LEWIS RIVER HYDROELECTRIC PROJECT
Fish Passage Decision Support Document

Prepared for the
Lewis River Science Work Group

July 28, 2017

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1.0 INTRODUCTION

This report describes a collaborative process through which science-based recommendations to the U.S. Fish and Wildlife Service and National Marine Fisheries Service (Services) were developed regarding whether to construct remaining anadromous fish passage facilities within the Lewis River hydroelectric project as described in Articles 4.5 through 4.8 of the Lewis River Settlement Agreement (Figure 1.0-1). The first two facilities constructed were the Merwin Upstream Fish Collector and the Swift Downstream Collector, allowing anadromous fish access to stream habitat upstream of Swift Dam. The remaining facilities to be constructed are as follows:

- Downstream Passage at Yale Dam (Settlement Agreement Article 4.5)
- Downstream Passage at Merwin Dam (Settlement Agreement Article 4.6)
- Upstream Passage at Yale Dam (Settlement Agreement Article 4.7)
- Upstream Passage at Swift Projects (Settlement Agreement Article 4.8)

Per Section 4.1.9 of the Settlement Agreement, the Licensees (PacifiCorp and Cowlitz PUD) "*shall construct and provide for the operation and maintenance of both upstream and downstream fish collection and transport facilities at each of Merwin Dam, Yale Dam, and the Swift projects as provided in the schedule in this Agreement unless otherwise directed by the Services pursuant to this Section.*" The decision to forgo fish passage facility construction at these projects is to be based on:

…receipt and review of New Information relevant to reintroduction and fish passage from any party, the members of the ACC [Lewis River Aquatic Coordination Committee] *may provide written comments to the Services regarding such New Information. Such comments shall be provided to the Services no later than five years prior to the date that PacifiCorp and/or Cowlitz PUD is to begin operating the relevant passage facility. If any New Information and comments are submitted to the Services, then approximately four and a half years prior to the date that PacifiCorp and/or Cowlitz PUD is to begin operating the relevant passage facility, the Licensees shall convene a meeting of the ACC for the purpose of discussing the New Information and comments. At such meeting, the Licensees shall solicit and obtain the Services' response to the New Information and related comments, unless the Services have provided the results of their review to the ACC earlier. If the Services have concluded that one or more of the passage facilities should not be constructed, then within 60 days after the meeting of the ACC, the Services shall advise the ACC in writing of such conclusion.*

…For purposes of this section, "New Information" is defined as information relevant to anadromous fish reintroduction and fish passage, including that presented by any Party, and provided to the Services and the Licensees. The Licensees must provide copies of such New Information to all the members of the ACC. This information may include, but is not limited to:

(1) Experience with upstream fish collection and transport facilities at other sites, including Merwin Dam.

(2) Experience with downstream fish collection facilities at other sites including Swift No.1 Dam

(3) Experience with the reintroduction efforts of spring Chinook, coho, and steelhead above Swift No. 1 Dam.

(4) Consideration of broader contextual information beyond the Lewis River Basin, including regional anadromous fish recovery efforts.

Section 4.1.9 of the SA further states that "*If the Services conclude upon review of New Information that one or more of the fish passage facilities should not be constructed, in lieu of designing, permitting, constructing, and operating the passage facility, PacifiCorp shall provide additional funds for projects in lieu of fish passage, as set forth in Section 7.6.*"

In 2016, PacifiCorp (2016) provided the following New Information[1] to the ACC:

- Review of information regarding fish transport into Lake Merwin and Yale Lake
- Habitat assessment of tributaries to Swift Reservoir, Yale Lake, and Lake Merwin
- Assessment of adult habitat access potential for spawning success
- Assessment of juvenile production potential and emigration success
- Evaluation of Lake Merwin predator impacts
- Assessment of anadromous/resident interactions
- Updated Ecosystem Diagnosis and Treatment (EDT) modeling
- Restoration opportunities related to fish habitat and fish production.

Near the end of the process, participants (described below) provided a written rationale for the selection of their preferred alternative for submission to the Services (Appendix A). A poll on the conclusion of the process revealed a lack of consensus recommendation that the Services had been hoping to receive. All, including the Services, agreed that the discussions had been productive and they had gained a deep understanding not only of the science but of each other's interests.

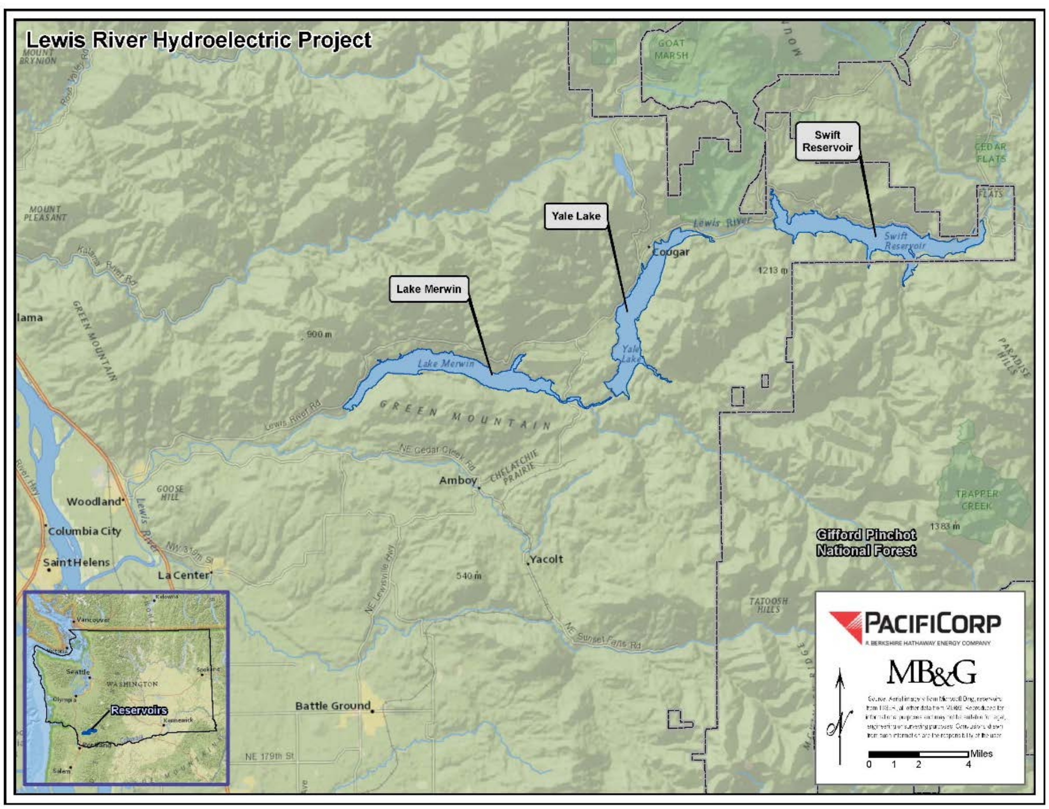


Figure 1.0-1. Lewis River Project Area.

[1] PacifiCorp. *New Information Regarding Fish Transport into Lake Merwin and Yale Lake, Executive Summary, Swift No. 1, Swift No. 2, Yale and Merwin Hydroelectric Projects*. June 24, 2016

1.1 Purpose/Need for Report

In June 2016, PacifiCorp submitted New Information Regarding Fish Transport into Lake Merwin and Yale Lake to the Services and the Lewis River Aquatic Coordination Committee (ACC). As stated in the Lewis River Settlement Agreement (Section 4.1.9), *"If the Services conclude upon review of the New Information that one or more of the passage facilities should not be constructed, in lieu of designing, permitting, constructing, and operating the passage facility, PacifiCorp shall provide additional funds for projects in lieu of fish passage."*

This report, prepared by Lyn Wiltse, PDSA Consulting, and Mike Bonoff, Mason, Bruce & Girard, Inc., documents the process by which a group of dedicated scientists evaluated the relative benefits of anadromous fish passage throughout the Lewis River project from a scientific perspective. This document has been finalized in consultation with the ACC at their July 13, 2017, meeting. Substantive changes in response to comments received were made and are identified in Appendix E.

Underpinning this process was a commitment to listen and understand each other's interests and to collaboratively explore strategies most beneficial to long-term fish recovery. The core workgroup members are shown below (Table 1.2-1).

1.2 Participants

Table 1.2-1 Core Workgroup Participants

PARTICIPANT NAME	ORGANIZATION	ACC FISH PASSAGE DECISION GROUP	INITIAL SCIENCE WORK GROUP*	CORE SCIENCE WORK GROUP
Members				
Michelle Day	National Marine Fisheries Service	✓	✓	✓
Mark Celedonia	US Fish & Wildlife Service	✓	✓	✓
Taylor Aalvik	Cowlitz Indian Tribe	✓		
Eli Asher	Cowlitz Indian Tribe	✓	✓	✓
Bob Rose	Yakama Nation	✓		
Ruth Tracy	USDA Forest Service	✓	✓	✓
Greg Robertson	USDA Forest Service	✓	✓	
Bryce Michaelis	USDA Forest Service	✓	✓	
Pat Frazier	WA Department of Fish & Wildlife	✓	✓	✓
Aaron Roberts	WA Department of Fish & Wildlife	✓		
Peggy Miller	WA Department of Fish & Wildlife	✓		
Bryce Glaser	WA Department of Fish & Wildlife	✓	✓	
Steve Manlow	Lower Columbia Fish Recovery Board	✓	✓	✓
Amelia Johnson	Lower Columbia Fish Recovery Board	✓	✓	
Amanda Froberg	Cowlitz PUD	✓	✓	✓
Frank Shrier	PacifiCorp	✓	✓	
Todd Olson	PacifiCorp	✓	✓	✓
Jeremiah Doyle	PacifiCorp	✓	✓	
Chris Karchesky	PacifiCorp	✓	✓	
Erik Lesko	PacifiCorp	✓	✓	

PARTICIPANT NAME	ORGANIZATION	ACC FISH PASSAGE DECISION GROUP	INITIAL SCIENCE WORK GROUP*	CORE SCIENCE WORK GROUP
Process Support				
Kim McCune, Note Taker	PacifiCorp	✓		
Mike Bonoff, Scientist, Technical Writer	Macon Bruce & Girard, Inc.	✓	✓	✓
Lyn Wiltse, Facilitator	PDSA Consulting, Inc.	✓	✓	✓
Technical Support				
Kevin Malone, EDT Modeling	DJWA	✓	✓	
Karl Dickman, EDT Modeling	ICF International	✓	✓	

**Also referred to as ACC Science Workgroup*

1.3 Evaluation Process and Biological Objectives

The overall objective of the process was to provide the Services with a science-based recommendation regarding the biological merits of full anadromous fish passage at the Lewis River projects, and based on this analysis, to seek technical consensus around the preferred fish passage and habitat restoration actions to be implemented at the Project. Absent technical consensus, the New Information developed would help inform the Services decision regarding the construction of additional upstream passage facilities at Yale and Swift, downstream passage facilities at Yale and Merwin, and habitat projects in lieu of fish passage.

Early in the process, the ACC In-Lieu Fish Passage group charged with developing recommendations to the Services agreed that the outcome would reflect the following criteria and key information:

- Most beneficial action for spring Chinook (first), and then coho and steelhead (consistent with NMFS Recovery Plan priorities)
- Proportional gain in salmon abundance, capacity, productivity, and spatial distribution
- Benefits of habitat action vs. fish passage for recovery
- Merwin predation

They also agreed that their objective in meeting was to engage in discussions leading to:

- The best decision (by the Services)
    - Fully justified
    - Meets criteria
    - Collaborative and supported by tribes and stakeholders
    - Data vs. deadline driven
    - Pride in the process and conclusions
    - Consistency with goals of the NMFS Recovery Plan (viability objectives for fish populations).

2.0 PROCESS OVERVIEW

The Services expressed a desire early in the process that their decision regarding passage into Lake Merwin and/or Yale Lake reflect the consensus of the ACC Fish Passage Decision Group. The group operated as a subset of the Lewis River ACC and was comprised of the USFWS, NMFS, Washington Department of Fish and Wildlife (WDFW), U.S. Department of Agriculture Forest Service (USDA FS), Tribes (Cowlitz Indian Tribe and Yakama Nation), the Lower Columbia Fish Recovery Board (LCFRB), and Utilities (PacifiCorp and Cowlitz PUD). These participants agreed to work together in an open and transparent manner and emphasized that the Services' decision should be justifiable and stand the test of time. PacifiCorp hosted several meetings for parties to engage in collaborative discussions of the additional information with the intent to reach agreement on a recommendation to inform the Services' decision. Toward that end, PacifiCorp hired a facilitator (Lyn Wiltse, PDSA Consulting) to ensure meetings were conducted in a fair and efficient manner, and that all voices were heard. They also provided a note-taker to record the proceedings of these meetings and to track action items (Kim McCune, PacifiCorp). PacifiCorp also brought in a scientist/technical writer to respond as needed to requests for data and information reviews, and to help document the discussion and decision-making process (Mike Bonoff, Mason, Bruce & Girard, Inc.).

The meetings of the ACC Fish Passage Decision Group occurred in 2016 on September 8 and 28; October 5, 13, and 20; November 3, 17, and 22, December 8 and on January 19, 2017. Participation was broad and attendees worked together collaboratively toward a recommendation driven by biological outcomes, i.e., juvenile and adult fish production and related goals of the Recovery Plan[2], recognizing that the preferred outcome would later be weighed against cultural and policy considerations. Detailed minutes were taken at these meetings to reflect discussions and track associated action items (Appendix B).

Discussion during the first several meetings identified five fish passage alternatives for evaluation (see Section 2.2). Although progress was made during these meetings the group recognized that additional time was necessary to fully evaluate the five fish passage alternatives; therefore, there was broad support for the Licensee's six-month Extension of Time request which FERC granted, shifting the deadline to August 24, 2017.

In hopes that the January 19, 2017 meeting would conclude the science-based perspective of the discussions, a smaller subset of the ACC Fish Passage Decision Group (ACC Initial Science Work Group) met separately on December 16, 2016 to create various matrices comparing the relative strengths of each of the passage alternatives from a biological perspective. Participants agreed that while these matrices (Alternatives Evaluation Tables, see Table 3.1.4) were a useful tool to move the future fish passage/in-lieu recommendation forward, they did not account for other important considerations such as impacts to bull trout or policy and cultural issues.

The Initial Science Work Group met again the morning of January 18, 2017, to continue their discussions and identify some additional EDT runs that would help to inform the review. This was in preparation for a meeting of the Fish Passage Decision Group meeting on January 19, 2017. At that meeting, Pat Frazier, WDFW, led a review of summary matrices developed at the December meeting, illustrating results of key EDT metrics for the five passage alternatives. The thought was to work through the biological matrices first, then turn attention to cultural and other nonbiological issues. During the discussion, all agreed that

[2] http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/lower_columbia_river/lower_columbia_river_recovery_plan_for_salmon_steelhead.html

salmon recovery/reintroduction is the priority goal, requiring analysis of salmon productivity, abundance, spatial structure, and diversity.

As mentioned above, bull trout were not a key driver initially in this evaluation as Mark Celedonia (USFWS) wanted first to see the habitat value of Yale to salmon and steelhead before looking at reintroduction impacts to bull trout. If the Yale habitat was found to be of little value to salmon/steelhead, then a fish passage decision could be made without going into an analysis of impacts to Yale bull trout. Given there is some value of Yale habitat to salmon/steelhead, impacts to bull trout were added to the discussion.

The Cowlitz Tribe expressed the view that according to the Lewis River Settlement Agreement, the in-lieu fund should not be a factor in the evaluation unless the Services deem passage inappropriate at one or more project locations. They also expressed concern that the biological analysis failed to address other issues, such as ecological interactions and marine-derived nutrients. The Cowlitz Tribe suggested that additional discussions be conducted with a larger group to focus on cultural and policy considerations. There was agreement on this that, led by the Services, this would occur at a later date and that these policy and cultural considerations were outside the scope of this process.

2.1 Transition to the Science Work Group

While a consensus recommendation was not reached at the January 19, 2017 meeting, there remained a strong desire among participants to continue working together toward consensus and a science-based deliverable that the Services would have in hand as they engaged in broader discussions, and in consultation with the tribes. Participants agreed that additional Science Work Group meetings would be beneficial. WDFW offered to host and chair these meetings at its office in Vancouver, with the first of these taking place on February 2, 2017. There was much discussion about data in the Alternatives Evaluation Tables and how rankings were performed. At the end of that meeting, participants agreed to meet again as an even smaller group (with one representative from each entity). By giving each entity a single seat at the table, the hope was there would be gains in focus, efficiency, and also effectiveness, as a smaller group allowed for more disclosure of distinct interests relative to the various alternatives. This smaller work group is referred to as the Core Science Work Group in the preceding table.

The Core Science Work Group met three more times, on February 22, March 17, and May 11, 2017. They agreed to drive toward a recommendation based solely on a non-subjective and nonbiased biological evaluation. To that end, participants reconfirmed the assumption that permanent fish passage facilities would achieve the performance standards laid out in the Settlement Agreement. There was also agreement that other aspects of the decision, such as the type of juvenile and adult collectors to construct, policy items and cultural issues (e.g., gravel-to-gravel) would be evaluated separately in future discussions led by the Services (See description under Section 4.0, Dialogue.)

2.2 Alternatives Development

A total of five alternatives were developed for analysis. All alternatives assumed continued operation of the Merwin Upstream Collection Facility and the Swift Floating Surface Collector (FSC) through the life of the FERC license. Fish passage facilities and operations included in each alternative are described below.

Alternative 1A1 – This scenario only includes a downstream floating surface collector near Yale dam. Adult fish are collected at the Merwin Upstream Collection Facility and a portion of the adults (TBD) are taken and released into Yale reservoir. Remaining adults are transported upstream of Swift Dam. Progeny produced by adults in tributaries to Yale Lake and that enter the Yale floating surface collector will be uniquely marked then transported to the Woodland Release ponds for release into the lower Lewis River. When those fish return as adults or jacks to the Merwin Upstream Collection Facility, they will be transported and released in accordance with a yet to be developed management plan aligned with recovery goals (e.g. connectivity to support gene flow).

Alternative 1A2 – In this scenario, a downstream floating surface collector will be constructed and put into operation at Yale Dam but no adults will be purposefully transported to Yale Lake. All adult upstream migrants collected at the Merwin Upstream Collection Facility will be transported and released upstream of Swift Dam. The primary purpose of the Yale FSC will be to collect any downstream migrants that may have passed through the Swift exclusion netting at the Swift FSC, then through the turbines at Swift No. 1 and Swift No. 2 or through spill at Swift Dam and into Yale Lake. Downstream migrating juveniles will not need to be uniquely marked.

Alternative 1B – For this scenario, all adults and jacks collected at the Merwin Upstream Collection Facility are taken to Yale Lake and released. Facilities include a downstream floating surface collector near Yale dam and an adult collection and sorting facility near either Swift No.1 dam or the Swift No. 2 power canal. The adults have the choice of either remaining in Yale Lake or tributaries to spawn or migrate to the upstream collection and sorting facility to be transported upstream of Swift Dam. Downstream migrating juveniles will not need to be uniquely marked.

