14; Good = 21; Excellent = 28

Appendix B:

USACE Memorandum for Estimated Minimum Discharge

CENWP-EC-HD 20 December 2010

MEMORANDUM FOR RECORD

SUBJECT: The Dalles East Fish Ladder Emergency Backup for the Auxiliary Water Supply System– Estimated Minimum Discharge

Objective:

1. The objective of this memo is to present the estimated minimum discharge needed for the emergency Auxiliary Water System (AWS) backup for The Dalles East Fish Ladder (TDEFL) System. The estimated minimum discharge will be used for the purpose of initial brainstorming and alternatives study currently being undertaken by HDR for the USACE Portland District (NWP) in FY11.

Background:

2. The AWS conduit supplies water to the East, West, and South fish Ladder entrances in order to attract and transport upstream migrating adult fish. Water is currently supplied to the AWS conduit by two fish unit turbines located on the west end of the powerhouse. The AWS normally operates with a total flow of up to 5,000 cfs. If both turbines fail, water supplied to the AWS would be severely limited or eliminated. To provide a backup supply of water to the AWS in case of failure of the two fish units, several alternatives have been evaluated assuming that at least 3400 cfs was needed to allow the ladder system (East, West and South) to remain in criteria in this type of emergency. Subsequent to these analyses, a special FFDRWG met on 2 November 2010 to discuss the operational (and ultimately discharge) requirements for a one year emergency situation. Based on discussions it was agreed that the minimum TDEFL operation that would be acceptable for emergency operations given the failure of both fish turbines would be to utilize the East Fish Ladder (EFL) entrance solely.
3. Design Criteria and preferences discussed at the 2 November 2010 meeting for this emergency operation (essentially in relative order of priority) is as follows:
    a. Maintain 1.5 ft. of head differential over the entrance weir.
    b. Conditionally assume utilizing 2 weirs but consider a new variable width vertical entrance structure (attraction flow properties downstream should be used in the evaluation of any entrance structure design).
    c. Maintain at least 8 ft. depth (tailwater elevation to top of the weir).

    Other operational criterion that need to be considered include:

    d. Water velocity of 1.5 to 4 fps (2 fps optimum) maintained for the full length of the lower end of the fish ladder that is affected by tailwater elevation.
    e. Water depth over fish ladder weirs: 1.0 ft. +/- 0.1 ft. and 1.3 ft, +/- 0.1 ft, during shad season.

Discussion:

4. Calculations of flow at the East entrance by weir were made for a range of tailwater elevations with the following equations, criteria, assumptions and constants:
    - Villamonte Equation for Submergence:
        - Q = (1 – (H2/H1)^1.5)^0.385*CwLH1^1.5
        - H1 = depth from water surface elevation (WSE) to top of weir;
        - H2 = depth from tailwater elevation (TW) to top of weir
    - Rehbok Equation for Weir Coefficient:
        - Cw = 3.22 + 0.44 H/P
        - H = H1; P = Weir height]
    - Head over weir of 1.5 ft.
    - Weir width of 8.67 ft.
    - Submergence minimum of 8 ft.
    - Invert elevation of 60 ft.
    - Channel Width of 34 ft.
    - No pier or contraction losses were used to allow for a more conservative discharge (ie: more emergency flow necessary).

5. Tailwater (TW) elevation used in the above equations can markedly influence the estimated flow. Both stage and flow duration curves for the period of record (1974-1999) were used to compile a range of possible tailwater elevations at The Dalles Dam (Table 1). As seen in the table, the forebay of Bonneville Dam can influence the tailrace elevation of The Dalles Dam such that there can be a range of tailwaters for a given flow. Although the most extreme values (maximum and minimum TW of record) would certainly bracket the full range of possible tailwaters in which an emergency backup plan may need to operate, a more reasonable approach is to focus on possible operations within the fish passage season for the higher flows (May/June) and lower flows (September/October). During the higher flows, there is a point where flow conditions are such that adult fish will hold rather than travel upstream. Assuming that this is around 450kcfs (more defined estimate TBD), the higher TW estimate for this discharge falls within the 5% exceedance for May and June. Looking at the lower tailwaters, a condition with minimum powerhouse flow (50kcfs) has a range of possible tailwaters within which both September and October 95% exceedance tailwaters fall.

    Using the higher of the 5% exceedance tailwaters for the high flow months of May and June (TW=86.6 ft.) will result in an estimated emergency backup flow of: Q(2 Weirs) = 1400 cfs

    Using the lower of the 95% exceedance tailwaters for the low flow months of September and October (TW=74.0 ft) will result in an estimated emergency backup flow of: Q(2 Weirs) = 1200 cfs

Conclusions:

6. Further discussion and thought may narrow down the range of tailwaters (and ultimately flows) considered necessary for emergency operation of TDEFL east entrance. However for this level of study and design, the range of discharge from 1200 to 1400 cfs is deemed sufficient. Ultimately, the hydraulics throughout the ladder system will need to be analyzed to ensure that all internal hydraulic criteria are met in order to maximize fish passage success. Also, as studies progress to a recommended design solution, the impact of system operations (such as the elevation of the Bonneville forebay) on an emergency ladder operation should be discussed and possible emergency operations to improve adult movement defined.

Recommendations:

7. For this phase of the design of alternatives for supplying emergency backup water to the AWS for TDEFL in the case where both fish units are out we recommend using flows in the range of 1200 to 1400 cfs.

Karen Kuhn
Hydraulic Engineer

REVIEW PROCESS:

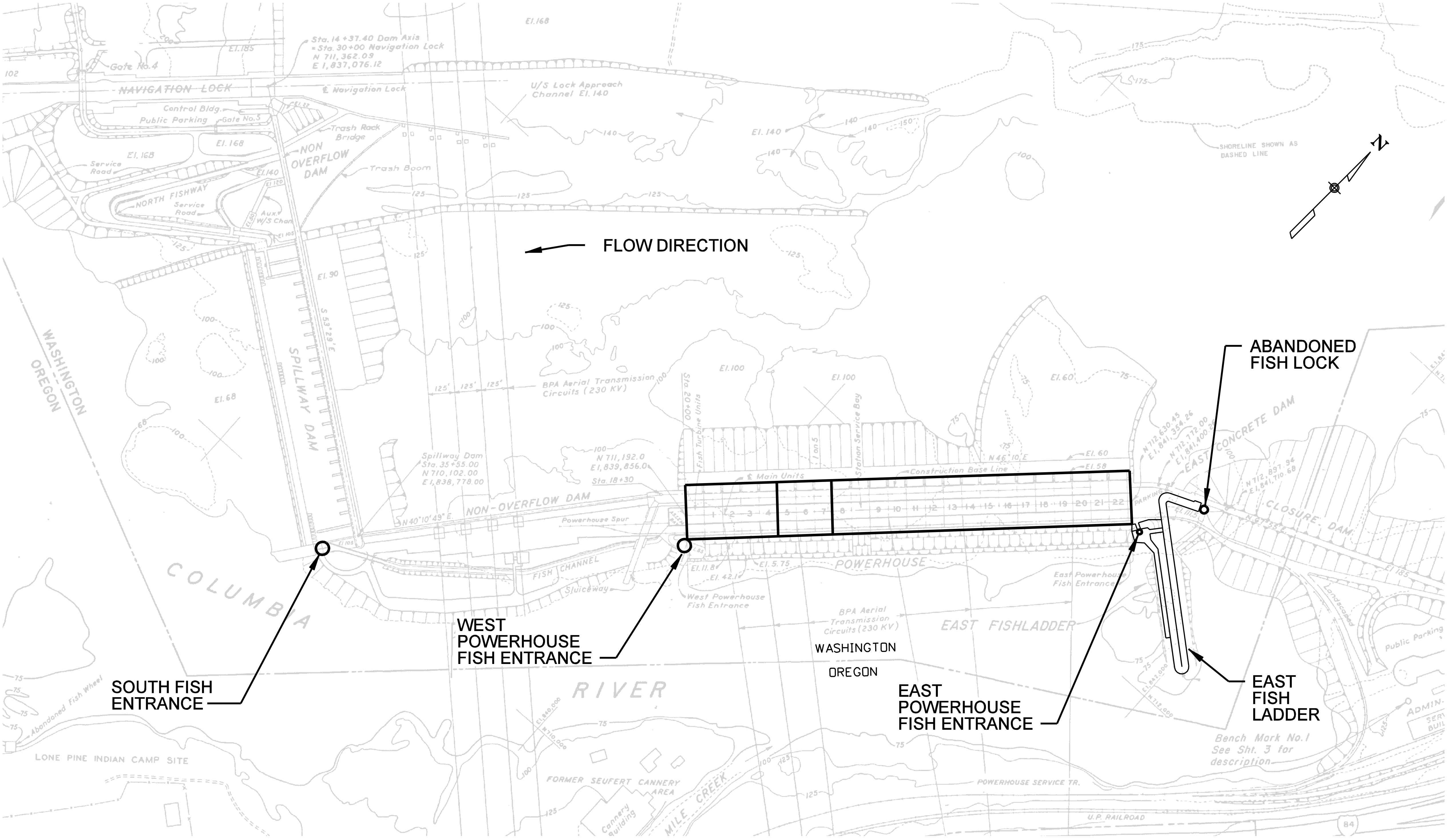
HD – Steve Schlenker
HD – Laurie Ebner
CF:
CENWP-EC-HD - Randy Lee
CENWP-EC-HD – Kyle McCune
CENWP-PM-E – Sean Tackley