Alternative 2 – Downstream FSCs will be constructed in Yale Lake and Lake Merwin near the dams and upstream collection and sorting facilities will be constructed at the Yale Tailrace and either Swift No. 1 dam or the Swift No. 2 Power Canal. All upstream migrants will be transported to Lake Merwin from the Merwin Upstream Collection Facility and adults will have the choice to either stay in Lake Merwin or move upstream to the Yale Upstream Collection and Sorting Facility. Adults and jacks collected at the Yale facility will be transported upstream into Yale Lake. Fish can either choose to remain in Yale Lake or continue upstream to the Swift Upstream Collection and Sorting Facility where, upon collection, they will be transported upstream of Swift Dam and allowed to spawn where they choose. Downstream migrants that enter any of the FSCs will be transported to the Woodland Release Ponds downstream of Merwin. Downstream migrating juveniles will not need to be uniquely marked.

Alternative 3 – Downstream passage facilities are not constructed at Yale or Merwin dams and upstream passage is not provided at Yale tailrace or either Swift No. 1 dam or the Swift No. 2 power canal. Upstream fish passage remains at Merwin Dam and downstream fish passage remains at Swift Reservoir only. According to the Settlement Agreement, the current (2016 inflation-adjusted) amount of the Enhancement Fund is $37.954 million. Available funds for habitat restoration per alternative are dependent on the number of adult- and juvenile-passage facilities constructed. A summary of the funds available and passage facilities to be built for each of the five alternatives is summarized below (Table 2.2-1).

Table 2.2-1. Summary of fish passage facilities, Enhancement Funds and fish operations for each of the five alternatives. The Merwin Adult Upstream Collection Facility and the Swift FSC are included in each alternative (DS=Downstream, US=Upstream)

	OPTION	ENHANCEMENT FUNDS	D/S COLLECTOR /MERWIN	D/S COLLECTOR /YALE	UPSTEAM COLLECTOR /YALE	UPSTREAM COLLECTOR /SWIFT	ADULT TRANSPORT
1A1 Yale	D/S Only	**$25.303 million**	NO	YES	NO	NO	Adults into Yale
1A2 Yale	D/S Only	**$25.303 million**	NO	YES	NO	NO	No adults into Yale; Collect entrained juveniles from Swift
1B Yale	U/S & D/S	**$18.997 million**	NO	YES	NO	YES	All adults into Yale & adults into Swift (volitionally only)
2 Yale & Merwin	U/S & D/S	**$0**	YES	YES	YES	YES	Move all adult fish into Merwin
3	Passage at Neither	**$37.954 million**	NO	NO	NO	NO	Move all adults into Swift (current scenario)

2.3 Define Data Needs

Participants evaluating the five passage scenarios required reviews of existing and, in some cases, additional data to inform their decision. This included new EDT modeling, review of existing Lake Merwin predation data, potential bull trout interaction, Regional Recovery Goals, Yale and Merwin habitat availability, and juvenile collection efficiency of other passage facilities in the Region. Information on each of these topics was provided to both work groups during meetings and through written summaries/memorandums to participants. A summary of the information requested is presented below.

2.3.1 Additional EDT Modeling

During FERC relicensing, habitat modeling was used to determine the potential of stream habitat upstream of Merwin Dam to support coho, Chinook, and steelhead[3]. Estimates of juvenile and adult production of each of these species were developed by using the Ecosystem Diagnosis and Treatment Model (EDT) (PacifiCorp and Cowlitz PUD 2004)[4].

EDT uses 46 habitat attributes and a set of biological inputs to compute the productivity, capacity, abundance, and diversity of the target salmonid species. The model is deterministic, as it does not incorporate uncertainty or randomness in modeling inputs. Rather it assumes that the relationship between fish performance and habitat quality and quantity is known and then uses a set of biological inputs to calculate fish performance. EDT has been used extensively in the Pacific Northwest as a tool to develop fisheries subbasin plans for the Columbia River, Snake River, Willamette River, and multiple rivers in

[3] Fall Chinook were also modeled but because fisheries managers decided not to reintroduce this Chinook race to areas upstream of Merwin Dam results are not discussed in this document.
[4] PacifiCorp and Cowlitz PUD 2004. Lewis River Fish Planning Document. Prepared by S.P. Cramer and Associates.

Puget Sound (https://www.nwcouncil.org/fw/subbasinplanning/home/). A complete description of the EDT model can be found in Lestelle et al. 1999[5].

In 2004, habitat data used in EDT modeling were derived from multiple sources including, 1) published literature, 2) results of relicensing studies, and 3) professional opinion. Because of a lack of data on habitat conditions in a large number of streams, professional opinion was used to rate habitat where such information was unavailable.

The results of the 2004 EDT analysis were used to help inform Lewis River Settlement Agreement discussions regarding possible anadromous fish production with the implementation of upstream and downstream fish passage structures at each of the three project dams (Merwin, Yale, and Swift).

As part of the development of New Information to inform fish passage, inputs to the EDT model were updated in 2016 (PacifiCorp 2016)[6]. Habitat surveys conducted by the United States Geological Survey (USGS) in tributaries upstream of Merwin Dam were the primary data source used in EDT modeling. The USGS data were supplemented by information collected during relicensing as part of the 2004 AQU-4 habitat report (PacifiCorp 2004)[7]. All new inputs to the EDT model were reviewed and approved by the ACC during a series of meetings held in 2015 and 2016. Information deemed necessary for evaluation of fish passage options were as follows:

1. Anadromous Fish Production- Theoretical adult and juvenile production originating from the three geographic analysis areas (Merwin, Yale, and Swift).

2. Habitat Limiting Factors and Reach Restoration Analysis- Stream habitat related factors that currently limit salmon and steelhead production in individual streams located in each geographic area of the basin, and changes in adult production with elimination of the limiting habitat factor.

3. Watershed Restoration Analysis- The increase in salmon and steelhead production if habitat conditions in each stream were restored to historical (Template) conditions. The results of this analysis are used to determine the key watersheds that, if restored, would produce the largest increase in adult abundance[8].

The 2016 EDT model results developed by ICF (Karl Dickman) and DJWA (Kevin Malone) were a key data set used to evaluate the five analysis alternatives. A summary of EDT results is presented in Section 3.1 of this report and in Appendix C.

[5] EDT: the ecosystem diagnosis and treatment method. Project number 9404600. Report. Bonneville Power Administration, Portland, Oregon

[6] PacifiCorp 2016. Lewis Ecosystem Diagnosis and Treatment Analysis. Prepared by D.J. Warren and Associates. Appendix C of New Information Regarding Fish Transport into Lake Merwin and Yale Lake.

[7] PacifiCorp 2004. AQU 4- Assessment of Potential Anadromous Fish Habitat Upstream of Merwin Dam.

[8] The template condition in EDT represents the baseline condition from which current conditions are compared. For the Lewis River, template conditions for habitat upstream of Merwin reflect pre-development conditions with the exception that the dams and reservoirs are in place; resulting in the conversion of stream habitat to reservoir. Stream habitat attribute ratings in the Lewis River downstream of Merwin only approximate pre-development habitat conditions. For example, because data were not available to quantify total side-channel habitat, the amount of side-channel habitat was set at 15 percent based on a simple assumption that there should have been more of this habitat type prior to development. Flow attribute ratings for the lower Lewis River mainstem assumed that dams were removed. Habitat in the mainstem Columbia River was rated based on current conditions.

The results of the analysis indicated that current habitat quantity and quality upstream of Merwin Dam was capable of producing approximately 12,253 coho, 2,014 spring Chinook and 2,005 steelhead, assuming fish survival through project structures was high (>95%) (Figure 2.3-1).

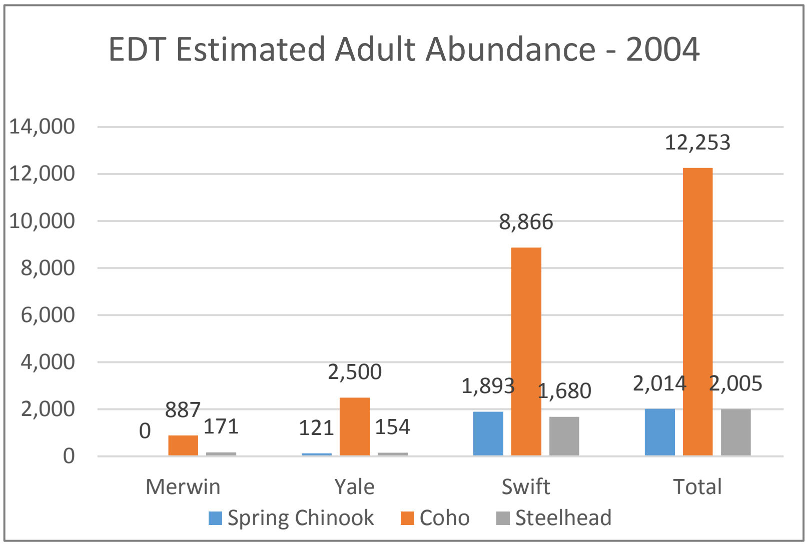


Figure 2.3-1. EDT estimates of spring Chinook, coho and steelhead adult abundance for Merwin, Yale, and Swift as developed during FERC relicensing in 2004.

2.3.2 Merwin Predation

A 2013 study conducted by the USGS and reported in the June 2016 New Information Report (PacifiCorp 2016) was designed to estimate the magnitude of predation mortality on current resident salmonids in Lake Merwin and to predict potential predation impacts on reintroduced juvenile anadromous salmonids. Northern Pikeminnow (*Ptychocheilus oregonensis)* was identified as an abundant predator of juvenile salmon in Lake Merwin in the 1950s and 1960s. The abundance of predatory sized Northern Pikeminnow (≥200 mm) was estimated at approximately 350,000 fish in 1961; however, the population has not since been assessed (PacifiCorp 2016). Potential predation impacts on reintroduced coho were discussed at several meetings; a summary is provided in Section 3.2 of this report.

2.3.3 Bull Trout Status

Interaction of re-introduced salmonids and federally listed bull trout was a topic discussed throughout meetings held in 2016. Of particular interest to participants was potential coho interaction with the Cougar Creek bull trout subpopulation (Yale Lake tributary). Per the USGS (PacifiCorp 2016), spawning timing of coho and similar substrate requirements suggest coho redd superimposition may be possible, particularly when large numbers of hatchery adults are released in areas with extant bull trout populations. A summary of information/data collected by PacifiCorp (Jeremiah Doyle) relative to bull trout interaction is presented in Section 3.3.

2.3.4 Assessment of Surface Collector Systems in the Pacific Northwest

The USGS provided a review of surface collector development, design, and performance at other dams and reservoirs in the Pacific Northwest. Information was also provided on the research and monitoring used to evaluate these systems at different projects.

3.0 DATA SUMMARIES

3.1 EDT

In the first step in the EDT analysis, the Science Work Group requested that Alternative 2 (Full Passage) as defined in the Settlement Agreement, be run under two different scenarios: Scenario 1 was developed to determine the maximum possible coho, spring Chinook, and steelhead adult returns to the basin; while Scenario 2 provided a more realistic estimate of adult returns given expected harvest rates, the use of less fecund spring Chinook hatchery fish for reintroduction, and additional mortality associated with adult fish having to pass multiple dams during migration. As was the case for the 2004 model runs, the majority of fish production originated from above Swift Dam, followed by Yale and then Merwin for the species modeled[9] (Figure 3.1-1) (PacifiCorp 2016). The adult abundance numbers reflected the amount of stream habitat located in river reaches associated with each dam; i.e. the more miles of habitat the more fish produced (Table 3.1-1).

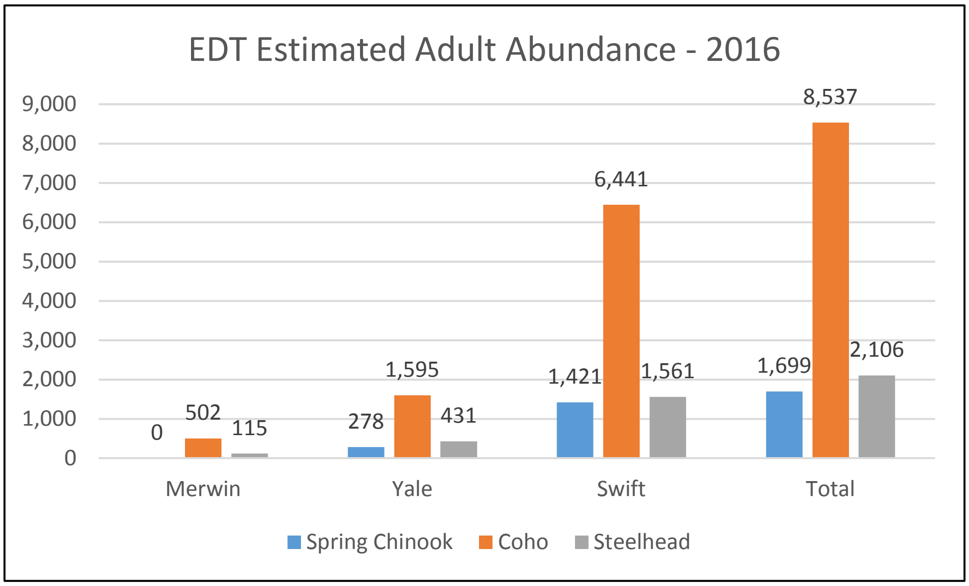


Figure 3.1-1. EDT Scenario 2 estimates of spring Chinook, coho and steelhead adult abundance for Merwin, Yale, and Swift as developed in June of 2016 (PacifiCorp 2016, Table 3.4).

The ACC Science Workgroup developed and approved assumptions for 2017 EDT model runs completed on January 18, January 19, and again on February 2, 2017. Assumptions and results for each model run, including the cost of restoration, and model documentation were discussed at the February 2, 2017 meeting (Appendix C). Alternatives modeled and associated kilometers of restored habitat in each are summarized below (Table 3.1-2). Candidate stream reaches for restoration in each model run are also shown below (Table 3.1-3).

[9] Spring Chinook were not modeled in Merwin as the only suitable habitat was in Speelyai Creek which was reserved for hatchery production.

Table 3.1-1. Available spawning habitat by species for the Merwin, Yale, and Swift geographic areas.

Species	Kilometers Spawning Habitat
Total Spring Chinook	**157.6**
Yale Lake	14.2
Swift Reservoir	143.3
Total Coho salmon	**186.9**
Lake Merwin	9.5
Yale Lake	29.6
Swift Reservoir	147.8
Total Winter Steelhead	**171.6**
Lake Merwin	9.5
Yale Lake	29.6
Swift Reservoir	132.5

Because funds available for habitat restoration varied by alternative, the amount of habitat restored also varied by alternative. For each alternative, the most productive spring Chinook streams, i.e. those producing the highest number of spring Chinook if restored to template conditions, were selected for restoration until monies were exhausted, assuming $500,000/mile ($311,000/kilometer) of restored habitat. Spring Chinook streams were emphasized for restoration based on direction given by the ACC Science Workgroup. Appendix C includes a full description of the modeling process, assumptions, and results.

Table 3.1-2. Description of EDT model runs conducted January 18, 19 and February 2, 2017.

	Model Run Date		
	1/18/2017	**1/19/2017**	**2/2/2017**
Alternatives Modeled	1A1, 1A2, 1B, 2 and 3	1A, 1B and 3	1A1, 1A2, 1B, 2 and 3
Approximate Kilometers of Stream Habitat Restored*	Alt 1A1 and 1A2 = 45.5 Alt 1B = 34.1 Alt 2 = 0 Alt 3 = 68.2	Alt 1A1 and 1A2 = 45 Alt 1B = 33.8 Alt 2 = 0 Alt 3 = 67.45	Alt 1A1 and 1A2 = 45.5 Alt 1B = 34.1 Alt 2 = 0 Alt 3 = 90.91 Swift Only Alt 3 = 99.01 (Swift + Lower Lewis)
Location of Streams Restored	Swift	Swift	Swift Only, and Swift + Lower Lewis River
Assumed Cost to Restore	$500,000 per Kilometer	$500,000 per Kilometer	$500,000 per Mile ($311,000 per Kilometer); $1.9 million per Mile of Lower Lewis River Mainstem Habitat
Species Modeled	Spring Chinook, coho, steelhead	Spring Chinook, coho, steelhead	Spring Chinook, coho, steelhead
Scenarios Modeled	Fish Passage Actions Only, and Fish Passage + Habitat Restoration	Fish Passage Actions Only, and Fish Passage + Habitat Restoration	Scenario 1: Swift Only, and Scenario 2: Swift + Lower Lewis Habitat Restoration (Fish Passage included in Both Scenarios)

Table 3.1-3 shows streams/reaches restored to Template conditions for the January 18, January 19 and February 2, 2017 EDT model runs. Note that the number of streams/reaches restored varied by alternative as restoration monies available varied. The total numbers presented reflect the amount of habitat that was restored to EDT Template conditions for Alternative 3; the alternative with the largest restoration budget.

Table 3.1-3 Streams/reaches restored to Template conditions for the January 18, January 19 and February 2, 2017 EDT model runs.

18-Jan		19-Jan		Feb 2- Upstream of Swift Only		Feb-2 Upstream of Swift and Mainstem Lewis River Below Merwin
Stream/Reach	Length (km)	Stream/Reach	Length (km)	Stream/Reach	Length (km)	Length (km)
Clear Creek	9.9	Clear Creek	9.9	Clear Creek	9.9	9.9
Clear Creek Lower	9.9	Clear Creek Lower	9.9	Clear Creek Lower	9.9	9.9
Clear Creek Small Tribs	3.17	Lewis 18	1.13	Clear Creek Small Tribs	3.17	3.17
Clearwater Creek	8.37	Lewis 19	0.81	Clearwater Creek	8.37	8.37
Clearwater Tribs	1.29	Lewis 20	8.85	Clearwater Tribs	1.29	1.29
Drift Creek	1.52	Lewis 21	1.61	Drift Creek	1.52	1.52
Drift Creek Upper	1.07	Lewis 22	1.77	Drift Creek Upper	1.07	1.07
P1	1.45	Lewis 23	5.63	Lewis 18	1.13	1.13
P10	0.48	Lewis 24	0.64	Lewis 19	0.81	0.81
P3	1.61	Lewis 25	0.48	Lewis 20	8.85	8.85
P7	1.77	Lewis 26	1.45	Lewis 21	1.61	1.61
P8	6.76	Lewis 27	0.32	Lewis 22	1.77	1.77
Pine Creek 1	2.82	P1	1.45	Lewis 23	5.63	5.63
Pine Creek 2	0.81	P10	0.48	Lewis 24	0.64	0.64
Pine Creek 3	1.61	P3	1.61	Lewis 25	0.48	0.48
Pine Creek 4	1.61	P7	1.77	Lewis 26	1.45	1.45
Pine Creek 5	1.61	P8	6.76	Lewis 27	0.32	0.32
Pine Creek 6	4.43	Pine Creek 1	2.82	P1	1.45	1.45
Rush Creek	4.02	Pine Creek 2	0.81	P10	0.48	0.48
S15	2.09	Pine Creek 3	1.61	P3	1.61	1.61
Swift Campground Creek	1.93	Pine Creek 4	1.61	P7	1.77	1.77
		Pine Creek 5	1.61	P8	6.76	6.76
		Pine Creek 6	4.43	Pine Creek 1	2.82	2.82
				Pine Creek 2	0.81	0.81
				Pine Creek 3	1.61	1.61
				Pine Creek 4	1.61	1.61
				Pine Creek 5	1.61	1.61
				Pine Creek 6	4.43	4.43
				Rush Creek	4.02	4.02
				S15	2.09	2.09
				Swift Campground Creek	1.93	1.93
				Mainstem Lewis Below Merwin		8.1
Total January 18	**68.22**	**Total January 19**	**67.45**	**Total February 2**	**90.91**	**99.01**

February 2, 2017 EDT model results for all five alternatives by species are presented below (Table 3.1-4). The run reflects the outcome for the model run wherein habitat is restored upstream of Swift and the mainstem Lewis River below Merwin Dam. Model results by species for the three individual geographic areas (Merwin, Swift, and Yale) are presented in Table 3.1-5.