Table 1 - Range of River Discharge and Tailwater Conditions for The Dalles Dam

Condition	Discharge	TW Range @ RM 190.89 for Bonn TW Range of 71.5-76.5 ft.*		TW @ Powerhouse
	cfs	ft	ft	ft
100 year event	680,000	91.5	93.3	
Maximum Tailwater				92.2
5% Exceedance June**				86.6
Max Q for Adult Movement***	450,000	83.4	86.0	
5 % Exceedance May**				85.4
Max Ph w/ 40% spill	430,000	82.8	85.4	
Max Ph	270,000	77.3	80.8	
Discharge 100kcfs (92% Flow Exceedance)	100,000	72.7	77.5	
Min Ph w/40% Spill	85,000	72.5	77.0	
Min Ph	50,000	71.8	76.8	
95% Exceedance Sept**				74.2
95% Exceedance Oct**				74.0
Minimum Operating Tailwater****				70.0

*Bonneville FB normal operating range 71.5 - 76.5 ft.
*Gage just downstream of Spillway (RM 190.89)
**Based on hourly readings
***Rough estimate, more recent data to be analyzed
****Fish Passage Plan 2010

Appendix C:
Sheets



PLAN VIEW
NOT TO SCALE

US Army Corps of Engineers® Portland District

PLAN VIEW
MAJOR PROJECT FEATURES

DESIGNED BY: RCM
DWN BY: TTN
CKD BY: RCM
SUBMITTED BY: RCM
PLOT SCALE: NTS
PLOT DATE:
SIZE: 17x11
FILE NAME: 147341-S01.dgn
DATE: December 15th, 2010
DRAWING NUMBER: 01

U.S. ARMY CORPS OF ENGINEERS
PORTLAND DISTRICT
PORTLAND, OREGON

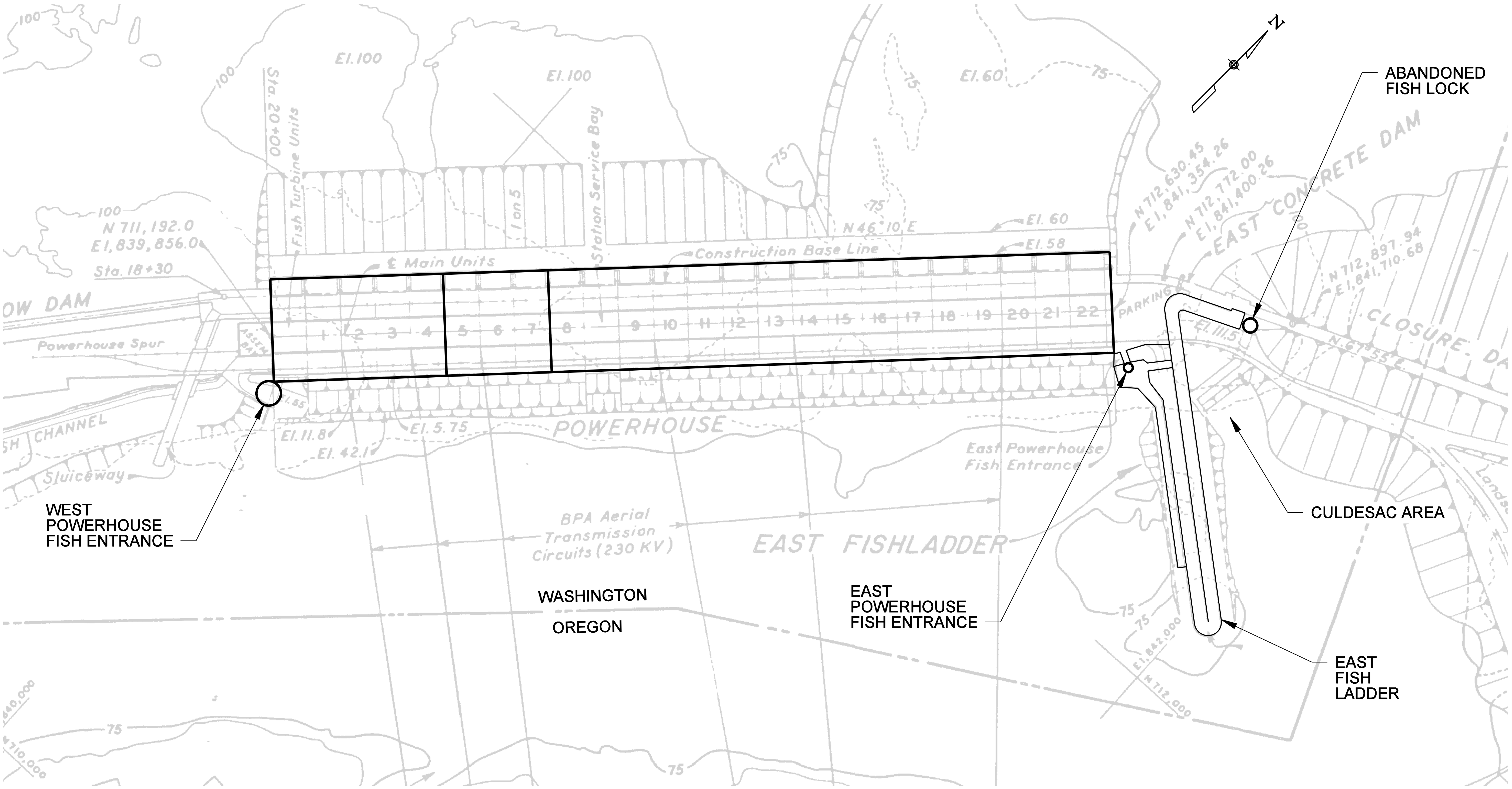
HDR ENGINEERING INC.

THE DALLES DAM
EAST FISH LADDER
AUXILIARY WATER SYSTEM
BRAINSTORMING MEETING REPORT

SHEET IDENTIFICATION
01
SHEET 1 OF 2

DESIGN FILE: 1_ENGINEERING_DWGS_CADD\SHEET FILES2% SUBMITTAL DRAWINGS\BASE DRAWINGS\

DATE AND TIME PLOTTED: $$$DATE$$$$ $TIME
BY USERNAME: TAM NGUYEN
SHEET NAME: PLAN VIEW MAJOR PROJECT FEATURES



PLAN VIEW
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PLAN VIEW
POWER HOUSE

DATE: December 15th, 2010	
DESIGNED BY: RCM	
DWN BY: TTN	CKD BY: RCM
SUBMITTED BY: RCM	
PLOT SCALE: NTS	PLOT DATE:
DRAWING NUMBER: 02	
SIZE: 17x11	FILE NAME: 147341-S02.DGN

U.S. ARMY CORPS OF ENGINEERS
PORTLAND DISTRICT
PORTLAND, OREGON

HDR ENGINEERING INC.

THE DALLES DAM
EAST FISH LADDER
AUXILIARY WATER SYSTEM
BACKUP LETTER REPORT

SHEET IDENTIFICATION
02
SHEET 2 OF 2

DESIGN FILE: 1_ENGINEERING_DWGS_CADD\SHEET FILES2% SUBMITTAL DRAWINGS\BASE DRAWINGS\

DATE AND TIME PLOTTED: $$$DATE$$$$ $TIME

BY USERNAME: TAM NGUYEN

SHEET NAME: PLAN VIEW POWER HOUSE