The best performing alternatives in regard to adult abundance, spatial structure, productivity, and diversity are shown in green in Table 3.1-4. To illustrate, the highest adult spring Chinook abundance was Alternative 3, with 3,911 fish. The numbers represent results wherein habitat is restored to EDT Template conditions both upstream of Swift and mainstem Lewis River habitat below Merwin Dam as identified in Table 3.1-3. Major assumptions used in the model run are also provided. Green cells represent the best performing alternative in regard to adult abundance, spatial structure, productivity and diversity for spring Chinook, coho and winter steelhead.

Table 3.1-4. February 2, 2017 EDT model run results, Scenario 2.

	Spring Chinook				Coho				Winter Steelhead				
Alternative	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance All Species
1A1	3,752	100%	5.76	86%	11,878	95%	7.6	80%	2,437	94%	12.81	82%	18,067
1A2	3,686	91%	6.40	86%	11,121	79%	8.2	86%	2,210	77%	14.51	85%	17,017
1B	3,532	100%	5.43	85%	11,011	95%	6.6	81%	2,196	94%	12.03	80%	16,739
2	2,800	100%	4.83	75%	8,445	100%	5.2	69%	1,943	100%	8.64	73%	13,188
3	3,911	91%	6.38	89%	12,153	79%	8.8	88%	2,280	77%	15.51	87%	18,344

Percent Difference Between Alternatives and Alternative 2 (Full Passage No Habitat)

	Spring Chinook				Coho				Winter Steelhead				
Alternative	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance All Species
1A1	34%	0%	19%	15%	41%	-5%	46%	15%	25%	-6%	48%	12%	37%
1A2	32%	-9%	33%	15%	32%	-21%	57%	23%	14%	-23%	68%	16%	29%
1B	26%	0%	13%	13%	30%	-5%	27%	17%	13%	-6%	39%	9%	27%
2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3	40%	-9%	32%	19%	44%	-21%	68%	27%	17%	-23%	79%	19%	39%

Parameter	Model Run Assumptions 2-Feb
Overall Downstream Survival (ODS)	75% (Alternatives 1A1, 1B, 2); 80% (Alternatives 1A2 and 3)
Juvenile Collection Efficiency (CE)	95%
Turbine/Spill Survival Rate for Swift No. 1 and Swift No.2, Respectively*	90%
Adult Trap Efficiency (ATE)	98%
Upstream Passage Survival (UPS)	99.50%
Spring Chinook, Coho and Steelhead Harvest Rates, Respectively	10%, 15%, 5%
Stream Habitat Restored to Template	1) Both Tributaries and Mainstem Lewis River Upstream of Swift (91 km, 56.5 miles) 2) All of 1 plus 8.1 km (5 miles) of Mainstem Lewis Below Merwin (total of 99 km, 61.5 miles).

*See Appendix C.

The percent change calculated for each parameter is based on the difference between each alternative and Alternative 2 (full passage, no habitat improvements). Spatial structure is highest under Alternative 2 as fish have access to habitat in all three geographic areas[10].

For all species combined, the most adults (18,344) were produced under Alternative 3 followed closely by Alternative 1A1 (18,067). The lowest performing alternative was Alternative 2 wherein fish passage is provided at all three projects and no restoration of habitat occurs. The total number of adults produced in Alternative 2 was 13,188. For winter steelhead, Alternative 1A1 produced the largest percent change in abundance (25%). Relative to recovery goals for all 5 alternatives, the EDT predicted total abundance values for each of the three species (spring Chinook, coho and winter steelhead) surpassed targets set for the Lower North Fork Lewis River as described in the May, 2010 Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan for the North Fork Lewis River (https://www.lcfrb.gen.wa.us/library salmonrecovery) (Table 3.1.5).

Alternative 3 also showed the largest increase in productivity for winter steelhead (79%) and coho (68%). Alternative 3 also had a lower percent change in productivity (32%) compared to Alternative 1A2 (33%) for spring Chinook, but the difference was small. Results vary for Alternative 1A2 and 3 due to the total amount of monies available for habitat restoration. Alternative 1A2 has a total of $25.303 million to spend while Alternative 3 has $37.954 million. This resulted in more miles of habitat being restored in Alternative 3 than Alternative 1A2 (Table 3.1-2 shows amount of habitat restored in each alternative).

Alternatives 1A1 and 1B showed the lowest percent change in spatial structure compared to Alternative 2. Alternative 3 showed the largest percent difference in spatial structure as fish only have access to stream habitat above Swift Dam. The largest increase in diversity (19%-27%) for all three species occurred under Alternative 3 as well. Alternative 1A2 had the second largest percent change in diversity (15%-23%) for all three species.

Table 3.1-5. Status and goals for spring Chinook, winter steelhead, and coho populations in the Lower North Fork Lewis River (modified from Washington Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan, Vols. I - III. Longview, Washington. May 2010).

Species	Population	Recovery priority[1]	Viability Status[2]	Viability Obj.[3]	Improve-ment[4]	Abundance Historical5	Abundance Current6	Abundance Target7
Spring Chinook	NF Lewis	Primary	VL	H	>500%	15,700	300	1,500
Winter Steelhead	NF Lewis	Contributing	VL	M	>500%	8,300	150	400
Coho	NF Lewis	Contributing	VL	L	50%	40,000	200	500

[1] Primary, Contributing, and Stabilizing designations reflect the relative contribution of a population to major population group recovery goals.
[2] Baseline viability is based on Technical Recovery Team viability rating approach.
[3] Viability objective is based on the scenario contribution.
[4] Improvement is the relative increase in population production required to reach the prescribed viability goal.
[5] Historical population size inferred from presumed habitat conditions using Ecosystem Diagnosis and Treatment Model and NMFS back-of-envelope calculations.
[6] Approximate current annual range in number of naturally-produced fish returning to the watershed.
[7] Abundance targets were estimated by population viability simulations based on viability goals.

[10] Spring Chinook were not modeled in the Merwin geographic area as the only stream deemed to have habitat that could support spring Chinook production was reserved for hatchery operations.

Table 3.1-6. February 2, 2017 EDT results for Merwin, Yale, and Swift geographic areas. Habitat restored is upstream of Swift and mainstem Lewis Downstream of Merwin.

	Adult				Juvenile		
Alternative 1A1	**Diversity**	**Productivity**	**Capacity**	**Abundance**	**Productivity**	**Capacity**	**Abundance**
	Spring Chinook						
Total	85.8%	5.8	4,541	3,752	447	888,465	580,932
Yale Lake	98.0%	3.9	388	288	604	129,948	74,364
Swift Reservoir	84.5%	5.9	4,152	3,453	433	758,516	503,113
	Coho						
Total	79.8%	7.6	13,681	11,878	209	1,005,894	716,191
Yale Lake	50.6%	4.8	1,792	1,417	282	443,251	210,248
Swift Reservoir	85.8%	7.8	11,827	10,315	204	553,799	438,448
	Winter Steelhead						
Total	82.1%	12.8	2,643	2,437	209	64,710	57,401
Yale Lake	68.1%	6.9	336	288	128	9,001	7,232
Swift Reservoir	85.3%	13.5	2,301	2,131	219	55,576	49,654
Alternative 1A2	**Diversity**	**Productivity**	**Capacity**	**Abundance**	**Productivity**	**Capacity**	**Abundance**
	Spring Chinook						
Total	85.9%	6.4	4,368	3,686	457	786,586	536,183
Swift Reservoir	85.9%	6.4	4,368	3,686	457	786,586	536,183
Coho	**Coho**						
Total	85.7%	8.2	12,670	11,121	213	574,002	462,102
Swift Reservoir	85.7%	8.2	12,670	11,121	213	574,002	462,102
	Winter Steelhead						
Total	85.4%	14.5	2,374	2,210	232	56,819	51,158
Swift Reservoir	85.4%	14.5	2,374	2,210	232	56,819	51,158
Alternative 1B	**Diversity**	**Productivity**	**Capacity**	**Abundance**	**Productivity**	**Capacity**	**Abundance**
	Spring Chinook						
Total	84.8%	5.4	4,329	3,532	378	681,845	451,245
Yale Lake	98.3%	3.6	368	266	562	119,210	66,264
Swift Reservoir	83.5%	5.6	3,961	3,252	362	562,635	380,701
	Coho						
Total	81.1%	6.6	12,976	11,011	175	907,379	617,164
Yale Lake	49.9%	4.0	1,521	1,145	300	505,004	204,211
Swift Reservoir	87.2%	6.8	11,380	9,702	167	396,314	318,552
	Winter Steelhead						
Total	80.3%	12.0	2,395	2,196	192	54,832	48,510
Yale Lake	65.3%	6.8	327	279	124	8,630	6,908
Swift Reservoir	83.4%	12.7	2,061	1,899	201	45,980	41,026
Alternative 2	**Diversity**	**Productivity**	**Capacity**	**Abundance**	**Productivity**	**Capacity**	**Abundance**
	Spring Chinook						
Total	74.7%	4.8	3531	2800	348	635,293	384,697
Yale Lake	98.0%	3.6	365	263	586	123,348	68,578
Swift Reservoir	72.4%	5.0	3,166	2,531	318	511,945	313,091
	Coho						
Total	69.5%	5.2	10,450	8,445	153	867,594	518,426
Merwin	68.0%	4.7	568	447	141	31,360	20,918
Yale Lake	48.4%	4.0	1,559	1,167	268	424,538	180,236
Swift Reservoir	73.7%	5.4	8,322	6,770	142	411,697	288,157
	Winter Steelhead						
Total	73.4%	8.6	2,197	1,943	144	51,206	43,270
Merwin	68.5%	5.0	82	66	94	1,941	1,479
Yale Lake	65.6%	6.7	330	281	122	8,626	6,894
Swift Reservoir	75.3%	9.2	1,777	1,583	150	40,414	34,526
Alternative 3	**Diversity**	**Productivity**	**Capacity**	**Abundance**	**Productivity**	**Capacity**	**Abundance**
	Spring Chinook						
Total	88.8%	6.4	4,638	3,911	474	851,209	583,416
Swift Reservoir	88.8%	6.4	4,638	3,911	474	851,209	583,416
	Coho						
Total	88.4%	8.8	13,720	12,153	233	636,032	519,327
Swift Reservoir	88.4%	8.8	13,720	12,153	233	636,032	519,327
	Winter Steelhead						
Total	87.0%	15.5	2,437	2,280	247	58,479	52,983
Swift Reservoir	87.0%	15.5	2,437	2,280	247	58,479	52,983

3.2 Bull Trout Interactions

At the October 20, 2016 meeting of the ACC Fish Passage Decision Group, Jeremiah Doyle (PacifiCorp) provided background and an overview of recent data collected concerning Cougar Creek bull trout. Highlights included:

- The USFWS completed the Bull Trout Recovery Plan that identified that the Lewis River bull trout population is one of seven core populations within the Lower Columbia Region.
- Cougar Creek bull trout are one of three local subpopulations in the Lewis River basin, others being Pine and Rush Creek in Swift Reservoir.
- All three subpopulations have been analyzed and found to be genetically distinct from each other.
- Cougar Creek has experienced introgression from populations upstream, but a distinct Cougar strain still exists.
- Cougar Creek is the only known available bull trout spawning habitat within Yale Reservoir.
- Approximately 1,700 meters of available bull trout habitat exist within Cougar Creek.
- Coho fry were unexpectedly encountered during bull trout electrofishing surveys of Cougar Creek in 2016.
- Progeny likely from an unknown number of coho adults spilled from Swift Reservoir during a December 2015 high water event.
- Given the timing of the high water event, spilled coho were likely late stock adults, of which 3,435 were released into Swift Reservoir in 2015.
- Within Cougar Creek, coho were captured only in the lower portion of the creek. Fork length of 300 coho captures averaged 48 millimeters.
- Coho to bull trout fry densities within Cougar Creek were observed to be 5 to 1.
- Coho fry were also observed within Constructed Channel and Ole Creek, tributaries to the Swift Bypass Reach.

3.3 Merwin Predation

Section 3.5 of the New Information Report (PacifiCorp 2016) describes work by USGS assessing predation risks to re-introduced anadromous salmonids in Lake Merwin. USGS developed an annual consumption rate by a population of 1,000 large Northern pikeminnow of approximately 16,000–40,000 age–0 spring Chinook salmon rearing in the reservoir. A population of 11,240 fully piscivorous (≥ 300 mm) Northern pikeminnow in Lake Merwin was determined at a 95% confidence interval. A key assumption made in the USGS analysis was that predation would shift from kokanee to anadromous fish.

A handout summarizing predation impacts in Lake Merwin was provided to participants at the November 22, 2016, meeting of the ACC Fish Passage Decision Group. Based on USGS's estimated abundance; it noted that the 11,240 piscivorous Northern Pikeminnow in Lake Merwin could consume between 179,840 and 449,600 juvenile coho on annual basis. At the low end, this would exceed the EDT-based abundance estimate of the combined number of coho juveniles (109,209) originating from the six tributaries to Lake Merwin, collected and transported to release ponds in the lower Lewis River[11].

The summary noted above applied USGS's predation rates, assuming year-round rearing in the reservoir by juvenile salmon and steelhead. USGS noted that the annual predation rate did not take into account

[11] EDT-based juvenile production numbers in Table 3.1-5 reflects 0-1+ age juveniles leaving the North Fork Lewis at the mouth of the Columbia River and not the number leaving the release ponds.

monthly variation in migration rates of anadromous salmonids and timing or reservoir thermal regimes. The study notes that, in Swift Reservoir, median rearing time for hatchery-reared spring Chinook is 2 months, and for coho 4 months. It also notes that 30 percent of chinook are rearing in the reservoir for more than 9 months.

USGS concluded that large Northern pikeminnow represent a substantial predation threat to anadromous smolts in Lake Merwin. However, as noted in discussion at the November 22, 2016 meeting, and again on May 11, 2017, assumptions of a shift from kokanee to anadromous fish and year-round rearing in the reservoir likely overestimate predation impacts to anadromous smolts in Lake Merwin.

3.4 Assessment of Surface Collectors in the Pacific Northwest (USGS)

In a presentation given December 8, 2016, to the Lewis River ACC Fish Passage Decision Group, Toby Kock of the USGS reviewed surface collectors at the following projects:

1. Upper Baker – Baker River
2. Lower Baker – Baker River
3. Swift Dam – Lewis River
4. North Fork – Clackamas River
5. River Mill – Clackamas River
6. Round Butte – Deschutes River
7. Cougar Dam – McKenzie River
8. Cushman Dam – Skokomish River

The USGS found that surface collector performance varies by project and the relatively unique physical conditions and species present at each. Factors that are likely affecting system performance include inflow, effective forebay size, operating environment, and target species.

The juvenile collection efficiency of the surface collectors examined ranged from 1 percent to over 98 percent (Table 3.4-1). Average collection efficiency for Chinook, coho, sockeye, and steelhead was 50%, 70.5%, 86.8% and 62.5%, respectively.

Table 3.4-1. Estimated juvenile collection efficiency of surface collector systems reported by the USGS. Data are preliminary with a final report due in 2017.

	Species			
Location	**Chinook**	**Coho**	**Sockeye**	**Steelhead**
Upper Baker		92.5%	86.3%	
Lower Baker		92.1%	87.3%	
Cushman		32.9%		
Swift Dam	0%	11.8%		18.6%
North Fork	87.3%	94.5%		95.5%
River Mill	98.3%	98.9%		96.9%
Round Butte	62%			39%
Cougar	<1%			
Average	**50%**	**70.5%**	**86.8%**	**62.5%**

4.0 DIALOGUE

The members of the Core Science Work Group engaged in extensive dialogue regarding the biological consequences of each of the various alternatives. They considered likely long-term impacts as well as possible unintended consequences of each. The term "dialogue" is especially appropriate as it comes from the Greek words *dia* (meaning "through") and *logos (meaning "word" or "meaning")*. Essentially, dialogue is a flow of meaning among parties.

After the decision to transition the Science Work Group meetings to the smaller Core Science Work Group, the attending representative of each participating entity committed to drafting a position paper reflecting the current thinking of their organizations, describing which alternative they preferred along with the supporting science (Appendix A). These were distributed to Work Group members for review prior to the meeting held on February 22, 2017, and they were extremely helpful in sparking dialogue.

At the February 22, 2017 meeting, Pat Frazier (WDFW), who hosted the meeting, posed the question: "What is the best use of fish passage and/or in lieu finds to provide the best benefits to salmon and steelhead in the Lewis River?" and asked if others agreed that their focus would be to answer that question looking through the lens of science. His intent was to help guard against scope creep and ensure a science-based focus. This question was accepted as on target by all with the exception of Eli Asher (representing the Cowlitz Indian Tribe). Citing the Settlement Agreement, Eli suggested that the more appropriate question was whether there was sufficient compelling scientific data (new information) indicating it was not wise to build full passage at both Merwin and Yale. That said, Eli acknowledged that as he was not in attendance at the ACC In-Lieu Fish Passage Group meetings that spawned the Science Work Group. Reminding all that the Tribe would weigh in separately with the Services on this issue, he said he would not stand in the way of the work group's focus on answering the question posed by Pat.

At the end of the February 22, 2017 meeting, a roll call vote revealed that four of the five alternatives remained. Narrowing the number of alternatives on the table showed progress. There was discussion around exploring the addition of an adaptive management / Monitoring and Evaluation (M&E) program associated with Alternative 1B, which became a unique Alternative 1B+. WDFW offered to flesh this out for further consideration and present what such a program might entail at the March 17, 2017 meeting.

The draft adaptive management/M&E plan, prepared by WDFW was distributed for participants to review ahead of the meeting on March 17, 2017, and Alternative 1B+ was considered by all at the meeting. Additional questions were raised about how the M&E and adaptive management programs might be operationalized. At the end of that meeting, largely in recognition that PacifiCorp would fund the adaptive management program, Todd Olson (PacifiCorp) volunteered to develop further detail around what the 1B+ M&E program might include (see Appendix D for both WDFW and Utility Drafts). Again, this was sent out for all to consider prior to the final meeting on May 11, 2017. Note: The Services participated fully in these meetings, though they did not submit a position paper. Nor did they take part in the polling of preferred alternatives that occurred at the end of each of the Core Science Work Group meetings.

5.0 SCIENCE–BASED RECOMMENDATIONS

During the final meeting of the Core Science Work Group on May 11, 2017, Todd Olson walked through the document he prepared to further describe how Alternative 1B+ M&E program (temporary upstream collection at Swift, downstream at Yale) might work (see Draft in Appendix D). Results of the M&E program would ideally determine the ultimate size of permanent fish collection facilities at Yale and help identify both positive and negative impacts to bull trout. There were questions about the adaptive management piece (sizing and moving from a temporary to a permanent facility, etc.) and the what-ifs with respect to bull trout interaction. Todd explained that PacifiCorp would be able to expand the Swift facility for upstream passage – but not likely for downstream at Yale (i.e., turn a temporary juvenile collector into a permanent collector). There was concern that if the temporary juvenile collector does not prove effective, juveniles would be trapped in Yale Reservoir, thereby creating a landlocked population. There was also concern about the delayed timing of the construction of the facilities and whether the effectiveness of passive downstream collection would be sufficient to achieve recovery goals or Settlement Agreement performance standards. The Utilities expressed interest in further analysis/development of triggers, optimal numbers of fish being transported into Yale – adaptive management components.

After additional dialogue, members of the Core Science Work Group collectively agreed that they had reached the point where more data would not bring them closer to a consensus recommendation to the Services on a preferred alternative. It was time to document the work of this group and pass it on to the Services for review. Once again, the commitment of the members of this group was evident as they agreed that if the Services came back with an additional ask of the group, they would be happy to reconvene. Otherwise, their work is memorialized in this document and will help to inform the Services as they coordinate policy-level meetings and consultation with the Tribes. There was no consensus on a preferred alternative.

Position papers describing their preferred Alternative were shared by each Participant at the February 22, 2017 meeting at WDFW's offices in Vancouver (Appendix A). The final votes for the preferred Alternative to recommend to the Services were as follows, based on discussion at the May 11, 2017 meeting at Merwin HCC:

- 1B: USDA FS
  - Rationale: Though comfortable with the staged approach of the upstream collector, there was concern about the extended timing (delay) of the full downstream collector. Measures such as deferred, incremental, or limited coho releases into Yale with concurrent bull trout population monitoring provide adaptive management opportunities while avoiding interference with passage infrastructure design and/or construction time frames related to the reintroduction of anadromous species.

- 1B+: WDFW and LCFRB
  - LCRFB Rationale: Concern that predation in Merwin would be a mortality sink. There is a greater potential for recovery if we take advantage of Yale.
  - WDFW Rationale: While emphasizing the need for adequate juvenile collection downstream, this provides a good path toward getting the passage facilities constructed and ensuring they are properly sized. WDFW agreed with LCRFB that we might end up worse

off (regardless of the in lieu) by putting fish into Merwin due to predation and lack of habitat. Providing access to Merwin Reservior would not benefit spring Chinook, and provide only a minimal increase in coho and steelhead abundance.

- 2: The Cowlitz Tribe
  - Rationale: While finding the M&E portion of Alternative 1B+ to be comprehensive, there was doubt that the passive, downstream migration would be effective. Also expressed concern about the adaptive management piece and the what-ifs with respect to bull trout interaction. And finally, reiterated that the Settlement Agreement says that if any party brings New Information indicating that reintroduction is inappropriate, then alternative approaches should be discussed. If the Services deem that reintroduction is indeed inappropriate, then and only then should the option of in-lieu fund/habitat actions be considered. The Cowlitz Tribe believes that reintroduction is appropriate. The Tribe does not see that a fatal flaw has been exposed regarding reintroduction.

- 3: The Utilities
  - Rationale: While understanding why everyone has an interest in Yale, they do not see it as a clear biological win to put fish passage into Yale. This view is based on the EDT estimated fish production using the in-lieu habitat fund. They also acknowledged that others feel the other VSP parameters are important.

At the conclusion of the May 11, 2017 meeting, Mark Celedonia (USFWS) and Michelle Day (NMFS) expressed sincere appreciation to everyone at the table for remaining committed to a collaborative exploration of the various alternatives through so many meetings over the past several months. They found this especially heartening in consideration of the extremely stretched resources of the participating organizations. Through this process, they have gained a rich understanding not only of the biological issues but of the various perspectives of those so dedicated to actions that will ultimately lead to achieving escapement and other recovery goals of listed species.

APPENDIX A

Position Papers from Core Science Team Work Group Member Organizations provided on February 22, 2017

Appendix A – Cowlitz Tribe

March 1, 2017

The National Marine Fisheries Service and United States Fish and Wildlife Service (Services) have invited members of the Lewis River Aquatic Coordinating Committee (ACC) to form a subgroup of members to advise the Services on their technical opinions of new information gathered by PacifiCorp and Cowlitz PUD (Utilities) to inform potential intervention in scheduled fish passage improvements through the Lewis River Project. The spirit and language of the Settlement Agreement does not allow for ACC or ACC subcommittee revision of this spirit or language; rather, the ACC may serve an advisory role to the Services in their decision regarding the appropriateness of reintroduction. If the Services decide that new information indicates that full fish passage is inappropriate, they may intervene in the scheduled implementation of fish passage through the project. This action would trigger contributions by the Utilities to an in-lieu account that may be used for a variety of salmon and steelhead recovery actions:

> Section 4.1.9(a)
> The Licensees shall construct and provide for the operation and maintenance of both upstream and downstream fish collection and transport facilities at each of Merwin Dam, Yale Dam, and the Swift Projects as provided in the schedule in this Agreement unless otherwise directed by the Services pursuant to this Section. New Information (defined below) relevant to reintroduction and fish passage into Yale Lake or Lake Merwin may be available to the Services that may influence the implementation of fish passage into and out of these reservoirs, or that could result in the Services determining that reintroduction or fish passage for anadromous fish is inappropriate. **If the Services conclude upon review of the New Information that one or more of the passage facilities should not be constructed, in lieu of designing, permitting, constructing, and operating the passage facility, PacifiCorp shall provide additional funds for projects in lieu of fish passage, as set forth in Section 7.6.** […] [emphasis added]

The evaluation of alternatives combined with associated in-lieu payments is clearly contrary to the spirit and language of the Settlement Agreement. The facilitated process conducted at the request of the Services has conflated the separate fish passage implementation and in-lieu processes outlined in the Settlement Agreement. For example, the informal titles of the subgroups, such as "ACC In-Lieu Science Review" presume that in-lieu funding is a foregone conclusion. The substance of the discussions has focused on the amount of potential in-lieu funding as a driving evaluation criterion. This appears to be an intentional misreading of the Settlement Agreement. The technical decision at hand for the Services is whether or not previously agreed-upon implementation of full fish passage into Merwin and Yale is now *inappropriate* based on new information.

The Cowlitz Indian Tribe's technical perspective is that reintroducing anadromous salmonids to Merwin and Yale reservoirs and associated tributaries continues to be an appropriate action to support salmon and steelhead recovery goals as described in the Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan and the Lewis River Settlement Agreement. None of the new information provided during this evaluation has convinced the Tribe's staff that full reintroduction of anadromous salmonids to their native range in the Lewis basin is an inappropriate action. The most prominent arguments voiced against full reintroduction over the course of several meetings include concerns over limited habitat availability in Merwin Reservoir and tributaries, predation risk in Merwin Reservoir, performance of fish collection facilities in general, and bull trout interaction with coho in Yale Reservoir. The Tribe's technical staff will not directly address concerns related to feasibility, suitability, cost, or effectiveness of habitat actions funded by in-lieu contributions unless the Services first decide that fish passage through the Lewis River Project is inappropriate.

While the relative benefit to populations of reintroduction to Merwin are apparently lower than to Yale or Swift, EDT modeling conducted during this review indicates that Merwin can provide productive spawning and rearing habitat, particularly for coho and steelhead. Merwin does not appear to be a population sink provided that PacifiCorp is able to successfully implement upstream and downstream passage per the requirements of the FERC license. The relatively short tributary reaches and steep habitat existed prior to the current license term, and while they have been more thoroughly quantified, they have not fundamentally changed since license issuance.

Merwin appears to have an abundant population of northern pikeminnow, many of which are large enough to pose a predation risk to juvenile salmonids. This is a potential problem created and perpetuated by the hydropower project, not an insurmountable barrier to planned reintroduction. Pikeminnow predation has been a perennial concern in Merwin long before the current license term, and hardly constitutes new information. In the late 1950s and early 1960s, the Washington Department of Fisheries and Pacific Power and Light investigated Merwin Reservoir as potential coho rearing habitat. While growth was excellent, survival was lower than desired. The study identified [northern pikeminnow] as the likely culprit, leading to treatment of Merwin Reservoir with 45 tons of rotenone in an attempt to control the predators. Predator control and mitigation techniques have improved in the intervening five decades, and we are confident that the current incarnations of the responsible parties can mitigate this potential risk to reintroduced salmonids by evaluating and adaptively managing after reintroduction.

Fish collection remains a challenge, particularly juvenile collection at high-head dams such as those in the Lewis project. This is, however, a challenge primarily of technology and forgone generation revenue; neither is a compelling reason for the Services to declare reintroduction inappropriate for the license term. PacifiCorp appears to enthusiastically embrace and promote improvements in fish collection technology. We have faith that this progress will continue, and will provide an example for success throughout the region.

Bull trout interaction with reintroduced salmon, particularly in Cougar Creek, is a potential risk to a population that has been isolated by the construction and operation of the Lewis River Project. While coho reintroduction to Yale may impact bull trout, these two species coexisted since time immemorial. If they can no longer coexist, that is a direct result of the hydropower project, and should not be used to preclude or artificially restrict equally ESA-listed salmon access to productive tributaries to Yale Reservoir.

In summary, the Tribe's technical staff appreciates the level of information gathered and analyzed by PacifiCorp's contractors and members of the ACC, but respectfully maintains that in sum, the new information does not render full reintroduction inappropriate. The Services should stand by the spirit and language of the Settlement Agreement and decline intervention in the established reintroduction plan.

Appendix A – Utilities

February 22, 2017

The following information was presented to the Lewis River Future Fish Passage In-Lieu Decision Science Subgroup on February 22, 2017 by Todd Olson on behalf of PacifiCorp and Cowlitz PUD ("Utilities"). For some items below, information is presented that may or may not have been verbally expressed to the subgroup at the meeting, but is information the Utilities feel is relevant to the support of their preferred alternative.

Recovery Goals:

1. **Settlement Agreement Outcome Goal:** Achieve genetically viable, self-sustaining, naturally reproducing, harvestable populations above Merwin dam greater than minimum viable populations.

2. **Lower Columbia River Salmon and Steelhead ESA Recovery Plan – June 2013:** The goal of this plan is for the Lower Columbia River Coho salmon ESU, Lower Columbia River Chinook salmon ESU, Lower Columbia River Steelhead DPS, and Columbia River Chum salmon ESU to reach the point at which they no longer need the protection of the Endangered Species Act and can be delisted. To meet Recovery Plan target goals ("minimum"):

    a. **SPCH restored to abundance of 1,500 adults**
    b. **WSTH restored to abundance of 400 adults**
    c. **Coho restored to abundance of 500 adults**

3. **Bull Trout Recovery Goals, Objectives and Criteria:** The ultimate goal of this recovery strategy is to manage threats and ensure sufficient distribution and abundance to improve the status of bull trout throughout their extant range in the coterminous United States so that protection under the Act is no longer necessary. When this is achieved, we expect that:

    • Bull trout will be geographically widespread across representative habitats and demographically stable in each recovery unit;
    • The genetic diversity and diverse life history forms of bull trout will be conserved to the maximum extent possible; and
    • Cold water habitats essential to bull trout will be conserved and connected.

4. **WDFW Columbia River Basin Salmon Management Policy:** The objectives of this policy are to promote orderly fisheries (particularly in waters in which the states of Washington and Oregon have concurrent jurisdiction), advance the conservation and recovery of wild salmon and steelhead, and maintain or enhance the economic well-being and stability of the fishing industry in the state.

5. **Lower Columbia Conservation and Sustainable Fisheries Plan:** The goal of this plan is to support efforts to return natural origin lower Columbia salmon and steelhead to healthy, harvestable levels while sustaining important fisheries (commercial and recreational).

Spring Chinook is the primary species of concern followed by Coho and Steelhead (according to NMFS Recovery Plan). The Plan also identifies North Fork Lewis River spring Chinook as a primary population.

Considerations:
With fish in hand, which alternative gives them the best chance for spawning and next generation? (In the near term, this could be hatchery production, e.g. spring Chinook)

Fish Passage/In Lieu is a tool towards fish recovery – which alternative gets us to maximum benefit?

Current Status – 2016

- Blank Wire Tag (BWT) Winter Steelhead – meeting minimum returns of 500 adults upstream of Swift since 2013.

Year	Number Transported
2012	189
2013	741
2014	1,033
2015	1,223
2016	767

- Wild Winter Steelhead (BWT offspring) – not meeting targeted NOR returns (~2,000 adults) (too early in the re-introduction program) – only transporting about 2,000 to 3,000 juveniles annually from the Swift FSC so far.

- Coho – not meeting target for Natural Origin Recruits – currently using hatchery origin fish to supplement upstream recruits.
    - Total number of coho transported upstream has varied from year to year since 2012. (*Note: in 2015 the upstream transport goal for coho changed from 9,000 to 7,500. Also, we started taking late-run coho upstream that same year – everything prior to 2015 was early-run only)*

Year	Number Transported	Transport Goal
2012	206	9K
2013	7,035	9K
2014	9,179	9K

2015	3,754	7.5K
2016	7,346	7.5K

- Typically, less than 10% of adult coho transported upstream are NOR except in 2016 when approximately 20% were NOR. (when FSC fish started returning, so ~1,470 fish)

- Spring Chinook – not currently meeting:
  - Minimum of 2,000 Natural Origin Recruits upstream – too early in reintroduction program. Since 2012, only in 2013 were adult spring Chinook transported upstream of Swift Dam (n = 579).
  - Minimum of 1,000 adults for hatchery broodstock needs. (only 455 total adults returned in CY2016)
  - Juvenile acclimation program needs. (100K juvenile fish annually as decided by the ACC – only 29K juveniles were released in CY2016)
    - There is evidence that acclimation fish may be residualizing in Swift Reservoir and spawning as resident fish.

- Bull Trout – 3 genetically distinct populations: Yale population appears to be stable as do the Swift populations.

Merwin

1. Extent of spawning and rearing habitat is limited compared to other areas.

Merwin has 5.1 miles of available spawning and rearing habitat for coho and steelhead, 0 miles for spring Chinook.

2. Contribution of fish passage into Merwin Reservoir to the Settlement Agreement Outcome Goal (increasing # of NORs) is less than that which can be achieved by other alternatives. (See total adult abundance by species of each alternative; example 1A1 adult coho total is 11,878 versus alt 2 total of 8,445 coho; alt 3 total is 12,153 coho)

From Lewis River EDT February 13, 2017 Tech Memo – Table B-1 and Table B-2 (both tables show same results for Merwin Adult Abundance) – Table 13.

Alt 2 – Full Fish Passage		
Geographic Area	**Adult Abundance**	**Juvenile Abundance**
Spring Chinook		
Merwin	0	0
Coho		
Merwin	447	20,918
Winter Steelhead		
Merwin	66	1,479

3. Significant population of Northern Pikeminnow – See USGS study (New Information Report, June 24, 2016)
    a. "We found Northern Pikeminnow represent a substantial predation threat to anadromous smolts in Lake Merwin."
    b. Estimate Merwin Reservoir holds 11,240 NPM > 300mm (large) and 544,259 NPM of size 200 – 299 mm (Sub adults)
    c. Size distribution information suggests predation by large Northern Pikeminnow and Tiger Muskellunge on smaller Northern Pikeminnow resulted in an attenuated size structure that likely reduces the overall pressure on salmonids – Cannibalism is occurring.
    d. Simulations indicate that yearly consumption by a population of 1,000 large (> 300 mm and fully piscivorous) NPM would be approximately 16,000 – 40,000 age-0 juvenile fish (40-60 mm).
    e. If you go with the most conservative estimate of 3,370 large NPM and the lowest yearly consumption of 16,000 age-0 fish per 1,000 large adults, predation could be 53,920 juvenile fish. This value is twice the size of the EDT Juvenile Abundance of coho and steelhead combined (see table above; 22,397 fish).
    f. With more available food (e.g. smolts), the population of larger NPM could grow in size. See USGS Table 10 (page 237) for NPM size distribution. Fish less than 300 mm feed on invertebrates, benthic fish and crayfish then switch to pelagic and benthic fish and crayfish once larger than 300 mm.

Period of time smolts/fry are in reservoir – PacifiCorp's M&E telemetry study in Swift reservoir reports that all three species use the reservoir throughout the year, and in some cases, multiple years. For example:

- In spring 2015, 382 juvenile coho were PIT tagged and released at the head of Swift Reservoir as part of PacifiCorp's Overall Downstream Survival Estimate. Later that spring (2015), 25 were recaptured at the FSC (~6%). The following spring (2016), an additional 78 fish (~20%) from the 2015 release were captured at the FSC. This is greater than three (3) times as many fish coming out the following year – suggesting that reservoir rearing is occurring. Reservoir rearing has also been observed for juvenile steelhead. (In 2015, 117 tagged and released in Swift Reservoir, 15 detected in 2015 and 6 in 2016) (Lewis River Fish Passage Program Annual Report 2016)

- Similar observations were made during the 2015 and 2016 acoustic telemetry evaluations – when 19 of the 200 juvenile coho (~10%) tagged and released as part of the 2015 evaluation were subsequently detected passing the FSC the following year in 2016. (Caldwell et al. 2016)

Yale

1. Extent of spawning and rearing habitat is greater than Merwin but less than Swift.

Yale has 17.4 miles of available spawning and rearing habitat.

2. Yale Bull trout population appears to be small and geographically limited:
   - Spawning use is limited to upper Cougar Creek.
   - 1,700 meters of available habitat within Cougar Creek.
   - Annual redd counts have been decreasing since 2013. (best year was 28 redds in 2008)
   - Number of unique detects by year of PIT tagged fish was highest in 2015 and 2016.
   - Coho juveniles found in lower Cougar Creek; but expect that adults could reach and spawn in upper Cougar Creek.
   - Coho to bull trout fry densities in Cougar Creek were observed to be 5 to 1.
   - Annual number of adult bull trout collected in the Swift Bypass reach appears to be stable; 22 to 32 fish per year since 2009.
   - Median condition factor (K factor) for Yale bull trout has annually improved since 2013.
   - Coho spawn after bull trout; potential redd imposition. (observed in Swift)

Concern is impact of 274 adult SPCH, 1,154 adult coho and 277 steelhead (1A1 EDT Adult Abundance Values) on the small Yale bull trout population. 1B has a much greater impact as all the Swift fish (additional 13,000 adults) must pass through Yale to get to the Swift upstream collector.

As we have observed upstream of Swift, coho adults will distribute with increasing tributary flows, but winter steelhead don't seem to readily disperse up into the tributaries as far as we had expected. Consequently, PacifiCorp has established a seeding program.

We expect the greatest impact of coho will be the loss of bull trout redds in Cougar Creek. Bull trout spawn later than SPCH, but coho spawn after bull trout. WSTH spawn in spring after bull trout fry emergence. Given we have only seen a maximum of bull trout 28 redds in one year (2008), a loss of only a couple of redds each year can be significant.

Per USFWS recovery goal of "**The genetic diversity and diverse life history forms of bull trout will be conserved to the maximum extent possible"** we cannot lose these bull trout. While 1A1 allows for managing the number of adult salmon and steelhead into Yale, how would we determine the appropriate "no harm" fish numbers? This determination would need to be done prior to the design of any fish collection facility. It does not make sense to build something then not be able to use it based on after-construction monitoring.

A management tool to protect bull trout in Yale could be a weir on Cougar Creek, only allowing bull trout to pass. The problem is that PIT tag data shows that bull trout adults like to go into and back out of the creek over the spawning period. A weir may delay or disrupt spawning behavior. If a weir is in place to limit other fish, the habitat loss equals an EDT abundance of 89 adult SPCH, 157 adult coho and 77 adult steelhead. You would also lose that area's spatial distribution (2.3 miles).

Regarding salmon/steelhead being an additional food source for bull trout, given the Yale bull trout K-factor is above 1.0 since 2008 and was 1.25 in 2016, these are healthy fish, not snake-heads needing food.

3. EDT results

The Utilities feel comfortable with the assumptions of cost per mile used in the February 2, 2017 EDT run which included upstream of Swift habitat restoration and mainstem habitat restoration downstream of Merwin.

$28.235m for 56.5 miles upstream of Swift.

$9.7m for 5 miles downstream of Merwin. (See Cramer report which suggested need of $4.7m for same area)

Note – the costs above assume that all riparian habitat in treated reaches need treatment; that is likely not the case.

In review of Table 12 of Kevin's February 13, 2017 EDT tech memo, Alternative 3 provides the highest abundance value for SPCH and coho, but is short 157 adult winter steelhead compared to Alternative 1A1. Alt 3 spatial distribution is less for all species than 1A1 (since fish do not have access to 17.4 miles of Yale habitat). Alt 3 productivity is close to or higher than other alternatives. Alt 3 has the highest diversity score.

With the focus on SPCH NORs and acknowledgement that the Lewis River is key habitat and is needed for recovery of SPCH, Alternative 3 moves us closer than the other alternatives to that goal.

Other items:

No fish: Utilities' concern is that we do not have enough "starter/hatchery stock" SPCH and may not in a given year, have enough "starter/hatchery stock" coho to meet all current program needs; nor to fully seed the habitat upstream of Swift. Last time we took SPCH upstream was 2013. For winter steelhead, we are on track to develop the wild winter steelhead run given the "starter stock" run of BWT fish has been greater than 500 fish the last 4 years, but a true NOR run of winter steelhead of significance size is expected to take many years.

Marine nutrients: Habitat projects will help carcasses "stick" in the tributaries and LR mainstem and not get flushed down into the reservoir.

Climate Change:

Frank reviewed information provided by Ruth Tracy at the USFS. A few observations:

1) The areas designated as habitat for Chinook and steelhead are not effectively different in terms of flow and temperature when comparing 1980 conditions and projected 2080 conditions; (Note: This suggests that habitat projects will remain effective over the long-term and not negated by climate change.)
2) The areas most affected by climate change are the smaller tributaries where flow is reduced and temperature increases in 2080 compared to 1980;
3) For bull trout, the lower reach of Rush Creek and most of the mainstem Pine Creek (including P8) are about 3 degrees-C warmer in 2080 and, depending on when the temperatures cool, may or may not support bull trout spawning.

Utilities Prefer Alternative: #3 Full In-Lieu Funding

In summary – Merwin has no SPCH habitat, minimal habitat for coho and steelhead, and a significant northern pikeminnow population that is food (small prey fish) limited. You get no return on investment by placing NORs into Merwin. Accordingly, the Utilities do not support fish passage into Merwin.

For Yale, while there is habitat available for SPCH, coho and steelhead, we have grave concern regarding the negative impacts to Yale bull trout. The Yale population is genetically distinct and per the USFWS Recovery Plan, must be protected. EDT's analysis of Alternative 3 demonstrates that through the In-Lieu Fund's restoration work, the greatest step towards increasing the adult abundance of SPCH and coho can be made with no impact to Yale bull trout. Given the current limited number of SPCH, we should be focusing on placing them in the best area which is upstream of Swift. Selecting Alternative 3 also directly responds to the Recovery Plan's statement, “Recovery of listed species will require concerted efforts to protect remaining areas of favorable habitat and restore habitat quality in significant historical production areas.”(Pg ES-11). Alternative 3 will also meet Recovery Plan adult abundance goals for SPCH, WSTH and coho.

By species – Alternative 3:
SPCH: Highest Adult Abundance (i.e., most fish); focus on best habitat for these fish (upstream of Swift)
Bull Trout: Protects these fish from any negative impact.
Coho: Highest Adult Abundance (i.e., most fish)
WSTH: Falls 157 adult fish short of 1A1; potential to spend In-Lieu $ for steelhead projects in EF LR which is a primary population.

Alternative 3 meets Recovery Plan adult abundance goals, maximizes adult abundance numbers of SPCH and coho, protects the distinct Yale bull trout population, and has the potential to improve WSTH habitat in EF.

Appendix A – WDFW

APPENDIX A – WDFW

Passage/In Lieu Alternatives
WDFW Preference

Question Posed:

What is the best use of fish passage and/or in lieu funds to provide the biggest benefit to the reintroduction species of salmon and steelhead in the Lewis River (Spring Chinook, coho and steelhead)?

Background Information:

<u>Habitat and Abundance</u>
EDT modeling results provides the following abundance estimates for the upper North Fork Lewis basin.

Species	Merwin Res.		Yale Res.		Merwin, Yale and Swift Res.
	Number of Adults	% of Total	Number of Adults	% of Total	Total Number of Adults
Spring Chinook	0	0	279	9	2,974
Coho	479	5	1263	14	9,071
Winter Steelhead	70	2	297	10	3,049

Available habitat, and resulting abundance estimate, in Merwin Reservoir and its tributaries is limited for coho and winter steelhead and nonexistent for spring Chinook. Providing access to Merwin Reservoir and its tributaries would provide no modeled benefit to spring Chinook and only limited increases in abundance of coho (5% of population total) and winter steelhead (2% of population total).

Habitat, and resulting abundance estimate, is available in Yale Reservoir and its tributaries. Habitat quantity appears to be adequate to support reintroduction/recovery of Lewis River salmon and steelhead. Providing access to Yale Reservoir and its tributaries is modeled to increase abundance by 279 for spring chinook, 1,263 for coho and 279 for winter steelhead, which represent 9%, 14% and 10% of the total population, respectively.

<u>Habitat and Abundance</u>
Utilizing the EDT model an analysis was completed to evaluate the relative impacts to VSP parameters based on which alternative was implemented. The output from the EDT modeling was used to compare the response of each VSP parameter (abundance, productivity, spatial structure and diversity) to the actions implemented (passage, habitat restoration of both) under the each alternative.

Spatial structure was maximized under the alternative including passage at both Merwin and Yale dams; however, the improvement was small with only a 7% difference between this alternative and the alternative providing passage at just Yale Dam. In contrast, the alternative that included passage at Merwin produced lower estimates for each of the other three parameters, as compared to the alternative with passage at Yale (includes modeled benefit from habitat restoration). For the remaining three VSP parameters model results predicted relatively similar results for the remaining four alternatives.

<u>Other Considerations</u>
It has been well documented that there is a large population of Northern Pikeminnow residing in Merwin Reservoir. Northern Pikeminnow abundance in Yale and Swift Reservoirs is relatively low. The predation rate of Northern Pikeminnow in Merwin Reservoir has not been accurately estimated, but based on information from other locations and the size of the population it is expected that there would be a high mortality rate of juvenile salmonids utilizing Merwin Reservoir for rearing and migration purposes. Effectiveness of reintroduction of salmon and steelhead into Merwin Reservoir and its tributaries will be limited by predation from Northern Pikeminnow.

There is a documented bull trout subpopulation that spawns in Cougar Creek and uses both Cougar Creek and Yale Reservoir for rearing purposes. Some data regarding the size of this subpopulation has been collected and results of redd surveys indicate that the subpopulation is small. Reintroduction of salmon and steelhead has the potential to adversely impact the health of this bull trout subpopulation, primarily by coho salmon through competition for spawning habitat. During discussion with the technical subgroup it was determined that bull trout were not a driver to the decision regarding passage (per technical subgroup decision on November 3 2016); however, it is still important that this population be protected. Bull trout are a listed species that are an important part of the ecosystem in the upper Lewis basin, consistent with USFWS Bull Trout Recovery Unit Implementation Plan (RUIP) that calls to “adaptively manage the recovery strategy to benefit all species”.

Preference:

Based on the information provided in the background section about WDFW’s preference is to move forward with the alternative that includes both juvenile and adult passage at Yale but no passage at Merwin (1B). This option provides an important lift to the population by increasing abundance, productivity and diversity. Additionally, providing adult passage at Yale Dam increases genetic interchange within the population and avoids the potential for genetic drift between the salmon and steelhead reintroduced into Yale Reservoir vs. Swift Reservoir.

It is however important to recognize the potential impact to the ESA-listed bull trout population that utilizes Cougar Creek and Yale Reservoir for spawning and rearing purposes. To that end reintroduction of salmon and steelhead into Yale Reservoir and its tributaries should occur in a phased process. It is recommended that an Implementation and Adaptive Management strategy, similar to that developed for above Swift Dam, be developed and approved by the ACC. This Implementation and Adaptive Management strategy would include activities to monitor baseline conditions for bull trout and population responses for salmon, steelhead and bull trout. Additionally, this Adaptive Management strategy would provide a framework and timelines for determining a release schedule for numbers of adult salmon and steelhead released, by species, into Yale Reservoir.

Appendix A – USDA FS

March 2017 Gifford Pinchot National Forest Alternative Recommendation related to the Lewis River Hydroelectric Projects Settlement Agreement 4.1.9 Review of New Information Regarding Fish Transport into Yale Lake and Merwin Reservoir.

The Gifford Pinchot National Forest recommends Alternative 1B with the addition of adaptive management measures addressing the release of coho into Yale Lake. This recommendation is based on information brought forward in meetings and documents since February 2016.

The upper North Fork Lewis subbasin has been identified as one of only three primary populations of spring Chinook in the Lower Columbia River region, and is therefore essential to recovery (Lower Columbia Fish Recovery Board). Most of the potentially productive spring Chinook habitat in this subbasin is above Swift Reservoir. About 12% of potential spring chinook spawning habitat exists in tributaries of Yale Lake (Yale), while no accessible tributaries in Merwin Reservoir (Merwin) are considered spring chinook spawning habitat.

Results of the five alternatives modeled in EDT indicate that all alternatives meet minimum population abundance recovery goals for all three species, spring chinook, coho and winter steelhead. Alternatives that allow for additional passage (all but Alternative 3), improve spatial structure and diversity benefits and the restoration funds associated with those alternatives could provide additional abundance, productivity, and diversity.

Benefits of passage into Merwin are limited in spatial structure, with no spring chinook spawning habitat and limited coho and steelhead spawning habitat (6% or less). Risk of high juvenile mortality is expected for all three anadromous species from predation in Merwin. The risk of predation reducing the number of out-migrating spring chinook juveniles at a time when existing spring chinook numbers are low minimizes the advantages of Alternative 2 during this period of recovery and license duration.

Of the alternatives allowing for passage into Yale only, Alternative 1B has the additional long term advantage of providing the facility for anadromous fish to volitionally move into Swift Reservoir. Through time, the development of a naturally productive wild anadromous fish population behavior would include volitional migration to spawn in a place of origin. A second long term benefit of 1B, amongst the alternatives allowing for passage into Yale only, would be the allowance of gene flow between the Yale and Swift populations, another element of a robust naturally productive fish population.

Adaptive management measures could address the concerns of coho interspecific competition with the small Yale bull trout population. These concerns are bull trout and coho feeding at similar trophic levels and utilizing similar prey resources, and the superimposition or redds from coho spawning after bull trout. Measures such as deferred, incremental, or limited coho releases into Yale with concurrent bull trout population monitoring provide adaptive management opportunities while avoiding interference with passage infrastructure design and/or construction timeframes related to the reintroduction of anadromous species.

Appendix A - LCFRB

The upper North Fork Lewis subbasin supports three populations of ESA-listed salmon and steelhead, including spring Chinook (Primary), winter steelhead (Contributing), and coho (Contributing). The subbasin also supports three populations of ESA-listed bull trout. To meet recovery plan goals, spring Chinook must be restored from very low to high viability, including an abundance of 1,500 adults. Winter steelhead must be restored from very low to medium viability, including an abundance of 400 adults. Coho must be restored from very low to low viability, including an abundance of 500 adults. See Table K-1 below from the recovery plan.

Table K-22. Status and goals of focal salmon and steelhead populations in the upper North Fork Lewis River.

Species	Population	Recovery priority[1]	Viability		Improve-ment[4]	Abundance		
			Status[2]	Obj.[3]		Historical[5]	Current[6]	Target[7]
Fall Chinook (Tule)	Lewis	Primary	VL	H+	280%	2,600	<50	1,500
Fall Chinook (Bright)	NF Lewis	Primary	VH	VH	0%	23,000	7,300	7,300
Spring Chinook	NF Lewis	Primary	VL	H	>500%	15,700	300	1,500
Chum	Lewis	Primary	VL	H	>500%	125,000	<100	1,300
Winter Steelhead	NF Lewis	Contributing	VL	M	>500%	8,300	150	400
Summer Steelhead	NF Lewis	Stabilizing	VL	VL	0%	n/a	150	--[8]
Coho	NF Lewis	Contributing	VL	L	50%	40,000	200	500

[1] Primary, Contributing, and Stabilizing designations reflect the relative contribution of a population to major population group recovery goals.
[2] Baseline viability is based on Technical Recovery Team viability rating approach.
[3] Viability objective is based on the scenario contribution.
[4] Improvement is the relative increase in population production required to reach the prescribed viability goal
[5] Historical population size inferred from presumed habitat conditions using Ecosystem Diagnosis and Treatment Model and NMFS back-of-envelope calculations.
[6] Approximate current annual range in number of naturally-produced fish returning to the watershed.
[7] Abundance targets were estimated by population viability simulations based on viability goals.
[8] A recovery target is not available at this time due to a lack of information regarding population dynamics.

The upper North Fork Lewis subbasin has been identified as one of only three primary populations of spring Chinook in the region, and is therefore essential to recovery. Most of the potentially productive spring Chinook habitat in the subbasin is above Swift Reservoir in the upper mainstem, the Muddy River, Clearwater Creek, and Clear Creek. To meet productivity improvement targets for this population, a 50% reduction in habitat threats is necessary, along with additional reductions for hatchery, harvest, hydropower and ecological interaction threats. Substantive improvements to habitat conditions are necessary during the 50-year recovery plan implementation period to meet the habitat threat reduction targets.

The Lower Columbia Fish Recovery Board (LCFRB) evaluated fish passage alternatives in light of recovery plan goals, objectives, threat reduction targets, and interim benchmarks for action implementation. EDT modeling suggests that all alternatives would likely meet minimum population abundance goals identified in the recovery plan. However, those that provide access into both Yale Reservoir and into Swift Reservoir and its tributaries would maximize benefits to spring Chinook, which is a high regional priority for recovery. In addition, modeling suggests that alternatives that combine passage with habitat restoration can provide additional abundance, productivity and diversity benefits, compared to providing passage only. Such alternatives would improve the potential for achieving recovery goals and providing harvestable populations over the long-term. This is especially true for spring Chinook.

The LCFRB understands the limitations and uncertainties associated with the various analyses conducted to support review of alternatives. However, we believe these analyses provide a sound basis for comparisons across alternatives, given the quality of data inputs and assumptions. Based on our review of the technical analyses to date, the LCFRB believes that Alternative 1B would provide the greatest opportunity to meet recovery goals and objectives in the long-term, provided it is modified to allow adaptive management of fish releases to reduce potential for interspecific competition with bull trout, and to address small population viability concerns. As a second but lower priority option, the LCFRB would not object to Alternative 1A1, provided similar adaptive management provisions are incorporated.

Alternative	Pros	Cons
1A1, Yale D/S only, adults into Yale	• Provides access to habitat in Swift Reservoir and tributaries. • Provides for additional production capacity for spring Chinook, steelhead and coho in Yale Reservoir tributaries. • Improves spatial structure for spring Chinook compared to Alternatives 1A2 and 3. • Provides management flexibility for releasing fish into Yale versus Swift reservoirs. • Minimizes potential predation on ESA-listed salmonids in Merwin Reservoir. • Provides restoration dollars to enhance habitat in the Yale and Swift reservoir tributaries, further increasing abundance, productivity, and diversity benefits, and likelihood of achieving threat reduction targets and benchmarks.	• Eliminates all production potential in Merwin Reservoir and tributaries, although analysis suggests potential spawner capacity is minimal for steelhead and coho, and negligible for spring Chinook. • Release of coho in Yale Reservoir will likely result in interspecific competition with bull trout. (*Note: to address this, we recommend considering direct transport of all or some coho into Swift Reservoir, with no or limited releases into Yale Reservoir*). • Separating Yale- from Swift-origin fish could result in reduced gene flow, if all fish are returned directly to the reservoir of origin.
1A2, Yale D/S only, no adults into Yale, collect entrained	• Provides direct access to Swift Reservoir and tributaries. • Reduces potential interspecific competition between bull trout and	• Not providing access into Yale Reservoir and tributaries reduces production potential and spatial diversity for all species, including spring Chinook.

juveniles from Swift	coho as no adults would be put into Yale Reservoir. • Minimizes potential predation on ESA-listed salmonids in Merwin Reservoir. • Provides restoration dollars to enhance habitat in Swift Reservoir tributaries, further increasing abundance, productivity, and diversity benefits, and likelihood of achieving threat reduction targets and benchmarks.	• No restoration work would be directly funded in Yale Reservoir tributaries, which would limit potential habitat capacity improvements.
1B, Yale D/S & U/S, all adults into Yale & adults into Swift (volitional only)	• Provides access to habitat in Swift Reservoir and tributaries. • Provides for additional production capacity for spring Chinook, steelhead and coho in Yale Reservoir tributaries. • Improves spatial structure for spring Chinook compared to Alternatives 1A2 and 3. • Allows fish to choose whether to remain in Yale or move into Swift Reservoir. As populations build, this may lead to increased gene flow between reservoirs. • Minimizes potential predation on ESA-listed salmonids in Merwin Reservoir. • Provides restoration dollars to enhance habitat in Yale and Swift Reservoir tributaries, further increasing abundance, productivity, and diversity benefits, and likelihood of achieving threat reduction benchmarks.	• Eliminates all production potential in Merwin Reservoir and tributaries, although analysis suggests potential spawner capacity is minimal for steelhead and coho, and negligible for spring Chinook. • Release of coho in Yale Reservoir will likely result in interspecific competition with bull trout. (*Note: to address this, direct transport of all or some coho into Swift Reservoir could occur, with no or limited releases into Yale Reservoir – steelhead and spring Chinook would still be allowed to choose between Yale and Swift Reservoirs*). • May limit management flexibility in terms of splitting releases into Yale vs Swift Reservoirs, which could be a concern with small populations. (*Note: to address this, adaptive management of releases depending on population size and other biological factors could be implemented*). • Produces fewer restoration dollars per stream mile than Alternatives 1A1 and 1A2.
2, Yale & Merwin, U/S & D/S, move all adult fish into Merwin	• Provides full upstream and downstream passage, maximizing spatial structure for all ESA-listed species.	• No modeled production benefits to spring Chinook in Merwin Reservoir and tributaries. • Results in lower abundance and productivity for steelhead and coho compared to options 1A1, 1A2, and 1B. • Could result in increased mortality for juveniles of all species in Merwin Reservoir from predation.

		• Release of coho in Yale Reservoir will likely result in interspecific competition with bull trout. • No funding would be available for habitat restoration. • Absent alternative sources of funding, unlikely that recovery threat reduction targets can be met within established benchmark timelines. • Modeling suggests that alternatives that combine passage with habitat restoration can provide additional abundance, productivity and diversity benefits that would not be realized by this alternative.
3, Passage at neither, move all adults into Swift (current scenario)	• Provides access to habitat in Swift Reservoir and tributaries. • Reduces potential interspecific competition between bull trout and coho as no adults would be put into Yale Reservoir. • Maximizes funds available for habitat restoration. • Minimizes potential predation on ESA-listed salmonids in Merwin Reservoir.	• Eliminates potential production capacity in Yale (all species) and Merwin reservoirs (steelhead and coho) and tributaries, as well as spatial structure and diversity benefits.

APPENDIX B

Meeting Notes of ACC Fish Passage Decision Group

Meeting Notes of ACC Fish Passage Decision Group
(CONFIDENTIAL)

Available upon request

APPENDIX C

EDT February 2, 2017 Memo

DJ Warren and Associates

Memo

To: Todd Olson

From: Kevin Malone

cc: Mike Bonoff

Date: February 2, 2017

Re: EDT Modeling In-Lieu Habitat Fund

EDT Modeling

This memo describes methods used to model in-lieu habitat actions in EDT for the Lewis River as well as modeling results for the January 18th, January 19th and February 2nd analyses.

An initial set of EDT model runs were developed for the January 18th and 19th meetings held at the WDFW Vancouver office and Merwin Dam, respectively. At the January 18th meeting, the ACC Science Subgroup asked that an additional set of model runs be completed that substituted (on a 1 to 1 kilometer basis) mainstem Lewis River habitat above Swift Dam for tributary habitat initially modeled.

After the January 19th meeting, two additional EDT model runs be completed. The two runs are as follows:

1. Combine all tributary and mainstem Lewis River habitat restored in the first two model runs.
2. Restore as much stream habitat as possible based on the assumption that restoration costs will be $500,000 per mile and total monies available are $37.954 million.

Both new model runs incorporated an overall downstream survival (ODS) rate of 75 percent for all alternatives that included juvenile fish passage at Yale Dam. The 75 percent ODS is the target value required in the Settlement Agreement when downstream passage at Yale is available.

Results from these latest EDT model runs will be provided to the Lewis River EDT Subgroup on February 2nd, 2017 at WDFW offices in Vancouver.

Methods

The five passage alternatives modeled using EDT are shown in Table 1. A description of each alternative is presented in Appendix A. The values used for Overall Downstream Survival (ODS), Juvenile Collection Efficiency (CE), Adult Trap Efficiency (ATE), Upstream Passage Survival (UPS) and Stream Habitat Restored to Template is presented in Table 2.

Table 1. The five passage alternatives modeled in EDT

	Option	Enhancement Funds*	Downstream Collector/Merwin	Downstream Collector/Yale	Upstream Collector/Yale	Upstream Collector/Swift	Adult Transport
1A1	Yale: D/S Only	**$25.303 million**	NO	YES	NO	NO	Adults into Yale
1A2	Yale: D/S Only	**$25.303 million**	NO	YES	NO	NO	No adults into Yale; Collect entrained juveniles from Swift
1B	Yale: D/S & U/S	**$18.997 million**	NO	YES	NO	YES	All adults into Yale & adults into Swift (volitionally only)
2	Yale & Merwin: U/S & D/S	**$0**	YES	YES	YES	YES	Move all adult fish into Merwin
3	Passage at Neither	**$37.954 million**	NO	NO	NO	NO	Move all adults into Swift (current scenario)

Selection of Streams for Restoration

January 18 EDT Model Run

For the January 18th EDT model run it was assumed that the maximum monies available for habitat restoration ($37.954 million) was sufficient to restore the following Swift area streams to Template condition as defined in EDT (Table 3):

1. Pine Creek
2. Swift Campground Creek
3. P1, P3, P7, P10, P8
4. Clear Creek and Small Tributaries
5. Clearwater Creek and Tributaries
6. Rush Creek
7. Drift Creek

These streams were selected based on previous EDT modeling showing that these streams produced the most spring Chinook if restored to Template. Additionally, at the December 16th (2016) subgroup meeting in Vancouver it was decided that for this round of modeling habitat actions would not be considered in the Muddy River due to concerns about past and on-going volcano effects (high sediment, mud flows etc.).

Table 2. Model assumptions by parameter for EDT model runs completed on January 18th, January 19th, and February 2nd, 2017.

Parameter	Model Run Date		
	18-Jan	**19-Jan**	**2-Feb**
Overall Downstream Survival (ODS)	80% All Alternatives	80% All Alternatives	75% (Alternatives 1A1, 1B, 2); 80% (Alternatives 1A2 and 3)
Juvenile Collection Efficiency (CE)	95%	95%	95%
Turbine/Spill Survival Rate for Swift No. 1 and Swift No.2, Respectively*	90%	90%	90%
Adult Trap Efficiency (ATE)	100%	100%	98%
Upstream Passage Survival (UPS)	100%	100%	99.5%
Spring Chinook, Coho and Steelhead Harvest Rates, Respectively	10%, 15%, 5%	10%, 15%, 5%	10%, 15%, 5%
Stream Habitat Restored to Template	Selected Tributaries Upstream of Swift	Selected Tributaries and Mainstem Lewis River Upstream of Swift	1) Both Tributaries and Mainstem Lewis River Upstream of Swift 2) All of 1 and Portion of Mainstem Lewis Below Merwin

* Turbine survival rate for Swift No.1 based on survival data collected at Mayfield Dam. Swift No.2 based on generic turbine survival rate for Columbia River mainstem dams equipped with Kaplan turbines.

Mainstem Lewis River reaches upstream of Swift were not selected for restoration as more detail was required on the feasibility and costs of actions before including them in the analysis. Finally, streams located within the Mt. St. Helens Monument were by law, off-limits to restoration work.

The seven streams selected for restoration have a combined length of 68.19 kilometers. Therefore, the assumption for modeling is that $37.954 million is sufficient to restore 68.19 kilometers of stream habitat to template condition. This equates to $556,714 per kilometer of stream.

The costs per kilometer for various habitat actions provided by Cramer are as follows:

1. LWD Placement - $72,800 per kilometer
2. Side Channel Construction - $1.93 per square meter
3. Riparian Placement - $4.82 per square meter

As shown in Table 4, the full $37.954 million is only available for alternative 3. The other alternatives have less money for habitat actions as these alternatives include additional fish passage structures. The amount of stream habitat that is assumed restored under each alternative is based on the ratio of monies available by alternative divided by the total monies available (Table 4).

Table 3. Streams/reaches restored to Template conditions for the January 18, January 19 and February 2 EDT model runs.

18-Jan		19-Jan		Feb 2- Upstream of Swift Only		Feb-2 Upstream of Swift and Mainstem Lewis River Below Merwin
Stream/Reach	**Length (km)**	**Stream/Reach**	**Length (km)**	**Stream/Reach**	**Length (km)**	**Length (km)**
Clear Creek	9.9	Clear Creek	9.9	Clear Creek	9.9	9.9
Clear Creek Lower	9.9	Clear Creek Lower	9.9	Clear Creek Lower	9.9	9.9
Clear Creek Small Tribs	3.17	Lewis 18	1.13	Clear Creek Small Tribs	3.17	3.17
Clearwater Creek	8.37	Lewis 19	0.81	Clearwater Creek	8.37	8.37
Clearwater Tribs	1.29	Lewis 20	8.85	Clearwater Tribs	1.29	1.29
Drift Creek	1.52	Lewis 21	1.61	Drift Creek	1.52	1.52
Drift Creek Upper	1.07	Lewis 22	1.77	Drift Creek Upper	1.07	1.07
P1	1.45	Lewis 23	5.63	Lewis 18	1.13	1.13
P10	0.48	Lewis 24	0.64	Lewis 19	0.81	0.81
P3	1.61	Lewis 25	0.48	Lewis 20	8.85	8.85
P7	1.77	Lewis 26	1.45	Lewis 21	1.61	1.61
P8	6.76	Lewis 27	0.32	Lewis 22	1.77	1.77
Pine Creek 1	2.82	P1	1.45	Lewis 23	5.63	5.63
Pine Creek 2	0.81	P10	0.48	Lewis 24	0.64	0.64
Pine Creek 3	1.61	P3	1.61	Lewis 25	0.48	0.48
Pine Creek 4	1.61	P7	1.77	Lewis 26	1.45	1.45
Pine Creek 5	1.61	P8	6.76	Lewis 27	0.32	0.32
Pine Creek 6	4.43	Pine Creek 1	2.82	P1	1.45	1.45
Rush Creek	4.02	Pine Creek 2	0.81	P10	0.48	0.48
S15	2.09	Pine Creek 3	1.61	P3	1.61	1.61
Swift Campground Creek	1.93	Pine Creek 4	1.61	P7	1.77	1.77
		Pine Creek 5	1.61	P8	6.76	6.76
		Pine Creek 6	4.43	Pine Creek 1	2.82	2.82
				Pine Creek 2	0.81	0.81
				Pine Creek 3	1.61	1.61
				Pine Creek 4	1.61	1.61
				Pine Creek 5	1.61	1.61
				Pine Creek 6	4.43	4.43
				Rush Creek	4.02	4.02
				S15	2.09	2.09
				Swift Campground Creek	1.93	1.93
				Mainstem Lewis Below Merwin		8.1
Total January 18	**68.22**	**Total January 19**	**67.45**	**Total February 2**	**90.91**	**99.01**

Table 4. Calculation of kilometers of stream habitat to target for restoration to Template for each analysis alternative.

Alternative	Habitat Fund	Fund Ratio (X)	Total Kilometers Habitat (Y)	Kilometers Habitat Restored (X*Y)
1A1	$25,303,000	66.7%	68.2	45.5
1A2	$25,303,000	66.7%	68.2	45.5
1B	$18,997,000	50.1%	68.2	34.2
2	$0	0%	68.2	0.0
3	$37,954,000	100%	68.2	68.2

The streams selected for restoration in each alternative was based on spring Chinook production potential. Thus, the highest producing stream was chosen 1st, followed by the 2nd and 3rd until the target number of kilometers for each alternative was achieved. Because reach lengths could not be altered the total amount of habitat restored in each alternative may have been slightly different than the target value.

EDT modeling was conducted for spring Chinook, coho and steelhead under two scenarios:

1. Alternatives modeled with fish passage actions only
2. Alternatives modeled with fish passage and habitat restoration.

A description of each model output (parameter) is provided in Table 5. Note that the productivity, capacity and abundance values produced by EDT are based on a Beverton-Holt production function.

Table 5. Definition of model outputs presented for each alternative.

Parameter	Definition
Abundance	The average number of adults or juveniles produced
Capacity	The maximum number of adults or juveniles the habitat can support
Spatial	The percent of the total spawning habitat available upstream of Merwin Dam that each species has access to by alternative. For example, because fish passage is provided at all three dams, fish have access to 100 percent of the spawning habitat in Alternative 2.
Productivity	Adult or juvenile recruits per spawners at low spawner abundance (i.e. absence of density dependence effects)
Diversity	The percent of all EDT life history trajectories that had a productivity of 1.0 or greater. The maximum possible score is 100 percent.
Extinction Risk	5 percent of all life cycle model runs were below the identified value. The lower the value the higher the extinction risk.

The total amount of spawning habitat available upstream of Merwin Dam is provided in Table 6.

Table 6. Available spawning habitat by species for Merwin, Yale and Swift geographic areas.

Species	Kilometers Spawning Habitat
Total Spring Chinook	157.593
Yale Lake	14.249
Swift Reservoir	143.344
Total Coho salmon	186.922
Lake Merwin	9.485
Yale Lake	29.589
Swift Reservoir	147.848
Total Winter Steelhead	171.596
Lake Merwin	9.485
Yale Lake	29.589
Swift Reservoir	132.522

January 19 EDT Model Run

At the January 18th meeting, the EDT subgroup asked that modelers look at substituting mainstem Lewis River upstream of Swift habitat for a similar amount of tributary habitat. A list of streams/reaches modeled on January 19th is shown in Table 3.

Because of time constraints (1-day turnaround) only alternatives 1A1, 1B and 3 were modeled.

The same two scenarios described for the January 18th model runs were also run for this modeling effort.

February 2 EDT Model Run

The January 18th EDT model run assumed that ~$500,000 per kilometer of stream was sufficient to restore the relatively high quality stream habitat upstream of Swift Dam to template conditions as defined by EDT. In conversations with Lower Columbia Recovery Board staff they were of the opinion that $500,000 per mile may be a better estimate of habitat restoration costs. If this is the case then the $37.954 million dollars is sufficient to restore 75.9 miles of stream.

Based on the new habitat restoration assumptions, the EDT Model was run under two conditions:

1) Upstream of Swift Habitat Restoration- For this run all tributary and mainstem Lewis River habitat upstream of Swift defined previously (January 18th and 19th) was restored to template condition (Table 3). The miles of restored habitat in this model run was 56.5 miles (90.91 kilometers) at an assumed restoration cost of $28.235 million. This left approximately $9.7 million that could be used as a reserve fund or spent on improving additional habitat.
2) Addition of Mainstem Lewis River Habitat Below Merwin Dam - In this model run, the remaining ~$9.7 million was assumed spent on restoring an additional 5 miles (8.1 km) of stream habitat in the mainstem Lewis River below Merwin Dam. Mainstem habitat was selected for restoration as it provided benefits to all species. The reaches restored were Lewis 1 Tidal A/B and Lewis 2 Tidal

B. The total amount of habitat restored for this run was 61.5 miles (99.01 km). Note that any benefits habitat improvements in the mainstem Lewis River may have on lower Lewis River and NF Lewis River fish populations was not analyzed.

An extinction risk analysis was not performed for this set of runs as previous model outputs showed little difference in risks between alternatives due to high population productivity for each species and alternative.

Because of concerns that juvenile mortality due to predation by other species may be higher in Merwin Reservoir than assumed in EDT, a predation analysis was conducted by running a simple population model with no variability using productivity and capacity values for Merwin Coho and steelhead derived from the EDT analysis.

EDT Model Results

January 18 EDT Model Runs

EDT model results for January 18 are presented in Table 7 (Passage Only) and Table 8 (Passage + Habitat).

January 19 EDT Model Runs

EDT model results for January 19 are presented in Table 9 (Passage Only) and Table 10 (Passage + Habitat)

February 2 EDT Model Runs

EDT model results for February 2 are presented in Table 11 (Upstream of Swift) and Table 12 (Upstream of Swift + Mainstem Lewis Habitat Below Merwin). A summary of fish production for the Merwin, Swift and Yale geographic areas for each model run is presented in Table 13 and Table 14. Note that in Table 13 and Table 14 total adult abundance for an alternative may not be equal to the sum of the individual populations (geographic areas). This results from differences in productivity and capacity between populations which when combined together into a single population results in small difference in abundance.

The results of increasing predation losses on juveniles migrating/rearing in Merwin Reservoir is presented in Table 15.

Table 7. January 18 EDT model run for Passage Only. No habitat restoration actions are included in the alternatives.

	All Species Combined															
	Spring Chinook				Coho				Winter Steelhead					Extinction Threshold		
Alternative	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance	S. Chin.	Coho	W. Sthd
1A1	2,929	100%	5.04	78%	8,564	95%	5.55	71%	1,967	94%	9.36	75%	13,460	1,064	1,461	845
1A2	2,649	91%	5.24	75%	7,356	79%	5.60	74%	1,645	77%	9.82	76%	11,650	1,109	2,266	740
1B	2,916	100%	4.81	77%	8,919	95%	5.16	72%	1,862	94%	9.04	75%	13,697	1,257	1,770	839
2	2,979	100%	5.08	77%	9,132	100%	5.52	70%	2,063	100%	9.14	75%	14,174	1,178	1,652	909
3	2,560	91%	5.27	73%	7,330	79%	5.65	71%	1,589	77%	9.87	73%	11,480	1,059	2,190	707

Percent Difference Between Alternatives and Alternative 2 (Full Passage No Habitat)

	Spring Chinook				Coho				Winter Steelhead					Extinction Threshold		
Alternative	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance	S. Chin.	Coho	W. Sthd
1A1	-2%	0%	-1%	1%	-6%	-5%	1%	1%	-5%	-6%	2%	0%	-5%	-10%	-12%	-7%
1A2	-11%	-9%	3%	-2%	-19%	-21%	1%	5%	-20%	-23%	7%	2%	-18%	-6%	37%	-19%
1B	-2%	0%	-5%	0%	-2%	-5%	-6%	3%	-10%	-6%	-1%	1%	-3%	7%	7%	-8%
2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3	-14%	-9%	4%	-6%	-20%	-21%	2%	1%	-23%	-23%	8%	-2%	-19%	-10%	33%	-22%

	All Species Combined															
	Spring Chinook				Coho				Winter Steelhead					Extinction Risk		
Alternative	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance	S. Chin.	Coho	W. Sthd
1A1	4	5	2	5	3	4	3	2	4	4	3	3	3	2	1	4
1A2	2	2	4	2	2	2	4	5	2	2	4	5	2	3	5	2
1B	3	5	1	4	4	4	1	4	3	4	1	4	4	5	3	3
2	5	5	3	3	5	5	2	1	5	5	2	2	5	4	2	5
3	1	2	5	1	1	2	5	3	1	2	5	1	1	1	4	1

	Combined Score				
Alternative	Abundance	Spatial	Productivity	Diversity	Extinction
1A1	14	13	8	10	7
1A2	8	6	12	12	10
1B	14	13	3	12	11
2	20	15	7	6	11
3	4	6	15	5	6

Table 8. January 18 EDT model run for Passage and Habitat.

	All Species Combined															
	Spring Chinook				Coho				Winter Steelhead					Extinction Threshold		
Alternative	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance	S. Chin.	Coho	W. Sthd
1A1	3,309	100%	5.48	80%	9,969	95%	6.9	76%	2,252	94%	11.82	76%	15,531	1,241	1,879	968
1A2	3,024	91%	5.69	79%	8,680	79%	7.1	81%	1,917	77%	12.60	78%	13,621	1,247	2,709	799
1B	3,266	100%	5.11	80%	9,880	95%	5.7	78%	2,112	94%	11.17	77%	15,257	1,418	2,037	947
2	2,979	100%	5.08	77%	9,132	100%	5.5	70%	2,063	100%	9.14	75%	14,174	1,136	1,630	916
3	3,120	91%	6.11	78%	9,431	79%	7.6	79%	1,946	77%	13.50	77%	14,497	1,252	2,848	849

Percent Difference Between Alternatives and Alternative 2 (Full Passage No Habitat)

	Spring Chinook				Coho				Winter Steelhead					Extinction Threshold		
Alternative	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance	S. Chin.	Coho	W. Sthd
1A1	11%	0%	8%	5%	9%	-5%	26%	8%	9%	-6%	29%	2%	10%	9%	15%	6%
1A2	2%	-9%	12%	2%	-5%	-21%	28%	15%	-7%	-23%	38%	5%	-4%	10%	66%	-13%
1B	10%	0%	1%	4%	8%	-5%	4%	11%	2%	-6%	22%	4%	8%	25%	25%	3%
2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3	5%	-9%	20%	1%	3%	-21%	38%	12%	-6%	-23%	48%	3%	2%	10%	75%	-7%

	All Species Combined															
	Spring Chinook				Coho				Winter Steelhead					Extinction Risk		
Alternative	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance	S. Chin.	Coho	W. Sthd
1A1	5	5	3	5	5	4	3	2	5	4	3	2	5	2	2	5
1A2	2	2	4	3	1	2	4	5	1	2	4	5	1	3	4	1
1B	4	5	2	4	4	4	2	3	4	4	2	4	4	5	3	4
2	1	5	1	1	2	5	1	1	3	5	1	1	2	1	1	3
3	3	2	5	2	3	2	5	4	2	2	5	3	3	4	5	2

	Combined Score				
Scenario	Abundance	Spatial	Productivity	Diversity	Extinction
1A1	20	13	9	9	9
1A2	5	6	12	13	8
1B	16	13	6	11	12
2	8	15	3	3	5
3	11	6	15	9	11

Table 9. January 19 EDT model run for Passage Only. No habitat restoration actions are included the alternatives.

	All Species Combined															
	Spring Chinook				Coho				Winter Steelhead					Extinction Threshold		
Scenario	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance	S. Chin.	Coho	W. Sthd
1A1	2,929	100%	5.04	78%	8,564	95%	5.55	71%	1,967	94%	9.36	75%	13,460	1,064	1,461	845
1B	2,916	100%	4.81	77%	8,919	95%	5.16	72%	1,862	94%	9.04	75%	13,697	1,257	1,770	839
3	2,560	91%	5.27	73%	7,330	79%	5.65	71%	1,589	77%	9.87	73%	11,480	1,059	2,190	707

	All Species Combined															
	Spring Chinook				Coho				Winter Steelhead					Extinction Risk		
Scenario	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance	S. Chin.	Coho	W. Sthd
1A1	3	3	2	3	2	3	2	1	3	3	2	2	2	2	1	3
1B	2	3	1	2	3	3	1	3	2	3	1	3	3	3	2	2
3	1	1	3	1	1	1	3	2	1	1	3	1	1	1	3	1

	Combined				
Scenario	Abundance	Spatial	Productivity	Diversity	Extinction
1A1	10	9	6	6	6
1B	10	9	3	8	7
3	4	3	9	4	5

Table 10. January 19 EDT model run for Passage and Habitat.

	All Species Combined																
	Spring Chinook				Coho				Winter Steelhead					Extinction Risk		
Scenario	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance	S. Chin.	Coho	W. Sthd
1A1	3,335	100%	5.60	81%	9,349	95%	5.8	77%	2,271	94%	11.81	77%	14,955	1,187	1,624	972
1B	3,255	100%	5.39	78%	9,574	95%	5.4	78%	2,054	94%	10.77	78%	14,884	1,385	1,912	927
3	3,120	91%	6.29	76%	8,993	79%	7.3	80%	1,926	77%	13.69	76%	14,038	1,231	2,775	841

	All Species Combined															
	Spring Chinook				Coho				Winter Steelhead					Extinction Risk		
Scenario	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance	S. Chin.	Coho	W. Sthd
1A1	3	3	2	3	2	3	2	1	3	3	2	2	3	1	1	3
1B	2	3	1	2	3	3	1	2	2	3	1	3	2	3	2	2
3	1	1	3	1	1	1	3	3	1	1	3	1	1	2	3	1

	Combined				
Scenario	Abundance	Spatial	Productivity	Diversity	Extinction
1A1	11	9	6	6	5
1B	9	9	3	7	7
3	4	3	9	5	6

Table 11. February 2 EDT model run for **Upstream of Swift.**

	All Species Combined												
	Spring Chinook				Coho				Winter Steelhead				
Alternative	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance
1A1	3,375	100%	5.48	81%	9,480	95%	6.1	79%	2,230	94%	11.69	77%	15,086
1A2	3,298	91%	6.05	81%	8,899	79%	6.5	85%	2,011	77%	13.25	81%	14,208
1B	3,279	100%	5.17	80%	9,582	95%	5.5	80%	2,049	94%	11.09	78%	14,911
2	2,800	100%	4.83	75%	8,445	100%	5.2	69%	1,943	100%	8.64	73%	13,188
3	3,184	91%	6.09	77%	8,869	79%	6.6	81%	1,943	77%	13.34	77%	13,996

Percent Difference Between Alternatives and Alternative 2 (Full Passage No Habitat)

	Spring Chinook				Coho				Winter Steelhead				
Alternative	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance
1A1	21%	0%	14%	8%	12%	-5%	17%	13%	15%	-6%	35%	5%	14%
1A2	18%	-9%	25%	8%	5%	-21%	25%	22%	4%	-23%	53%	10%	8%
1B	17%	0%	7%	7%	13%	-5%	6%	16%	5%	-6%	28%	7%	13%
2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3	14%	-9%	26%	4%	5%	-21%	26%	17%	0%	-23%	54%	6%	6%

	All Species Combined												
	Spring Chinook				Coho				Winter Steelhead				
Alternative	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance
1A1	5	5	3	5	4	4	3	2	5	4	3	2	5
1A2	4	2	4	4	3	2	4	5	3	2	4	5	3
1B	3	5	2	3	5	4	2	3	4	4	2	4	4
2	1	5	1	1	1	5	1	1	1	5	1	1	1
3	2	2	5	2	2	2	5	4	2	2	5	3	2

	Combined Score				
Scenario	Abundance	Spatial	Productivity	Diversity	Total
1A1	19	13	9	9	50
1A2	13	6	12	14	45
1B	16	13	6	10	45
2	4	15	3	3	25
3	8	6	15	9	38

Table 12. February 2 EDT model run for Upstream of Swift + Mainstem Lewis Below Merwin Dam.

	All Species Combined												
	Spring Chinook				Coho				Winter Steelhead				
Alternative	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance
1A1	3,752	100%	5.76	86%	11,878	95%	7.6	80%	2,437	94%	12.81	82%	18,067
1A2	3,686	91%	6.40	86%	11,121	79%	8.2	86%	2,210	77%	14.51	85%	17,017
1B	3,532	100%	5.43	85%	11,011	95%	6.6	81%	2,196	94%	12.03	80%	16,739
2	2,800	100%	4.83	75%	8,445	100%	5.2	69%	1,943	100%	8.64	73%	13,188
3	3,911	91%	6.38	89%	12,153	79%	8.8	88%	2,280	77%	15.51	87%	18,344

Percent Difference Between Alternatives and Alternative 2 (Full Passage No Habitat)

	Spring Chinook				Coho				Winter Steelhead				
Alternative	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance
1A1	34%	0%	19%	15%	41%	-5%	46%	15%	25%	-6%	48%	12%	37%
1A2	32%	-9%	33%	15%	32%	-21%	57%	23%	14%	-23%	68%	16%	29%
1B	26%	0%	13%	13%	30%	-5%	27%	17%	13%	-6%	39%	9%	27%
2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3	40%	-9%	32%	19%	44%	-21%	68%	27%	17%	-23%	79%	19%	39%

	All Species Combined												
	Spring Chinook				Coho				Winter Steelhead				
Alternative	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Abundance	Spatial	Productivity	Diversity	Total Abundance
1A1	4	5	3	3	4	4	3	2	5	4	3	3	4
1A2	3	2	5	4	3	2	4	4	3	2	4	4	3
1B	2	5	2	2	2	4	2	3	2	4	2	2	2
2	1	5	1	1	1	5	1	1	1	5	1	1	1
3	5	2	4	5	5	2	5	5	4	2	5	5	5

	Combined Score				
Scenario	Abundance	Spatial	Productivity	Diversity	Total
1A1	17	13	9	8	47
1A2	12	6	13	12	43
1B	8	13	6	7	34
2	4	15	3	3	25
3	19	6	14	15	54

Table 13. February 2 EDT results for Merwin, Yale and Swift geographic areas. Habitat Restored Upstream of Swift Only.

	Adult				Juvenile		
Alternative 1A1	**Diversity**	**Productivity**	**Capacity**	**Abundance**	**Productivity**	**Capacity**	**Abundance**
				Spring Chinook			
Total	80.6%	5.5	4,128	3,375	430	797,223	514,448
Yale Lake	97.5%	3.7	373	274	586	124,283	70,020
Swift Reservoir	78.9%	5.7	3,755	3,092	413	672,941	440,819
				Coho			
Total	78.7%	6.1	11,343	9,480	177	963,910	612,408
Yale Lake	50.2%	4.0	1,544	1,154	289	463,484	193,902
Swift Reservoir	84.5%	6.3	9,738	8,188	168	492,244	362,490
				Winter Steelhead			
Total	77.4%	11.7	2,439	2,230	192	59,485	52,232
Yale Lake	64.6%	6.9	324	277	128	8,748	7,012
Swift Reservoir	80.3%	12.4	2,110	1,939	201	50,607	44,792
Alternative 1A2	**Diversity**	**Productivity**	**Capacity**	**Abundance**	**Productivity**	**Capacity**	**Abundance**
				Spring Chinook			
Total	80.5%	6.0	3,951	3,298	436	695,860	469,059
Swift Reservoir	80.5%	6.0	3,951	3,298	436	695,860	469,059
Coho				**Coho**			
Total	84.7%	6.5	10,517	8,899	173	512,845	384,971
Swift Reservoir	84.7%	6.5	10,517	8,899	173	512,845	384,971
				Winter Steelhead			
Total	80.9%	13.3	2,176	2,011	215	51,834	46,275
Swift Reservoir	80.9%	13.3	2,176	2,011	215	51,834	46,275
Alternative 1B	**Diversity**	**Productivity**	**Capacity**	**Abundance**	**Productivity**	**Capacity**	**Abundance**
				Spring Chinook			
Total	79.6%	5.2	4,066	3,279	372	641,287	420,494
Yale Lake	98.3%	3.6	368	266	562	119,210	66,262
Swift Reservoir	77.8%	5.3	3,698	3,004	353	522,077	349,987
				Coho			
Total	80.5%	5.5	11,712	9,582	153	870,639	546,665
Yale Lake	49.9%	4.0	1,521	1,145	300	505,004	204,211
Swift Reservoir	86.5%	5.6	10,116	8,318	142	359,575	275,454
				Winter Steelhead			
Total	78.4%	11.1	2,252	2,049	179	51,338	45,024
Yale Lake	65.3%	6.8	327	279	124	8,630	6,908
Swift Reservoir	81.1%	11.7	1,918	1,754	187	42,486	37,610
Alternative 2	**Diversity**	**Productivity**	**Capacity**	**Abundance**	**Productivity**	**Capacity**	**Abundance**
				Spring Chinook			
Total	74.7%	4.8	3531	2800	348	635,293	384,697
Yale Lake	98.0%	3.6	365	263	586	123,348	68,578
Swift Reservoir	72.4%	5.0	3,166	2,531	318	511,945	313,091
				Coho			
Total	69.5%	5.2	10,450	8,445	153	867,594	518,426
Merwin	68.0%	4.7	568	447	141	31,360	20,918
Yale Lake	48.4%	4.0	1,559	1,167	268	424,538	180,236
Swift Reservoir	73.7%	5.4	8,322	6,770	142	411,697	288,157
				Winter Steelhead			
Total	73.4%	8.6	2,197	1,943	144	51,206	43,270
Merwin	68.5%	5.0	82	66	94	1,941	1,479
Yale Lake	65.6%	6.7	330	281	122	8,626	6,894
Swift Reservoir	75.3%	9.2	1,777	1,583	150	40,414	34,526
Alternative 3	**Diversity**	**Productivity**	**Capacity**	**Abundance**	**Productivity**	**Capacity**	**Abundance**
				Spring Chinook			
Total	77.4%	6.1	3,810	3,184	442	682,103	459,575
Swift Reservoir	77.4%	6.1	3,810	3,184	442	682,103	459,575
				Coho			
Total	81.4%	6.6	10,462	8,869	176	523,887	392,213
Swift Reservoir	81.4%	6.6	10,462	8,869	176	523,887	392,213
				Winter Steelhead			
Total	77.4%	13.3	2,100	1,943	217	50,471	45,073
Swift Reservoir	77.4%	13.3	2,100	1,943	217	50,471	45,073

Table 14. February 2 EDT results for Merwin, Yale and Swift geographic areas. Habitat Restored Upstream of Swift and Mainstem Lewis Below Merwin.

	Adult				Juvenile		
Alternative 1A1	**Diversity**	**Productivity**	**Capacity**	**Abundance**	**Productivity**	**Capacity**	**Abundance**
				Spring Chinook			
Total	85.8%	5.8	4,541	3,752	447	888,465	580,932
Yale Lake	98.0%	3.9	388	288	604	129,948	74,364
Swift Reservoir	84.5%	5.9	4,152	3,453	433	758,516	503,113
				Coho			
Total	79.8%	7.6	13,681	11,878	209	1,005,894	716,191
Yale Lake	50.6%	4.8	1,792	1,417	282	443,251	210,248
Swift Reservoir	85.8%	7.8	11,827	10,315	204	553,799	438,448
				Winter Steelhead			
Total	82.1%	12.8	2,643	2,437	209	64,710	57,401
Yale Lake	68.1%	6.9	336	288	128	9,001	7,232
Swift Reservoir	85.3%	13.5	2,301	2,131	219	55,576	49,654
Alternative 1A2	**Diversity**	**Productivity**	**Capacity**	**Abundance**	**Productivity**	**Capacity**	**Abundance**
				Spring Chinook			
Total	85.9%	6.4	4,368	3,686	457	786,586	536,183
Swift Reservoir	85.9%	6.4	4,368	3,686	457	786,586	536,183
Coho				**Coho**			
Total	85.7%	8.2	12,670	11,121	213	574,002	462,102
Swift Reservoir	85.7%	8.2	12,670	11,121	213	574,002	462,102
				Winter Steelhead			
Total	85.4%	14.5	2,374	2,210	232	56,819	51,158
Swift Reservoir	85.4%	14.5	2,374	2,210	232	56,819	51,158
Alternative 1B	**Diversity**	**Productivity**	**Capacity**	**Abundance**	**Productivity**	**Capacity**	**Abundance**
				Spring Chinook			
Total	84.8%	5.4	4,329	3,532	378	681,845	451,245
Yale Lake	98.3%	3.6	368	266	562	119,210	66,264
Swift Reservoir	83.5%	5.6	3,961	3,252	362	562,635	380,701
				Coho			
Total	81.1%	6.6	12,976	11,011	175	907,379	617,164
Yale Lake	49.9%	4.0	1,521	1,145	300	505,004	204,211
Swift Reservoir	87.2%	6.8	11,380	9,702	167	396,314	318,552
				Winter Steelhead			
Total	80.3%	12.0	2,395	2,196	192	54,832	48,510
Yale Lake	65.3%	6.8	327	279	124	8,630	6,908
Swift Reservoir	83.4%	12.7	2,061	1,899	201	45,980	41,026
Alternative 2	**Diversity**	**Productivity**	**Capacity**	**Abundance**	**Productivity**	**Capacity**	**Abundance**
				Spring Chinook			
Total	74.7%	4.8	3531	2800	348	635,293	384,697
Yale Lake	98.0%	3.6	365	263	586	123,348	68,578
Swift Reservoir	72.4%	5.0	3,166	2,531	318	511,945	313,091
				Coho			
Total	69.5%	5.2	10,450	8,445	153	867,594	518,426
Merwin	68.0%	4.7	568	447	141	31,360	20,918
Yale Lake	48.4%	4.0	1,559	1,167	268	424,538	180,236
Swift Reservoir	73.7%	5.4	8,322	6,770	142	411,697	288,157
				Winter Steelhead			
Total	73.4%	8.6	2,197	1,943	144	51,206	43,270
Merwin	68.5%	5.0	82	66	94	1,941	1,479
Yale Lake	65.6%	6.7	330	281	122	8,626	6,894
Swift Reservoir	75.3%	9.2	1,777	1,583	150	40,414	34,526
Alternative 3	**Diversity**	**Productivity**	**Capacity**	**Abundance**	**Productivity**	**Capacity**	**Abundance**
				Spring Chinook			
Total	88.8%	6.4	4,638	3,911	474	851,209	583,416
Swift Reservoir	88.8%	6.4	4,638	3,911	474	851,209	583,416
				Coho			
Total	88.4%	8.8	13,720	12,153	233	636,032	519,327
Swift Reservoir	88.4%	8.8	13,720	12,153	233	636,032	519,327
				Winter Steelhead			
Total	87.0%	15.5	2,437	2,280	247	58,479	52,983
Swift Reservoir	87.0%	15.5	2,437	2,280	247	58,479	52,983

Table 15. February 2 predation analysis for Coho and Steelhead populations associated with Merwin geographic area.

	Coho			Steelhead		
Percent Increase Predation	**Adult Productivity**	**Adult Abundance**	**Percent Change in Adult Abundance From EDT Baseline**	**Adult Productivity**	**Adult Abundance**	**Percent Change in Adult Abundance From EDT Baseline**
EDT Baseline	4.70	447	0.00%	5.00	66	0.00%
5%	4.47	419	-6.3%	4.75	62	-6.1%
10%	4.23	390	-12.8%	4.50	57	-13.6%
15%	4.00	362	-19.0%	4.25	53	-19.7%
20%	3.76	334	-25.3%	4.00	49	-25.8%
25%	3.53	305	-31.8%	3.75	45	-31.8%
30%	3.29	277	-38.0%	3.50	41	-37.9%
40%	2.82	220	-50.8%	3.25	33	-50.0%
50%	2.35	163	-63.5%	2.50	25	-62.1%

Appendix A: Description of Alternatives

Description of each Alternative

For all the following alternatives, the Merwin Upstream Collection Facility and the Swift floating surface collector (FSC) will continue to operate through the life of the license.

Alternative 1A1 – This scenario only includes a downstream floating surface collector near Yale dam. Adult fish are collected at the Merwin Upstream Collection Facility and a portion of the adults (TBD) are taken and released into Yale reservoir. The remainder of the adults are transported upstream of Swift dam. Progeny produced by adults in tributaries to Yale Lake and that enter the Yale floating surface collector will be uniquely marked then transported to the Woodland Release ponds for release into the lower Lewis River. When those fish return as adults or jacks to the Merwin Upstream Collection Facility, they will be transported and released in accordance with a yet to be developed management plan aligned with recovery goals (e.g. connectivity to support gene flow).

Alternative 1A2 – In this scenario, a downstream floating surface collector will be constructed and put into operation at Yale dam but no adults will be purposefully transported to Yale Lake. All adult upstream migrants collected at the Merwin Upstream Collection Facility will be transported and released upstream of Swift dam. The primary purpose of the Yale FSC will be to collect any downstream migrants that may have passed through the Swift exclusion netting at the Swift FSC, then through the turbines at Swift No. 1 and Swift No. 2 or through spill at Swift dam and into Yale Lake. Downstream migrating juveniles will not need to be uniquely marked.

Alternative 1B – For this scenario, all adults and jacks collected at the Merwin Upstream Collection Facility are taken to Yale Lake and released. Facilities include a downstream floating surface collector near Yale dam and an adult collection and sorting facility near either Swift No.1 dam or the Swift No. 2 power canal. The adults have the choice of either remaining in Yale Lake or tributaries to spawn or migrate to the upstream collection and sorting facility to be transported upstream of Swift dam. Downstream migrating juveniles will not need to be uniquely marked.

Alternative 2 – Downstream FSCs will be constructed in Yale Lake and Lake Merwin near the dams and upstream collection and sorting facilities will be constructed at the Yale tailrace and either Swift No. 1 dam or the Swift No. 2 power canal. All upstream migrants will be transported to Lake Merwin from the Merwin Upstream Collection Facility and adults will have the choice to either stay in Lake Merwin or move upstream to the Yale Upstream Collection and Sorting Facility. Adults and jacks collected at the Yale facility will be transported upstream into Yale Lake. Fish can either choose to remain in Yale Lake or continue upstream to the Swift Upstream Collection and Sorting Facility where upon collection, they will be transported upstream of Swift dam and allowed to spawn where they choose. Downstream migrants that enter any of the FSCs will be transported to the Woodland Release Ponds downstream of Merwin. Downstream migrating juveniles will not need to be uniquely marked.

Alternative 3 – Downstream passage facilities are not constructed at Yale or Merwin dams and upstream passage is not provided at Yale tailrace or either Swift No. 1 dam or the Swift No. 2 power canal. Upstream fish passage remains at Merwin dam and downstream fish passage remains at Swift reservoir only.

APPENDIX D

Adaptive Management Concepts and Strategies

<u>Assumptions:</u>

- This is a "phased implementation" alternative based on a monitoring and evaluation/adaptive management approach.
- Yale salmon/steelhead fish passage facilities are expected to be designed then built following the M&E period.
- M&E purpose is to determine number of spring Chinook, coho and winter steelhead adults that may be placed into Yale reservoir; considering significant positive and negative impacts to Yale bull trout population.
- To support M&E, bull trout upstream passage facility at Swift dam or Swift No. 2 powerhouse area will be constructed and placed into operation by December 31, 2021. Yale bull trout downstream collection (modular floating Merwin-type collector as described in Settlement Agreement) will be installed and operating by December, 31, 2020.
- Results of the M&E can help determine the size of final Yale fish passage facilities and design considerations (e.g., facility location).
- M&E does not significantly impede near-term progress towards ESA recovery goals; it should not take away Swift NORs for study purposes until some to-be-determined minimum level of native populations have been established upstream of Swift.

<u>Collaboration:</u>

- Participants will set their current preferred fish passage/In-Lieu alternative "on the shelf" as this alternative is being developed.

<u>General Approach:</u>

Phase 1: Expand Yale bull trout monitoring program to establish appropriate baseline data for purposes of detecting negative and positive effects of salmon and steelhead reintroduction. A workgroup will be convened to establish monitoring activities. Such activities may include, but not be limited to the following:

- Expand bull trout redd surveys to encompass all other tributaries (other than Cougar Creek) with accessible anadromous fish habitat.
- If bull trout redds are observed during the bull trout spawning period, in streams other than Cougar Creek, these streams will be re-visited in the following summer and sampled by electrofishing for juvenile bull trout distribution.
- Continue Cougar Creek PIT antenna operation to document temporal landscape with concern to spawning migrations.
- Continue pre-existing Cougar Creek Nb (parental population size) electrofishing surveys to document juvenile distribution and abundance and to describe potential interactions.
- To expand on juvenile period of use within Cougar Creek, deploy a 5-ft rotary screw-trap under the bridge in Cougar Park for an entire year during the first year of deployment. Subsequent deployment periods will be driven by catch rates and observed timing during first year.
- Determining primary and secondary productivity in Cougar Creek.

- Determining seasonal diet composition and growth/energetics of bull trout in Cougar Creek.

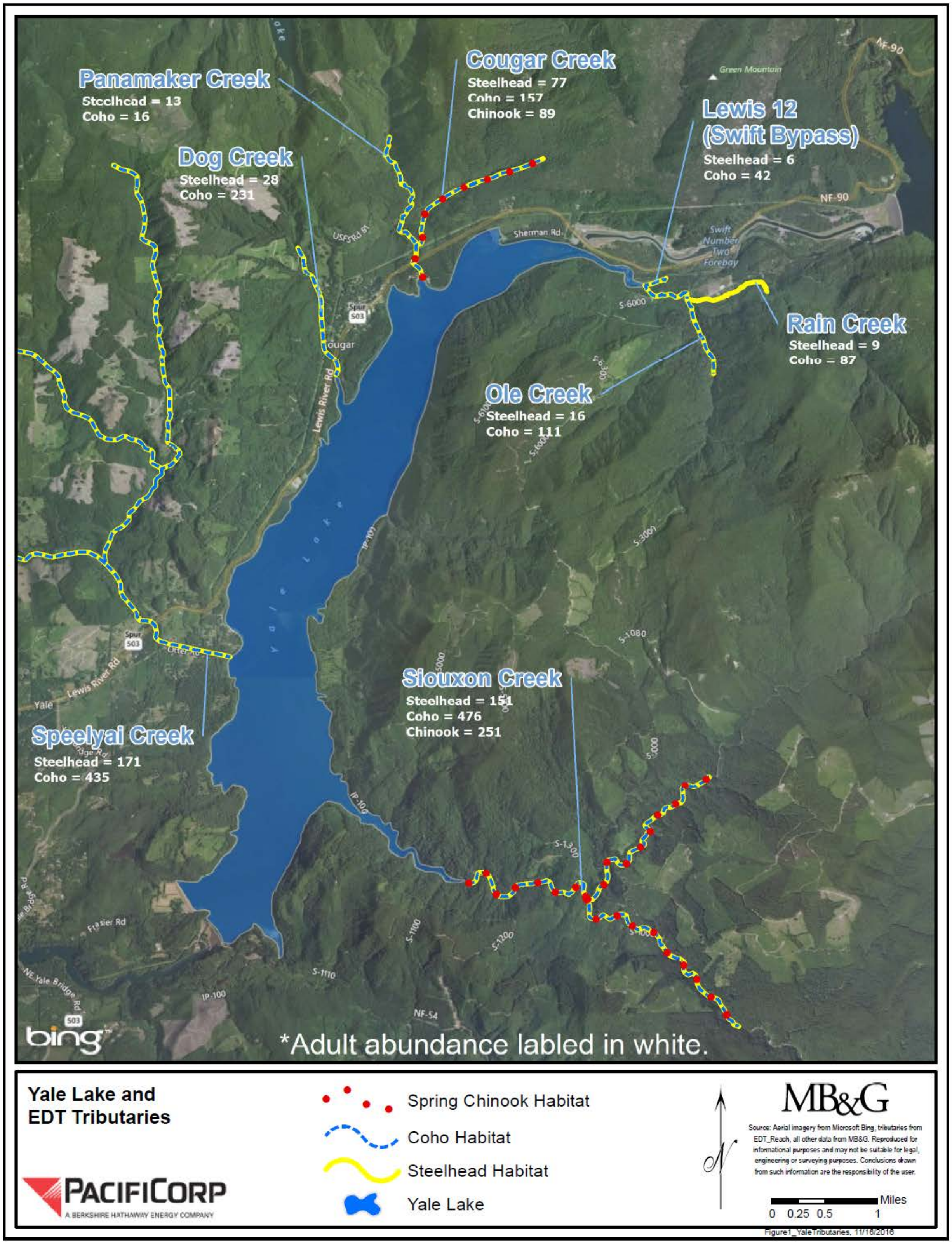
Phase 2: Place predetermined number of adult anadromous fish (NORs returning to Swift) into Yale and monitor spatial distribution and changes to baseline metrics.

- Continue Phase 1 monitoring program, expand timing of surveys to account for species life cycle.
- Place set amount of salmon/steelhead adults in Yale, using adult capacity estimated using the EDT model (see Figure 1). A portion of full reintroduction will be used initially. Release number needs to be enough to allow salmon and steelhead to effectively fully distribute to available habitat. All anadromous fish placed in Yale will receive a PIT tag for Yale monitoring purposes.
- Perform redd surveys for all released species on an appropriate day-cycle of all available anadromous habitat during each species' spawn time.
- Bull trout redds in Cougar Creek will be uniquely visually demarcated and re-visited for disturbance through the coho spawn timeframe.
- Screw trap in Cougar Creek will continue operation to assess changes in species assemblage, abundance, and changes in bull trout juvenile emigration to reservoir timing.
- Evaluate effect of salmon and steelhead reintroduction on Cougar Creek primary and secondary productivity.
- Evaluate effect of salmon and steelhead reintroduction on in diet and growth/energetics of bull trout in Cougar Creek.

<u>Schedule:</u>

- Phase 1 – 2018 through 2021 (Period of bull trout fish passage construction and to allow Swift NOR populations to become established)
- Develop impact triggers to bull trout - 2021
- Phase 2 – 2022 through 2025
- Services decide on number of adult anadromous fish to be placed into Yale - January, 2026
- Design, permit and construct Yale downstream collector - 2026 – 2030 (2 years design, 1 year permitting, 2 years construction)
- Permit and construct salmon/steelhead modifications to Swift upstream trap - 2027 – June 2030 (1 year final design, 1 year permit, 2 years construction)

Figure 1. Yale Lake and EDT Tributaries



Yale Salmon and Steelhead Reintroduction
Implementation and Adaptive Management Strategy

WDFW is recommending that adult passage be established in Yale Reservoir, which will include release of adult salmon and steelhead into Yale Reservoir. The Lewis River Settlement Agreement (SA) Section 4.3 states that "Once upstream adult collection and transport facilities are constructed at all of the Merwin, Yale, and Swift Projects, then PacifiCorp shall provide for the transport of adult Transported Anadromous Species collected at Merwin Dam to Lake Merwin". It is WDFW's assumption that if Merwin adult collection facilities are not built, the long-term goal would be for transport of these fish to Yale Reservoir. This full scale release of salmon and steelhead into Yale Reservoir needs be implemented in a manner that achieves reintroduction goals while minimizing risk to listed bull trout spawning in Cougar Creek, a tributary of Yale Reservoir. Full scale release of salmon and steelhead into Yale Reservoir may have unintended negative impacts on reintroduction above Swift Dam or the resident bull trout population in Yale Reservoir; therefore, WDFW is recommending a phased approach to reintroduction into Yale Reservoir. Key questions that need to be addressed as part of this phased approach include:

- How are reintroduced salmon and steelhead interacting with resident bull trout? The answer to this question may vary depending on the species being reintroduced.
- How effectively are reintroduced salmon and steelhead accessing habitat upstream of Swift Dam? This question includes two components: 1) how well are the fish migrating through the reservoir? and 2) how effective is the collection facility at capturing fish for transportation to above Swift Reservoir?

This document provides a suggested approach towards an implementation and adaptive management strategy. Additional details regarding timeline, decision points and criteria should be developed only after there is an agreed to framework in place.

As this reintroduction effort is initiated it is important to remember that the majority of high quality salmon and steelhead habitat exists upstream of Swift Dam. It will be important to ensure that the effectiveness of reintroduction efforts already in place upstream of Swift Reservoir are not reduced by reintroduction efforts in Yale Reservoir. Additionally, the reintroduction program into Yale Reservoir is expected to include spring Chinook, winter steelhead and coho. Coho have the largest potential to interact with bull trout because they spawn at similar times and it is expected that both species will utilize Cougar Creek as a key spawning location. Therefore, an increased level of caution should be used for coho reintroduction Into Yale Reservoir.

<u>Phased Reintroduction</u>

During the initial phase of reintroduction limited numbers of salmon and steelhead would be released into Yale Reservoir. The majority of the fish would still be released into Swift Reservoir for the following reasons:

- Need to determine if fish released in Yale Reservoir are able to effectively "self-sort" and access habitat upstream of Swift Dam (as well as in Yale tributaries).
- Interactions with bull trout by each species needs to be evaluated.

When it has been determined that fish are successfully negotiating their way through Yale Reservoir and the collection facility is successfully capturing adults migrating to areas upstream of Swift Dam, then increased numbers of fish should be released in Yale Reservoir. This decision would need to be made individually for each species being passed upstream. The number for fish released into Yale Reservoir will need to take into account interactions with bull trout. For instance, if there is significant overlap in spawning or rearing habitat utilized a reduced level of fish released into Yale Reservoir may be appropriate.

In addition to the number of fish for each species, it will also be necessary to determine the origin (i.e. natural or hatchery origin) of the fish used for reintroduction into Yale Reservoir. For example, an advantage of using natural origin (NOR) fish may be that better spatial distribution may be achieved along with higher initial productivity, thus jump-starting re-introduction more quickly. The disadvantage may be that it could reduce the number of NORs accessing habitat upstream of Swift Reservoir.

As the phased reintroduction continues increased numbers of fish would be placed in Yale Reservoir. Increases in numbers of fish released into Yale Reservoir will be determined based on the data produced by the monitoring and evaluation program. The long-term goal would be to release all fish into Yale Reservoir when it has been determined that fish are able to effectively "self-sort" and access habitat upstream of Swift Dam (as well as in Yale tributaries) and that impacts to bull trout are acceptable, allowing them to persist in Yale Reservoir and contribute to the Lewis River core bull trout population

<u>Monitoring and Evaluation</u>

This phased implementation strategy will require a comprehensive monitoring program to collect data necessary to evaluate the results of this reintroduction effort. Data will need to be collected both prior to reintroduction and following reintroduction. In addition to other elements, the monitoring and evaluation plan will have to address the two key questions presented earlier in this document:

- How are reintroduced salmon and steelhead interacting with resident bull trout?
- How effectively are reintroduced salmon and steelhead accessing habitat upstream of Swift Dam?

Monitoring interactions with, and possible impacts to, bull trout in Cougar Creek will be a high priority for monitoring activities. Prior to releasing salmon or steelhead into Yale a more intensive bull trout monitoring program should be instituted. This bull trout monitoring effort should collect key data regarding adult abundance, adult distribution, juvenile rearing densities, and juvenile production.. This data needs to be collected prior to reintroduction and then during reintroduction. Changes in these data will allow for evaluation of the impact of reintroduction on bull trout utilizing Cougar Creek for spawning and rearing purposes.

For the reintroduced species a full VSP monitoring program needs to be implemented. The monitoring plan in place for upstream of Swift Dam provides a good template for this monitoring plan. The monitoring plan for this reintroduction should build and improve on the plan currently in place upstream of Swift Dam. The key VSP parameters to focus on are abundance, spatial structure and productivity.

This monitoring plan will also have to evaluate effectiveness of passage through Yale Reservoir to upstream of Swift Dam. This evaluation will have two components: 1) effectiveness of fish in passing through Yale Reservoir and 2) effectiveness of collection facility in capturing adults to allow for continued upstream migration. Specific methodology regarding design and implementation of these studies should be part of the detailed monitoring and evaluation plan and adaptive management strategy. The methodology used to evaluate the adult collection facility at Merwin Dam should provide a basis upon which to build the evaluation in Yale Reservoir.

Marking Considerations

Depending on the type of data being collected, additional marking strategies may need to be utilized. The marking needs will be driven by the types of monitoring activities being implemented. For instance, it may be prudent to mark all juveniles migrating out of Yale Reservoir because this may assist in evaluating effectiveness of reintroduction and help determine where to release fish upon their return to Merwin Dam. In the case of passage questions, a telemetry tag may be more effective in tracking movement through the reservoir and evaluating collection efficiency at the adult facility.

APPENDIX E

Comment Matrix

Lewis River Hydroelectric Project - Fish Passage Decision Support Document

Reviewer Comments (abbreviated). Note: only substantive comments shown, all other text edits accepted.

Reviewer	Affiliaton	Page (s)	Comment	Action
Todd Olson	PacifiCorp	Various	Contributed various gramatical additions, omissions, punctuation edits, and basic grammar. No other major context alterations.	Edits Incorporated
Amanda Froberg	Cowlitz PUD	Various	Contributed various gramatical additions, omissions, punctuation edits, and basic grammar. No other major context alterations.	Edits Incorporated
Ruth Tracy	USFS	20	Expanded on USDA FS rationale (using text previously provided in Appendix A).	Added text to Section 5.0 re: Alt. 1B
Amelia Johnson	LCFRB	15	Recommended EDT-results be discussed in context of Recovery Plan goals.	Added summary table (3.1.5) and text re: recovery goals
Amelia Johnson	LCFRB	App. A Utilities Position Paper	Minimum viability involves more than just adult abundance targets. Spatial structure and genetic diversity are also recovery viability criteria.	Comment noted, Position Papers remain as submitted 2/22/17 unless authors provided minor edits to their own sections.
Pat Frazier	WDFW	3	Suggested adding statement that this document was reviewed by the ACC prior to completion.	Comment addressed, Section 1.1
Pat Frazier	WDFW	3	Suggested deleting the "purely" adjective before *scientific perspective.*	Comment addressed, Section 1.1
Pat Frazier	WDFW	3	Confirm January meeting dates.	Comment addressed, Section 1.1
Pat Frazier	WDFW	6	Clarify language with respect to consideration of bull trout in this process.	Comment addressed, see Section 2.0
Pat Frazier	WDFW	9	Reorganize text to clarify 2004 vs. 2016 EDT modeling.	Comment addressed, see Section 2.3.1
Pat Frazier	WDFW		Text describing EDT Model Scenario 2 redundant.	Comment addressed, text deleted
Pat Frazier	WDFW	9	Recommend defining template conditions (in EDT).	See Footnote 8
Pat Frazier	WDFW	12, 15	Regarding Table 3.1.4 (showing EDT Model Runs for February 2, 2017) provide text for why Alternatives that logically should be the same are different. i.e., 1A2 and 3 abundance and productivity should be the same.	Comment addressed; results differ for Alternative 1A2 and 3 due to differences in available funds. Table 3-1-2 has been updated to show the amount of habitat restored in each alternative; text added to p. 15.
Pat Frazier	WDFW	18	Regarding Secton 3.3, Merwin Predation, add information explaining what assumptions mean for predations rates. i.e., they are likely lower than with assumptions because rearing is not likely year round and monthly variation in migration rates and timing and thermal regimes may partition the anadromous species and Northern Pikeminnow.	Comment noted; previous draft recognized predation rates assuming shift from kokanee to anadromous fish may overestimate predation; text in Section 3.3 further modified.
Pat Frazier	WDFW	20	Provided edits clarifying adaptive management elements of Alt. 1B+ in Section 5.	Edits accepted
Eli Asher	Cowlitz Tribe	7/12/17 Email to M. Bonoff, L. Wiltse, K. McCune	Stated the decision support document faithfully represented the process, noted Appendix A merged with a table from the Recovery Plan.	Comment noted, App. A issue resolved.